Nov. 20, 1956 A. S. CAMERON 2,771,038

OIL AND WATER WELL PUMPING PLANT

Filed June 1, 1954 2 Sheets-Sheet 1

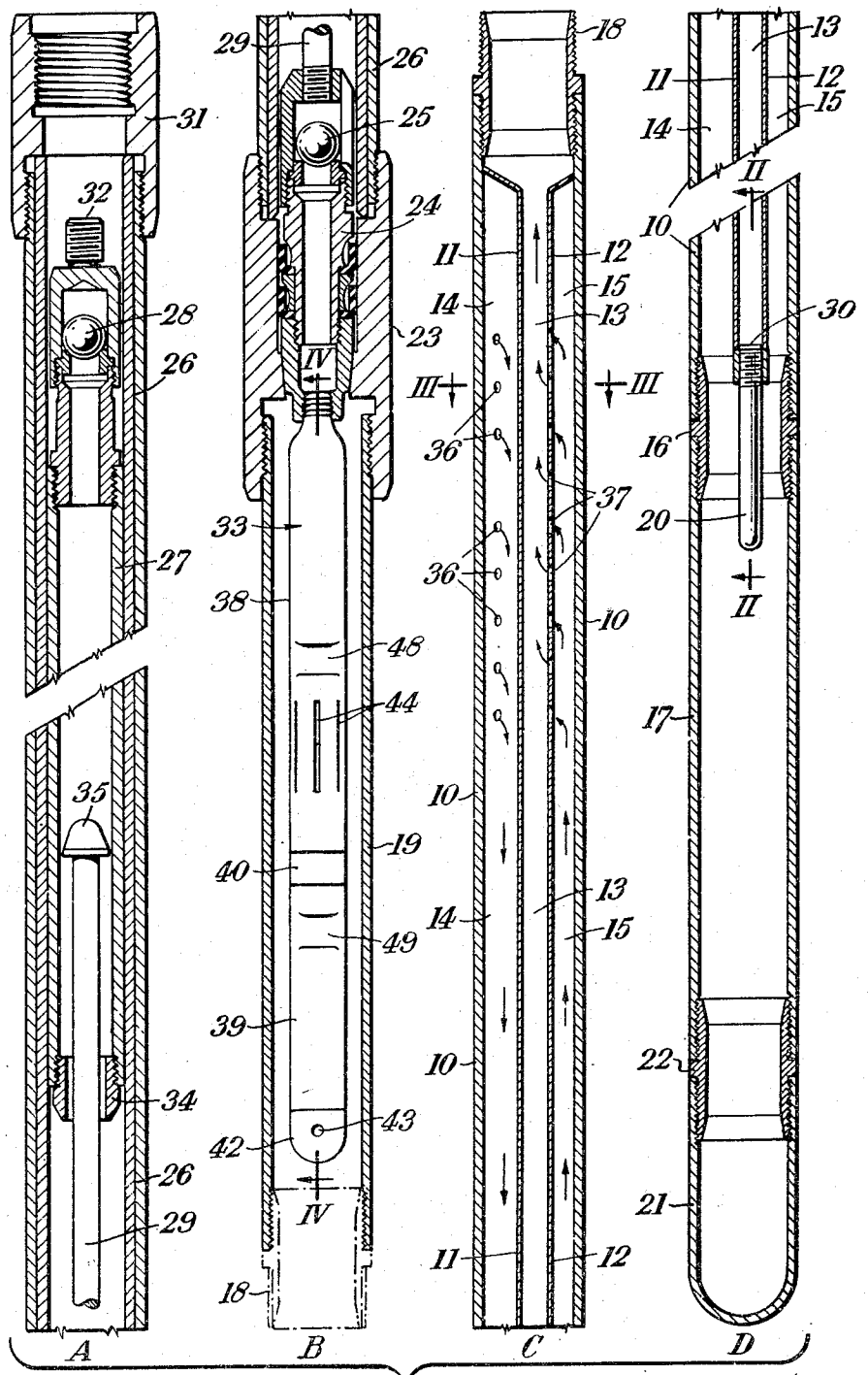


Fig. 1.

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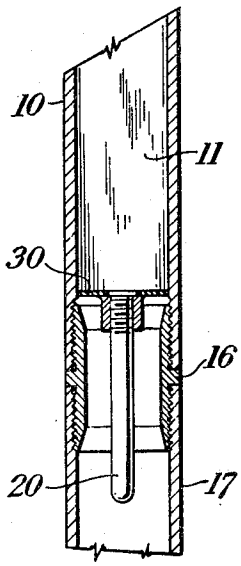


Fig. 2.

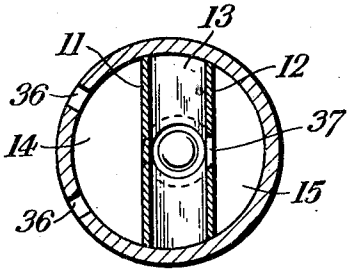


Fig. 3.

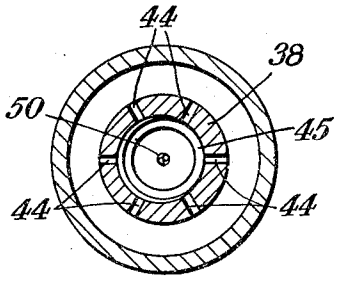


Fig. 5.

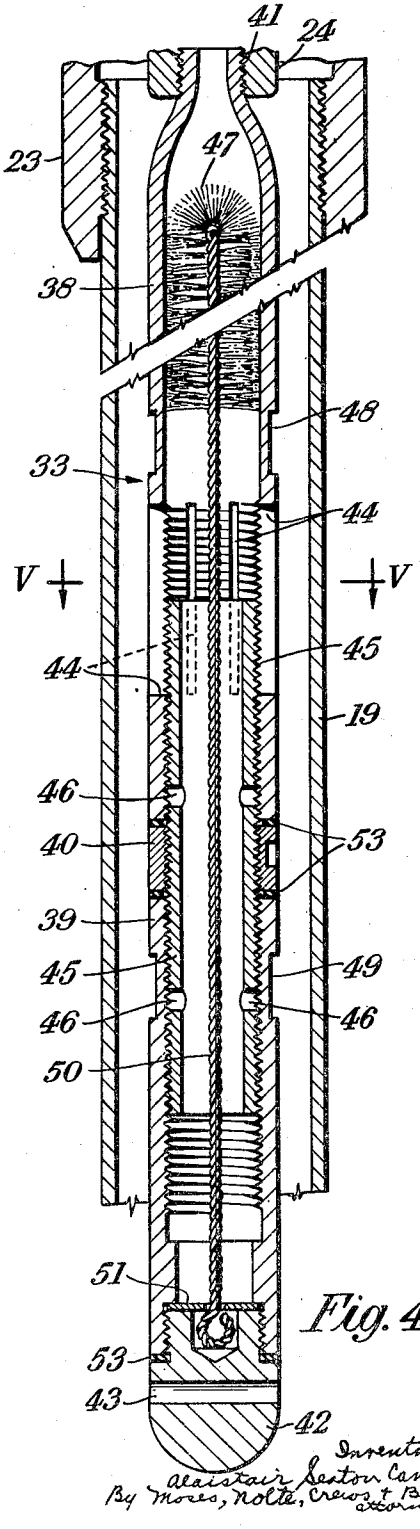


Fig. 4.

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OIL AND WATER WELL PUMPING PLANT

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Application June 1, 1954, Serial No. 433,726

4 Claims. (Cl. 103—203)

This invention relates to equipment for pumping oil and water wells.

The range of pumps available for use with such equipment is limited, particularly in the case of oil wells, and in order to provide for various conditions, e. g. viscosity and turbidity, of the liquid being pumped it is frequently desirable to control the rate of pumping otherwise than by varying the speed and/or stroke of the pump. To achieve this it is necessary to throttle the flow of liquid to the pump. Such flow control has hitherto necessitated withdrawal of the tubing string from the well in order to make adjustment in the gas anchor tube fitted beneath the pump or to replace a flow "bean" or the like, disposed between the anchor tube and the pump, by another of different size. Withdrawal of the tubing string from a deep well and its subsequent replacement in the well is an arduous and lengthy undertaking and involves a serious loss of time and production. It also involves the risk of serious damage to or loss of the tubing string and a consequent costly fishing job.

The invention provides an apparatus for pumping oil and water wells comprising a flow control device, fitted to the body of the standing valve of the pump and withdrawable therewith from the tubing string, and a sand and gas trap constituted by a long tube fitted to the tubing string beneath the standing valve and divided by longitudinal partitions into three compartments, viz. a central compartment open at the top to the flow control device and closed at the bottom and two outer compartments closed at their upper ends and communicating at their lower ends to form a U-shaped channel, one of the outer compartments, hereinafter termed the first outer compartment, having one or more large inlets near its upper end and the central compartment having, near its upper end, one or more inlets through which liquid can flow into the central compartment from the other or second outer compartment, which is of smaller cross sectional area than the first outer compartment.

The flow control device is constituted by a tube, closed at its lower end, communicating at its upper end with the bore of the standing valve and having one or more slots for controlling the flow of liquid to the pump. If it is desired to alter the output of the pump, it is only necessary to withdraw the sucker rods, the plunger and standing valve of the pump and the flow control device attached thereto, leaving the tubing string in position, and to replace the flow control device by another with slots of a different size or, if the flow control device has adjustable slots, to effect appropriate adjustment of the size of the slots. This can be done comparatively quickly.

It is customary to employ, in oil well pumping equipment, three sizes of pumps, of 2", 2½" and 3" diameter, and to use with each pump tubing of corresponding diameter. It is only necessary to withdraw the tubing string when it is desired to replace the pump and tubing by a pump and tubing of another size or to inspect or clean the trap. The flow control device may conveniently be

manufactured in three sizes, one appropriate for each size of pump and the capacity of each size being infinitely variable, by adjustment of its slots, from minimum to maximum flow to provide for any change required in the output of the associated pump. Change in the output of the pump can thus be effected, as already described, without pulling the tubing string by appropriate adjustment of the flow control device. The flow control device can also be withdrawn, when required, for cleaning, inspection or replacement by means of the sucker rods. The flow control device is only replaced by one of a different size when the tubing string is withdrawn for the purpose of changing the size of the pump and tubing.

The trap forms a protected reservoir from which the pump draws its oil. The trap thus eliminates the sudden surge with the tendency to pull in sand and gas which is caused by the action of an ordinary oil well pump. The liquid must travel in a U-shaped path to reach the central compartment. The trap may conveniently be 20 feet in length with the result that the liquid must travel 40 feet before reaching the central compartment. This results in a considerable separation of gas and sand from the liquid before it enters the pump. As the first outer compartment, through which the liquid travels downwardly, is of greater cross-section than the second outer compartment, through which the liquid travels upwardly, the downward velocity of flow in the first outer compartment is relatively slow, thereby facilitating gravity separation of sand from the liquid and affording the gas an opportunity to rise and escape.

Preferably the inlets to the first outer compartment and to the central compartment are each constituted by a plurality of holes spaced along the length of the compartment. The arrangement and size of the holes constituting the inlet for gas and liquid to the first outer compartment is such that any gas which separates from the liquid in the trap will return through said inlet holes. That is to say that the inlet holes offer less resistance to the return of gas than is offered by the long column of liquid, e. g. 20 feet long, through which the gas would have to pass downwardly to enable it to enter the second and smaller outer compartment.

By reason of the provision of the flow control device, the trap can be constructed with inlet holes suited to the maximum output of the largest pump and the largest diameter of tubing likely to be employed and will require no alteration when the output of the pump is reduced, or the pump is exchanged for another of smaller size, the only change required being adjustment or replacement of the flow control device. This, as already explained, does not involve pulling the tubing string which need only be done at infrequent intervals for inspection or cleaning of the trap, or when the size of the pump and tubing is to be altered. The combined cross section of the inlet holes must be such as to provide the throughflow required when operating with the largest pump at maximum output. The individual holes are of large size, e. g. ⅜–½" diameter, so obviating any risk of plugging.

One specific embodiment of pumping apparatus according to the invention will now be described in detail, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal section through the apparatus, portion A of the figure showing the upper part of the pump, portion B the standing valve and flow control device and portions C and D the gas and sand trap,

Figs. 2 and 3 are sections taken respectively on the lines II—II and III—III in Fig. 1,

Fig. 4 is a section, on a larger scale, on the line IV—IV in Fig. 1, and

Fig. 5 is a section on the line V—V in Fig. 4.

Like reference characters denote like parts throughout the figures.

The sand and gas trap is constituted by a metal tube **10** of 3½ inches outside diameter and 3 1/16 inches internal diameter and 20 feet in length. Within the tube are two parallel longitudinal partitions **11** and **12**, ⅛ inch in width, which are spaced ⅞ inch apart and are respectively 1⅛ inches and 13/16 inch distant from the inner wall of the tube, the last two measurements being along a diameter of the tube normal to the partitions. These partitions **11**, **12** define a central compartment **13**, closed at the bottom, and two outer compartments **14**, **15**, each closed at the top. Fitted to the lower end of the tube **10** by a union **16** is a bottom anchor nipple **17**, closed at its lower end by a bull plug **21** attached thereto by a union **22**, and fitted to the top of the tube **10** by a union **18** is an extension nipple **19** 2 feet in length and open at its upper end.

It will be understood that the three tube sections shown, for convenience, side by side in portions B, C and D of Fig. 1 are, in reality, superposed, that shown in portion B being uppermost and that shown in portion D being lowermost. The central compartment **13** is closed at its lower end by a plate **30** and bull plug **20** (Fig. 2). The plugs **20**, **21** are removable for cleaning purposes. The extension nipple **19** is screwed into the pump extension shoe **23**, which contains the tubular valve body **24** of the standing valve **25** of the pump.

The pump barrel **26** contains the usual plunger **27**, upper valve **28** and Garbutt rod **29** and is attached at its upper end by a union **31** to the tubing string of the pump (not shown). The sucker rods (also not shown) are attached to the threaded spigot **32** at the top of the plunger **27**. A flow control device **33**, described in more detail below, is screwed into the lower end of the body **24** of the standing valve. When it is desired to withdraw the standing valve body **24** and the flow control device **33** the sucker rods are lifted, thereby engaging the plunger nut **34** with the head **35** of the Garbutt rod **29**, so permitting of withdrawal of the above-mentioned parts by continued upward movement of the sucker rods.

Liquid is admitted to the upper end of the wider outer compartment **14** of the gas and sand trap through sixteen inlet holes **36**, eight of which only are shown in Fig. 1, in the tube **10**, each ⅜ inch in diameter. It will be understood that there is a second row of eight inlet holes **36** in the tube **10**, each hole in the second row being close to, and at the same level as, one of those shown (see Fig. 3). Liquid is admitted from the upper end of the narrower outer compartment **15** to the central compartment **13** through nine holes **37** in the partition **12**, each hole **37** being ½ inch in diameter.

The flow velocity in the first compartment **14** of the trap favours the deposition of sand and encourages separation of gas and its escape through the upper row of inlet holes **36**. The gas escaping through these holes into the annular space between the casing of the well and the tubing above the pump may be collected and used for oilfield operations. The majority of the sand separated in the trap collects in the anchor nipple **17**, but the central compartment **13** constitutes an additional sand settling compartment.

The flow control unit **33**, which is shown in detail in Fig. 4, is constituted by a tubular body, formed of two sections **38**, **39**, spaced by a locking ring **40** and formed respectively with flats **48**, **49** to take a wrench. The upper section **38** of the body is screw-threaded at its upper end **41** for engagement with a corresponding screw thread on the standing valve body **24**. The bottom end of the lower section **39** of the body is closed by a solid bull plug **42** formed with a throughgoing hole **43** for receiving a bar. Six longitudinal flow control slots **44** are provided in the upper section **38** of the body, each 3" long and ⅛" wide. Inside the body is an adjustable externally

threaded sleeve **45** the upper edge of which cooperates with the slots **44** to determine the effective area thereof. The sleeve **45** can be screwed, by insertion of a bar into the lower one of a pair of throughgoing holes **46** in the sleeve, into or out of the upper section **38** of the body to adjust the effective length of the slots **44** as desired. The locking ring **40** is then screwed on to the exposed part of the sleeve until it contacts the lower end of the upper section **38** of the body, whereafter the lower section **39** of the body is screwed on to the lower end of the sleeve until its upper edge meets the lower edge of the ring. The upper bar hole **46** is provided to permit of rotation of the sleeve **45** in case it should freeze in the lower section **39** of the body when the locking ring **40** is unscrewed to obtain access to the sleeve.

The flow control device contains a wire filtration and cleaning brush **47** fitting closely within the upper section **38** of the body and disposed above the slots **44**. This serves to deny access to the standing valve **25** of undesirable matter, e. g. soft rope, fine grained sand and scale, in the oil which may have passed the trap. The stem **50** of the brush extends downwardly through the lower section **39** of the body and is detachably positioned within the body by an anchor plate **51** which is removably positioned between the bull plug **42** and the lower section **39** of the body. Copper washers **53** are provided between the locking ring **40** and the adjoining sections of the body and between the bull plug **42** and the lower section of the body.

What I claim as my invention and desire to secure by Letters Patent is:

1. In pumping apparatus for oil and water wells comprising a tubing string and a pump having a barrel fitted to the lower end of the tubing string and including at its lower end a standing valve, which is withdrawable upwardly from said barrel and tubing string, the combination of a gas and sand trap constituted by a long tube closed at its lower end, attached at its upper end to the pump barrel and divided by longitudinal partitions into three segmental compartments, namely a central compartment open at the top and closed at the bottom and two outer compartments closed at their upper ends and communicating at their lower ends, one of said outer compartments being of larger cross sectional area than the other outer compartment and having one or more large inlets near its upper end through which liquid can flow downwardly through said larger outer compartment and thence upwardly, through said smaller outer compartment and the central compartment having, near its upper end, one or more inlets through which liquid can flow into the central compartment from said smaller outer compartment, and a tubular flow control device disposed within said long tube above the upper open end of said central compartment, said flow control device being closed at its lower end, having an open upper end attached to the standing valve so that it may be withdrawn upwardly from the tubing string with said standing valve and having in its wall at least one adjustable slot for controlling the flow of liquid from said central compartment to said pump.

2. In pumping apparatus for oil and water wells a combination as claimed in claim 1, wherein said flow control device comprises upper and lower sections, the flow controlling slots being formed in said upper section, a locking ring disposed between and spacing said sections, and an externally threaded sleeve engaging internal threads in both of said sections, said sleeve being adjustable to vary the effective area of said slots and said locking ring serving to lock said sleeve in adjusted position.

3. In pumping apparatus for oil and water wells, a combination as claimed in claim 1, wherein the flow control device contains a wire filtration and cleaning brush fitting closely therein and disposed above the slots.

4. In pumping apparatus for oil and water wells a combination as claimed in claim 1, wherein said flow

control device comprises upper and lower sections, the flow controlling slots being formed in said upper section, a locking ring disposed between and spacing said sections, and an externally threaded sleeve engaging internal threads in both of said sections, said sleeve being adjustable to vary the effective area of said slots and said locking ring serving to lock said sleeve in adjusted position, said flow control device containing a wire filtration and cleaning brush fitting closely within the upper section thereof and disposed above the slots, said brush having a downwardly extending stem detachably secured to the lower section of the flow control device.

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