Aug. 13, 1957 J. S. TAYLOR 2,802,535

PARAFFIN SCRAPER

Filed Jan. 7, 1955 2 Sheets-Sheet 1

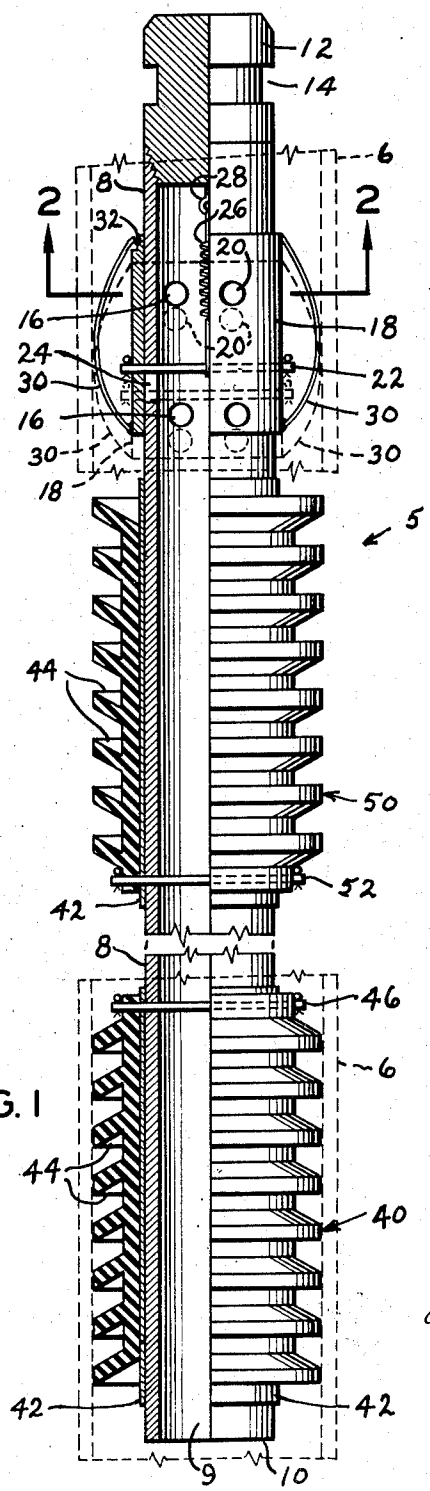


FIG. 1

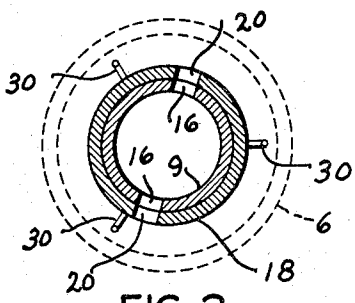


FIG. 2

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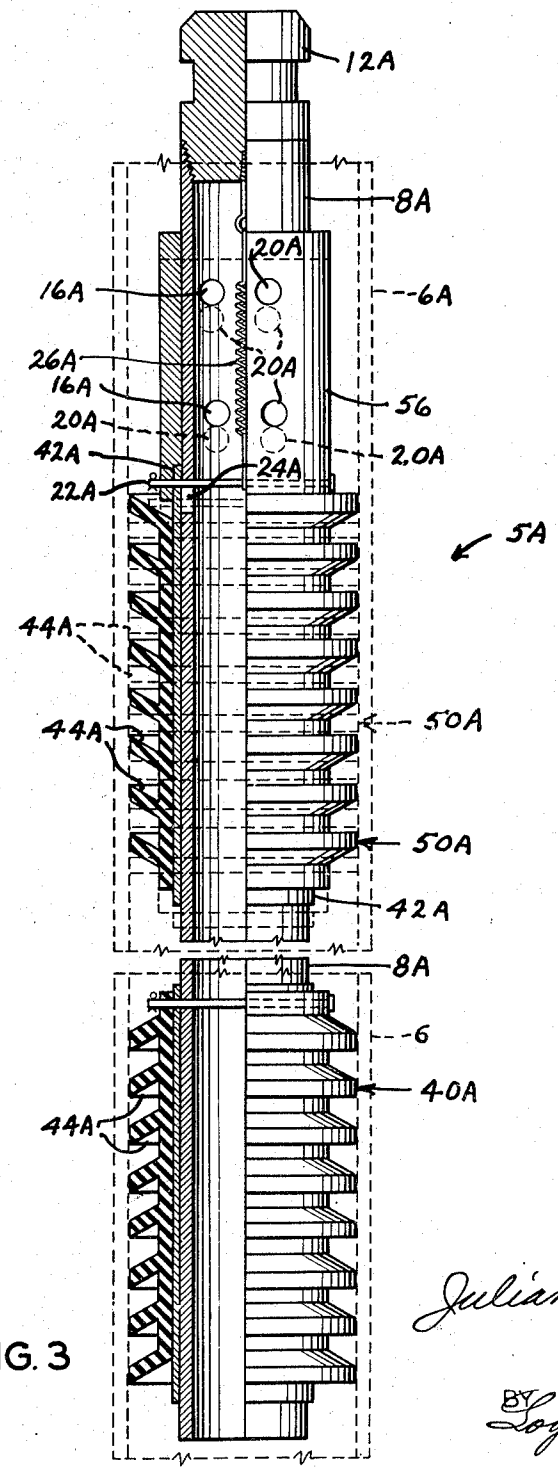


FIG. 3

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PARAFFIN SCRAPER

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5 Claims. (Cl. 166—170)

The present invention relates generally to oil wells, and more particularly to a device for cleaning the bore of the tubing of paraffin in an oil well.

In the operation of oil wells, it has been found that paraffin and other asphaltic or bituminous compounds tend to collect on the bore of the tubing within the well. This accumulation builds up gradually until it seriously restricts the flow of the well, and sometimes entirely clogs it. When either of these conditions arise, it becomes necessary to pull the tubing from the well and clean it of the accumulations of paraffin by steaming or some other suitable manner. This operation takes considerable time and is expensive, not only from the standpoint of labor costs but by the delay in obtaining production from the well until the tubing has been cleaned and re-run into the well.

The present invention is designed to overcome this accumulation of paraffin in the tubing by providing a device that is continuously operated by the pressure of the well, or by gas or air injected into the bottom of a well from the surface. The device is equipped with packing elements which seal with the wall of the tubing, and scrapes the same free of paraffin as gas pressure raises the device within the bore of the tubing.

The device of the present invention is particularly intended to be used in a "stop-cock" well, or in an intermittent gas lift well. A "stop-cock" well, as it is known in oil field parlance, is an oil well which has some bottom hole pressure, but not enough to produce oil by natural flow. Such a well may be "shut-in," that is, the casing or tubing closed at the top of the well to permit the well to build up pressure. After a selected length of time the well is opened and the built up pressure will produce fluid from the well until the pressure drops below the critical point.

The intermittent gas lift well, as herein mentioned, has reference to a well which will produce a comparatively small number of barrels of oil per day, and which has been equipped for gas or air injection adjacent the bottom of the well at selected intervals for producing the oil accumulated within the tubing. The use of the device of the present invention in a gas lift well will lower the gas to oil production ratio, because the device tends to utilize virtually all of the gas pressure. By efficiently using the gas injected into the well, the device will increase the output from low production wells by approximately fifty percent.

Briefly, in its preferred embodiment, the present invention comprises a tubular body closed at its upper end and vertically disposed within the flow pipe or tubing of an oil well. A sleeve having a ported wall is slidably carried by the upper end portion of the body. Spring means hold the sleeve in position so that its ports mate with co-operating ports in the wall of the body for permitting fluid and gas to pass through the body as the same moves downwardly through the tubing. A packing element having downwardly opening cups is circumferentially carried by the lower end portion of the body

for trapping gas below the device to lift the same by engaging and sealing with the wall of the tubing. Guide members connected to the sleeve and frictionally engaged with the wall of the tubing overcome the spring means to mismate the sleeve and body ports upon upward movement of the device. An upper packing element having upwardly opening cups is carried by the body intermediate its ends for engaging and sealing with the tubing wall to lift fluid thereabove as gas pressure raises the body. Thus when the device is placed within the tubing of an oil well having a rate of gas flow slightly under the volume required to lift fluid when the tubing is open at the top, the device gravitates toward the bottom of the tubing until it reaches a stop placed within the tubing. Fluid is ordinarily present at this point in the tubing. Turbulence of gas through the fluid is trapped by the cups of the lower packing element which creates a differential in pressure across the two packing elements and lifts the device slightly causing the guide members to overcome the spring resistance and mismate the ports. Thereafter gas pressure build-up, below the device, seals the lower packer with the tubing wall to lift the device while the upper packing element cups are sealed with the tubing wall by the weight of the fluid being lifted.

Upon reaching the top of the tubing the built-up gas pressure below the device is bled off through the fluid flow line allowing the expanded packing elements to be released to retract from their seal with the tubing wall allowing the device to start its return trip to the bottom.

The principal object of the invention is to provide a device for removing paraffin deposits from the bore of oil well tubing, and which is continuously operated by the gas and fluid pressure flow from the well.

Another object is to provide a device of the class described having a pair of packing elements which utilize the thrust of the well flow to raise the device and simultaneously clean the bore of the well tubing, and which upon reaching the top of the well, and gas pressure has been bled off, will allow the device to gravitate toward the bottom of the well.

A further object of this invention is to provide a device of the class described which requires little or no attention after being placed in operation.

Yet another object is to provide a device for cleaning paraffin from the bore of the tubing of an oil well, and which will not restrict the flow of fluid from the well.

A still further object is to provide a device of this class which is actuated by the injection of gas into the bottom of a well.

An additional object of the present invention is to provide a device of this class which has relatively few moving parts to become worn or to get out of order.

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

Figure 1 is a fragmentary elevational view, partly in section, of the device installed in the tubing of a well, as illustrated in dotted lines;

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

Figure 3 is a fragmentary cross-sectional view, similar to Fig. 1, partly in section, illustrating an alternate embodiment of the device.

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

In the drawings:

Referring now to Figs. 1 and 2, the reference numeral 5 indicates the device, as a whole, which is cylindrical in general configuration and is operatively installed for vertical reciprocation in the bore of a well tubing 6. The device 5 includes an elongated tubular body 8, the bore 9 being open at its lower end 10 and closed at its

upper end by a threadedly engaging head 12. The head 12 is provided with an annular groove 14 to enable a conventional fishing tool to grip and hold the head 12 in case the device should have to be fished out of a well. Adjacent its upper end, the wall of the body 8 is provided with a plurality of ports 16. A sleeve 18 is longitudinally slidable on the body 8, over the ports 16. The wall of the sleeve 18 is provided with a like plurality of ports 20 in co-operative alignment with said ports 16, for the purposes more fully explained hereinbelow. The longitudinal or vertical movement of the sleeve 18, relative to the body 8, is limited by a transversely disposed pin 22 rigidly carried by the sleeve 18 and which extends through a pair of diametrically opposed vertically elongated slots, one of which may be seen in Fig. 1, and is indicated by the numeral 24. The vertical length of the slots 24 is such that the ports 16 and 20 are aligned or mated when the pin 22 is at the upper limit of the slot and the parts are mis-mated when the pin is at the lower limit of the slot. As a means for normally retaining the sleeve 18 at the upper limit of its travel to keep the ports 16 and 20 in open communication, a helically-wound tension spring 26 has one end connected to the lower surface of the head 12 by an eye-screw 28, and its opposite end hooked over the pin 22 intermediate its ends. A plurality of vertically disposed equidistantly spaced guide members 30, preferably three heavy spring steel wires, each has its lower end rigidly connected to the periphery of the sleeve 18 adjacent its lowermost end. The upper free end of each guide member 30 slidably contacts a comparatively small slot 32 adjacent the uppermost end of the sleeve. The guide members 30 are arcuately curved or bowed outwardly sufficiently for engaging frictionally the bore of the tubing 6. The purpose of the guide members 30 is to slide the sleeve 18 downwardly upon the body 8 to mis-mate the ports 16 and 20, as is more fully explained hereinbelow.

Adjacent its lower end, the body 8 is circumferentially enclosed by an elongated conventional packing element 40. The element 40 is composed of a sleeve 42 having a bore which slidably receives the periphery of the body 8. Exteriorly the sleeve 42 is covered with a resilient material which is formed into a cupped shape, as at 44. The diameter of the cups of the element 40 is of a selected size which allows them, when in repose, to slide freely through the bore of the tubing 6, and when the cups resist gas or fluid pressure they expand slightly and seal with the wall of the tubing 6, as explained more fully hereinbelow. The element 40 is disposed around the body 8 with the cups 44 opening downwardly and is held on the body 8 by a transverse pin 46 extending through the body and the element 40 adjacent the upper end of the element.

A second packing element 50, which is identical with the element 40, is installed on the body 8 at a selected point between the element 40 and the sleeve 18, with the cups 44 opening upwardly. The element 50 is similarly connected to the body 8 by a transverse pin 52 adjacent the lower end of the element.

An alternate embodiment of the device 5A is illustrated in Fig. 3.

This alternate embodiment 5A may be manufactured more cheaply than the above described preferred embodiment and is designed to be used in wells where gas is present in sufficient quantities to be expendable. In other words, some gas flows by the packing elements before the ports are mis-mated, as is more fully explained hereinbelow. The alternate embodiment 5A includes a similar tubular body 8A which has a plurality of ports 16A adjacent its upper end. A sleeve 56 which is similar to the sleeve 18 is slidable longitudinally and disposed around the body 8A over the ports 16A. The sleeve 56 is provided with a like plurality of ports 20A for mating and mis-mating with the ports 16A. The longitudinal movement of the sleeve 56, to mate and mis-mate the ports, is similarly limited by a transversely disposed pin 22A rigidly carried by the sleeve 56 adjacent its lowermost end and which extends through a pair of diametrically opposed vertically elongated slots in the wall of the body 8A. One of the slots 24A may be seen in Fig. 3. A similar packing element 50A is installed on the body 8A below the sleeve 56. In this embodiment the lowermost end of the sleeve 56 is bored out to receive the uppermost end of the packing element sleeve 42A. The pin 22A extends through suitable perforations in the packing sleeve 42A to move the packing element 50A and the sleeve 56 simultaneously. Similarly a tension spring 26A is connected between the head 12A and the pin 22A to normally urge the pin toward the upper limit of its travel.

The lower end portion of the body 8A is similarly provided with a packing element 40A having downwardly opening cups 44A.

Operation

In operation the device 5, which weighs approximately six pounds in its preferred embodiment, is placed within the tubing 6 at the top of a well, not shown. In this position of repose the ports 16 and 20 are mated. Gas or fluid may pass through the bore 9 and out the mated ports 16 and 20. The ports are large enough to permit the passage of some fluid and free gas at the rate of 125,000 cubic feet per day from a well having a head pressure of approximately forty pounds per square inch. With the ports open, the packing elements 40 and 50 do not frictionally engage the bore of the tubing, and the device 5 falls toward the bottom of a well which does not contain gas or fluid at the rate of approximately 18 feet per second. With the tubing 6 full of fluid, such as crude oil, the rate of fall in the same well is approximately 4 feet per second. As the device gravitates toward the bottom of the well, the guide members 30 frictionally engaged with the bore of the tubing 6 assist the spring 26 in keeping the ports 16 and 20 mated. The device will gravitate toward the bottom of the well, not shown, until the lower end 10 contacts a stop, not shown, placed in the tubing 6 at a selected point. The downwardly opening cups of the lower packing element 40 engage the fluid usually present near the bottom of the well which cushions the downward movement of the device as it nears the stop. Thus, in an intermittent gas lift well, when gas is injected into the well below the device and under greater velocity than the above referred to rate, a pressure drop or differential is set up across the two packers 40 and 50. This pressure drop causes a slight upward movement of the device which mis-mates the ports 16 and 20, as shown in dotted lines, Fig. 1. The mismating of the ports shuts off of the fluid and gas flow through the device, which causes the gas pressure leaking past the lower packer to create a turbulence within the recess of each of the cups 44 and flare them into contact with the wall of the tubing 6. The frictional resistance of the guide members 30, with the tubing wall, aid in overcoming the tension spring 26. Thus, gas and fluid pressure of the well against the lower packing element 40, raises the device toward the top of the well. Upon the upward movement of the device the cups of the upper packing element 50 engage the fluid above the same and turbulence within the cups partially seals these cups against the tubing wall and thereby carries the fluid above the device to the top of the tubing. The upwardly opening cups 44 of the upper packer will generally conform to any irregularity of the tubing wall and scrape off and carry any paraffin adhering thereon. The tubing at the top of the well is preferably provided with a lubricator, not shown, which is simply a selected length of the tubing which projects upwardly above the fluid outlet or flow line connection. The inertia of the device carries it upwardly past the flow line connection into the lubricator. The fluid within the lubricator

acts against the packers to cushion the impact of the device. When a sufficient amount of the fluid and gas has been bled off through the flow line connection and the intermittent control has stopped the injection of gas, the device moves downwardly and as the downward movement starts, the spring **26** raises the sleeve **18** to mate the ports **16** and **20**. With the ports thus mated, the device is ready for another downward trip, thus completing one cycle of operation.

The operation of the alternate embodiment **5A** is identical with relation to the embodiment shown in Fig. 1, except that the ports **16A** and **20A** are held in alignment by the spring **26A** without the aid of guide members frictionally contacting the tubing wall. Gas is injected into the well, as disclosed hereinabove, and the frictional resistance of the cups **44A** to the tubing partially seals the cups with the wall of the tubing to allow the gas pressure to move the device upwardly. This frictional resistance is not constant during the entire upward travel of the device and some gas from below the device escapes through the bore of the body and the partially mated ports. Upon upward movement of the device the ports are mis-mated, or partially mis-mated, near the bottom of the well, by the upper packing element **50A** pulling the sleeve toward the lower limit of its travel by the resistance and turbulence of fluid in the tubing **6A** to the upwardly opening cups **44A** and mainly by the friction of the cups with the tubing wall. This action is shown by dotted lines, Fig. 3. Thereafter, the operation of the alternate embodiment is similar with the operation of the preferred embodiment.

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 paraffin scraper for oil wells, comprising: an elongated vertical tubular body having circumferentially spaced-apart ports in its wall adjacent its upper end, said body having a pair of diametrically opposed elongated slots disposed vertically adjacent the ports; a tubular sleeve longitudinally slidably disposed on said body, said sleeve having spaced-apart ports for communicating with the ports in said body when the sleeve is at the upper limit of its travel and for mis-mating with the ports in said body when the sleeve is at the lower limit of its travel; a transverse pin extending through said sleeve and the slots of said body for limiting the sliding movement of said sleeve; a plurality of cirmumferentially spaced-apart guide members rigidly connected at one end to said sleeve for frictionally engaging the wall of the well pipe in which said scraper is used to slidably move the sleeve; a solid head threadedly connected to the upper end of said body for closing the same; a tension spring within said body, said spring having its ends connected to said head and said pin, respectively, for normally urging the sleeve toward the upper limit of its travel; an expandable downwardly opening tubular cup packer element rigidly connected to said body adjacent its lower end; and an expandable upwardly opening tubular cup packer element rigidly connected to said body in spaced-apart relation above the first said cup packer, said packers frictionally engaging and sealing with the wall of the well pipe in which the scraper is used upon upward movement of the same.

2. A paraffin scraper for oil wells, comprising: an elongated tubular vertical body, having circumferentially spaced-apart ports in its wall adjacent its upper end, said body having a pair of diametrically opposed elongated vertical slots adjacent the ports; a tubular sleeve longitudinally slidably disposed on said body, said sleeve having spaced-apart ports for communication with the ports in said body when the sleeve is at the upper limit of its travel and for mis-mating with the ports in said body when the sleeve is at the lower limit of its travel; a transverse pin extending through said sleeve and the slots of said body for limiting the sliding movement of said sleeve; a plurality of circumferentially spaced-apart guide members rigidly connected at one end to said sleeve for frictionally engaging the wall of the well pipe in which the scraper is used for slidably moving the sleeve; a solid head threadedly connected to the upper end of said body for closing the same; a tension spring within said body, said spring having its ends respectively connected to said head and said pin, for normally urging the sleeve toward the upper limit of its travel; and a pair of elongated tubular packing elements rigidly connected to said body intermediate its ends in spaced-apart superposed relation below said sleeve, the uppermost said element having at least one sealing cup opening upwardly and the lowermost said element having at least one sealing cup opening downwardly for sealing with the wall of the well pipe, the diameter of said elements being substantially equal with relation to the bore of the well pipe in which the scraper is used.

3. A paraffin scraper for oil wells, comprising: a vertically elongated tubular body having circumferentially spaced-apart ports in its wall adjacent its upper end, said body having a pair of diametrically opposed vertically elongated slots adjacent the ports; a tubular sleeve longitudinally slidably disposed on said body, the lower end of said sleeve having an enlarged bore, said sleeve having spaced-apart ports in its wall for communicating with the ports in said body when the sleeve is at the upper limit of its travel and for mis-mating with said ports in said body when the sleeve is at the lower limit of its travel; a head threadedly engaged with the upper end of said body for closing the same; an elongated tubular packing element slidably disposed around said body and having a portion of its upper end closely received by the enlarged bore of said sleeve, said packing element having a series of upwardly opening cups for expanding and sealing with the wall of the well pipe upon upward movement of the scraper; a pin extending transversely through said sleeve, said upper end portion of said packer and the aligned slots of said body, for limiting the sliding movement of said sleeve and said packer with relation to said body; a second elongated tubular packing element rigidly connected at its upper end to the lower end portion of said body, said packing element having a series of downwardly opening cups for expanding and sealing with the wall of the well pipe to trap gas below the scraper; and a tension spring within said body having its ends connected to said head and said pin, respectively, for normally urging the sleeve and the upper end portion of the first said packing element toward the upper limit of their travel.

4. A paraffin scraper for oil wells, comprising: a vertically disposed tubular body having a closed upper end, said body having ports in its wall adjacent said closed end and having a pair of diametrically disposed vertically elongated slots in its wall adjacent the ports; means for closing the ports when the scraper is moved upwardly within the well and for opening the ports when the scraper moves toward the bottom of the well, said means including a tubular sleeve slidably disposed on the upper end portion of said body, said sleeve having a ported wall for mating and mis-mating with the ports on said body, flexible guide members carried by said sleeve for frictionally engaging the wall of the well pipe in which the scraper is used for longitudinally moving said sleeve with relation to said body, and a pin rigidly carried transversely by said sleeve and extending through said pair of slots for limiting the sliding movement of said sleeve; and upper and lower packing means carried by said body for frictionally engaging and sealing with the wall of the well pipe in which the scraper is used upon upward movement of the latter, said lower packer means

including, an expandable downwardly opening cup element of resilient material adjacent the lower end of said body, said upper packing means including, an expandable upwardly opening cup element of resilient material carried by said body in spaced superposed relation with the first said packer.

5. A paraffin scraper for oil wells, comprising: a vertically disposed tubular body having a closed upper end, said body having ports in its wall adjacent said closed end and having a pair of diametrically disposed vertically elongated slots in its wall adjacent the ports; means for closing the ports when the scraper is moved upwardly within the well and for opening the ports when the scraper moves toward the bottom of the well, said means including a tubular sleeve slidably disposed on the upper end portion of said body, said sleeve having a ported wall for mating and mis-mating with the ports in said body, and a pin extending transversely through said sleeve and said pair of slots for limiting the sliding movement of said sleeve relative to said body; spring means connected to said pin and said closed end for normally

holding said sleeve at the upper limit of its travel and mating the ports; upper packing means connected to said sleeve and slidably carried by said body for sealing with the wall of the pipe in which the scraper is used and for longitudinally moving the sleeve, thereby opening and closing the ports, said packing means including a tubular element having upwardly opening expandable cups; and a lower tubular packing element carried by the lowermost portion of the body below the upper packer and having downwardly opening expandable cups for sealing with the wall of the well pipe to trap gas below the scraper.

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