May 18, 1954 W. S. CRAKE 2,678,696

PARAFFIN SCRAPER FOR WEELS

Filed April 24, 1951 3 Sheets-Sheet 1

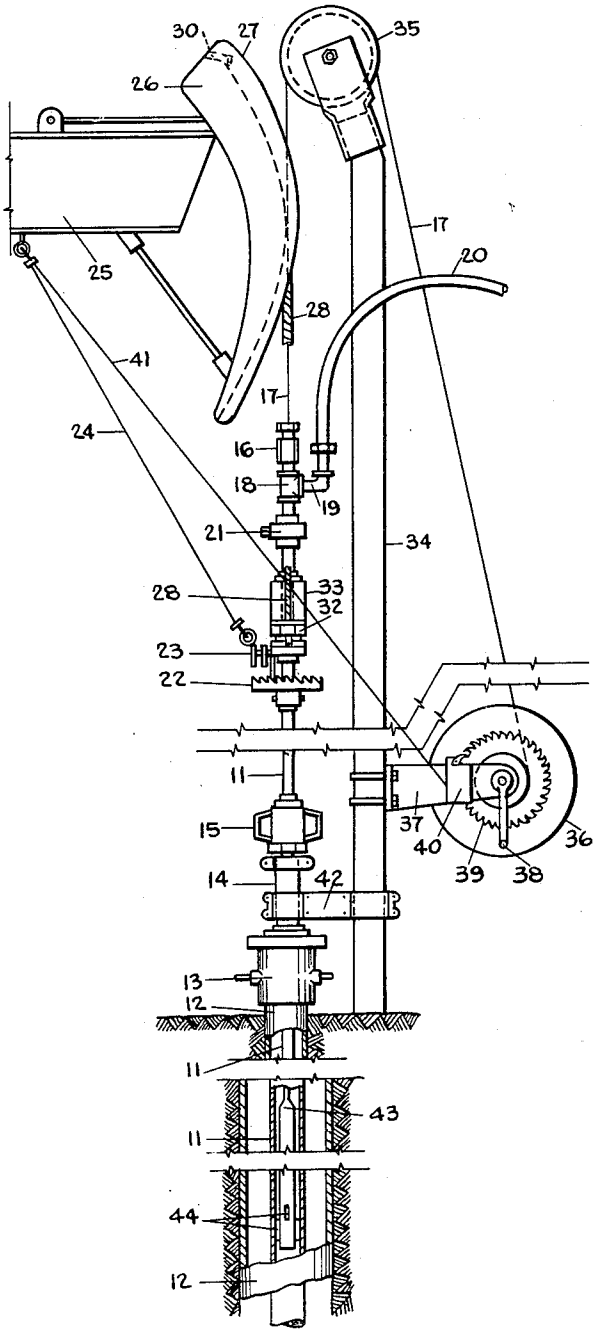


FIG. 1

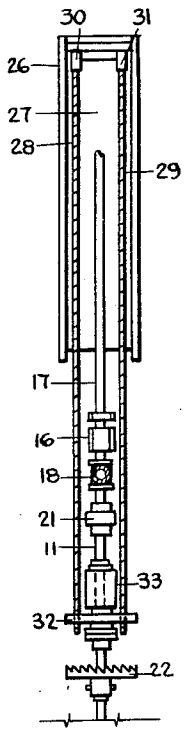


FIG. 2

Inventor: Wilfred S. Crake

By: [signature]

His Attorney

May 18, 1954 W. S. CRAKE 2,678,696

PARAFFIN SCRAPER FOR WEELS

Filed April 24, 1951 3 Sheets-Sheet 2

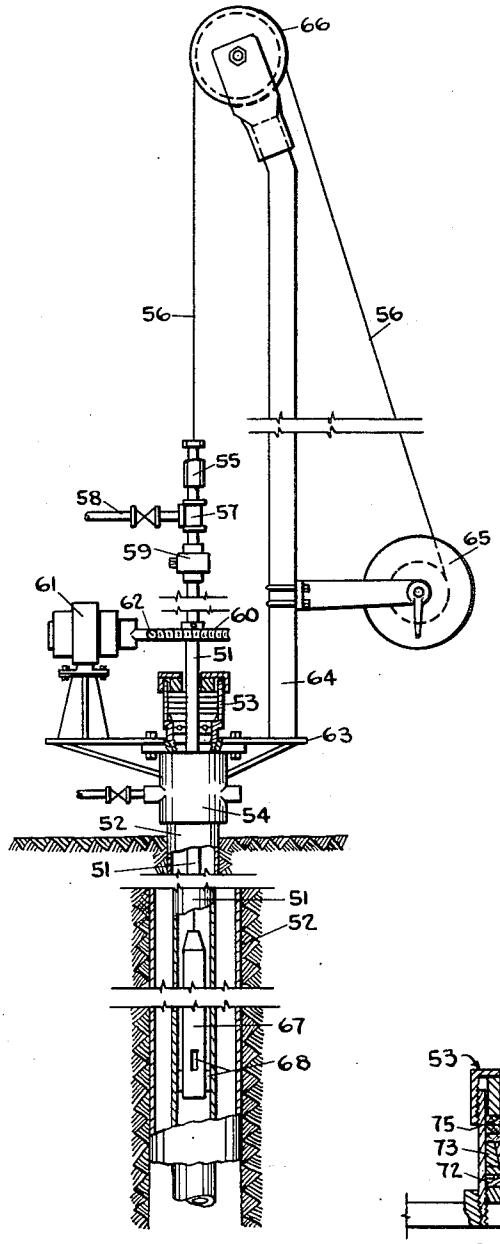


FIG. 3

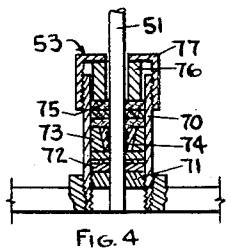


FIG. 4

Inventor: Wilfred S. Crake

By: [signature]

His Attorney

May 18, 1954 W. S. CRAKE 2,678,696

PARAFFIN SCRAPER FOR WEELS

Filed April 24, 1951 3 Sheets-Sheet 3

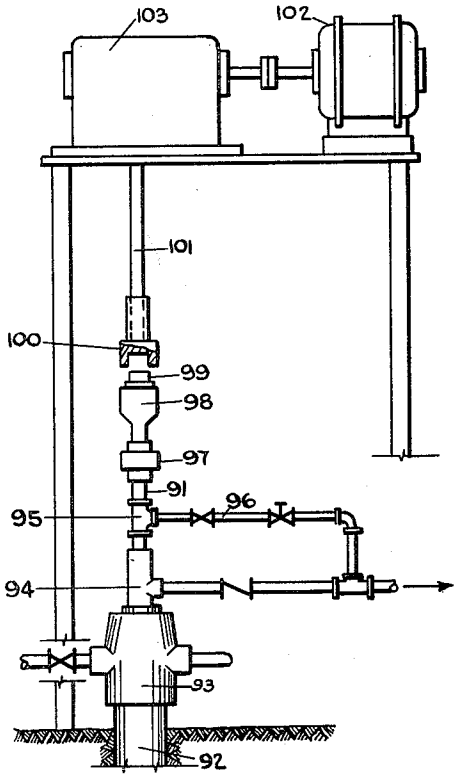


FIG. 8

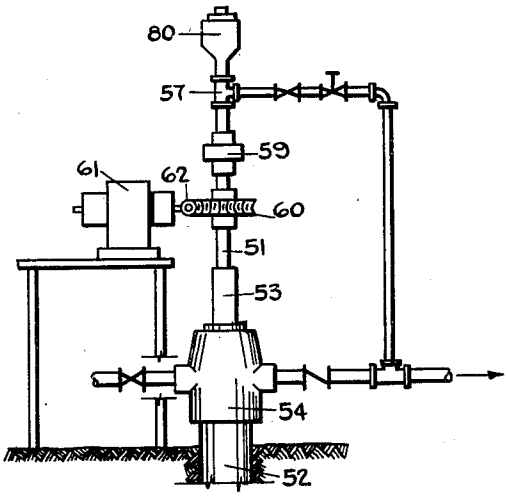


FIG. 5

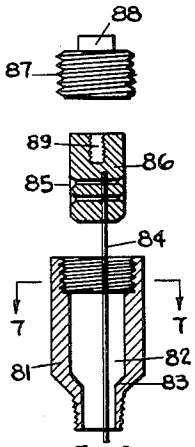


FIG. 6

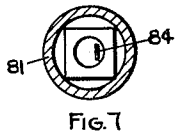


FIG. 7

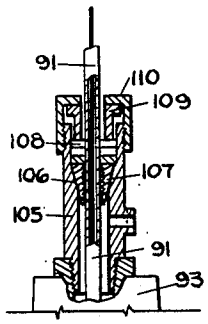


FIG. 9

Inventor: Wilfred S. Crake

By: [signature]

His Attorney

Patented May 18, 1954 2,678,696

UNITED STATES PATENT OFFICE

2,678,696

PARAFFIN SCRAPPER FOR WELLS

Wilfred S. Crake, Houston, Tex., assignor to Shell Development Company, Emeryville, Calif., a corporation of Delaware

Application April 24, 1951, Serial No. 222,708

8 Claims. (Cl. 166—18)

1

This invention relates to the removal of deposits from the internal walls of oil well pipe and pertains more particularly to the removal of paraffin or other deposits from the interior of an oil production tubing string in a well when said well is being produced.

It is well recognized that in some oil-producing areas the oil may contain a substantial amount of a waxy constituent, such as paraffin, which is in the liquid state when at the bottom-hole well temperature and pressure. As the oil is pumped or allowed to flow up the production tubing to the top of the well, the temperature of the oil gradually decreases until a point is reached at which the paraffin crystallizes out and accumulates on the internal walls of the tubing. In time, the paraffin accumulation continues to build up until the volume of production from the well is materially reduced or stopped entirely. The operator of the well is then faced with the problem of removing the paraffin, the removal thereof being generally both expensive and time-consuming.

It is therefore an object of this invention to provide an apparatus for preventing the accumulation of paraffin deposits on, or for removing accumulated paraffin deposits from, the internal wall of a production tubing in an oil well.

Another object of the present invention is to provide a device for removing paraffin deposits from the interior of a reciprocating production tubing which is employed to actuate a well pump, said paraffin removal taking place while the well is being produced and without the necessity of shutting down the well pump.

A further object of this invention is to provide an apparatus for continuously removing paraffin deposits from the interior of a production tubing in a flowing oil well without interrupting the production of the well.

Another object of the present invention is to provide a paraffin-removing device adapted to pass through an oil well production tubing, said device being arranged in said tubing in a manner to permit the reciprocation and/or rotation of the device with respect to the tubing.

These and other objects of this invention will be understood from the following description of the invention as shown in the accompanying drawing, wherein:

Figure 1 is a view, partly in enlarged detailed cross section, of the present paraffin-removing apparatus positioned in and above a well, said well being produced by reciprocation of the production tubing secured to a pump.

Figure 2 is an enlarged side elevation view of a portion of the equipment shown in Figure 1 for reciprocating and rotating the production tubing.

2

Figures 3, 5 and 8 are views, partly in enlarged cross section, of other embodiments of the present paraffin-removing apparatus positioned in and above a free-flowing well.

Figure 4 is a cross-sectional view of the stuffing box 53 shown in Figure 3.

Figure 6 is a cross-sectional view of the hanger head 86 shown in Figure 5.

Figure 7 is a cross-sectional view taken along the line 7—7 of Figure 6.

Figure 9 is a cross-sectional view of the tubing hanger 94 shown in Figure 8.

Referring to Figure 1 of the drawing, one embodiment of the present invention is illustrated as utilized to remove paraffin from the interior of a production tubing 11 extending down into a well casing 12 to a plunger-type well pump (not shown) which is reciprocated by repeated upward and downward movement of the tubing 11 in a manner described in Patent Number 2,552,153 to W. Crake, granted September 4, 1945. Suitable closure means are provided at the top of the well casing 12 around the production tubing 11, such for example as a wellhead assembly 13, provided with a short section of tubing 14 and a gland 15 which closes the upper end of tubing 14 in a fluidtight manner.

The upper end of the production tubing 11 is closed by a stuffing box or sealing gland 16 which is adapted to pass a wire line or ribbon strip 17 therethrough and into the tubing 11. Below gland 16 a T 18 having an elbow 19 connected thereto, may be inserted in the tubing 11 to provide means for leading oil or other fluid from the top of the tubing. Conduit 20 is then attached to elbow 19 for leading the production fluid to suitable storage facilities (not shown).

In order that the production tubing 11 may be rotated, for purposes to be described later, while the pipe connections 18 and 19 and conduit 20 at the top of said tubing 11 remain stationary, a swivel joint 21 is provided in the production tubing below the T 18. Any well known type of apparatus such as a supporting swivel 33 and ratchet device 22 is provided for rotating the tubing 11. As shown in Figure 1, a ratchet wheel 22 may be fixedly attached to the outside of tubing 11 at a point below the swivel joint 21. A spring-loaded ratchet or pawl 23 is affixed to the tubing 11 for actuating the ratchet wheel 22. The pawl 23 in turn may be actuated by a cable 24 which is secured to the pawl 23 at one end and at the other end to the walking beam

25 of a well pump assembly (not shown) positioned adjacent the well.

Secured to one end of the walking beam 25 of the pumping assembly is an arc-type beam hanger or horsehead 26 having a preferably recessed arcuate outer surface 27 in which a pair of wire ropes, 28 and 29 are movably positioned (Figure 2). The ropes 28 and 29 are anchored at the upper ends thereof in a pair of sockets 30 and 31 which are in turn affixed to the horsehead 26. The lower ends of the ropes 28 and 29 are fixedly attached to a cross bar or yoke member 32 which is secured around the production tubing 11 below a stop member 33. The stop member 33, which may include a rotatable bearing on which the tubing 11 is supported, in turn is affixed to the outer wall of the tubing 11 either above or below the swivel joint 21.

With the above-described construction it may be seen that the normal rocking motion of the walking beam 25 and horsehead 26 will alternately raise and lower ropes 28 and 29, yoke 32 and production tubing 11. At the same time, each rocking motion of the walking beam 25 will cause cable 24 to move the spring-loaded pawl 23 with respect to the ratchet wheel 22 so that the latter is slowly turned in a horizontal plane through bearing in 33 together with the production tubing 11 to which it is affixed. Swivel 21 causes fittings 18, 19 and 20 to remain stationary in a horizontal plane.

Positioned adjacent the well head assembly 13 is a mast or pole 34 having mounted at its upper end a pulley 35 over which passes wire line 17. A drum 36 on which the wire line or ribbon 17 may be reeled is secured by means of a suitable bracket 37 near the lower end of the mast 34. The drum 36 may be rotated by a hand crank 38 or any other suitable prime mover means for reeling the wire line 17 in or off the drum 36 at whatever speed desired. One form of prime mover means may comprise a ratchet wheel 39 affixed to one side of the drum 36 with an automatic ratcheting device, diagrammatically represented at 40, mounted on bracket 37 for rotating the ratchet wheel 39 and drum 36. The ratcheting device 40 may in turn be periodically actuated by a cable 41 secured to the walking beam 25 of the pumping assembly. In the embodiment illustrated in Figure 1, the mast 34 is held stationary with respect to the reciprocating and rotating mechanism by a bracket 42.

The wire line 17 may be of any cross-sectional shape, for example, square, round, hexagonal, flat rectangular, or the like. In operation, a small sinker bar 43 is secured to the lower end of the wire line 17 and serves to maintain a fixed tension on said line. If desired, the sinker bar 43 may be provided with a plurality of radially or laterally extending cutting knives 44 of any suitable type. Preferably, the sinker bar 43 is positioned at a predetermined depth within the production tubing 11. During pumping operations, the production tubing 11 is raised and lowered a few feet with each stroke of the pump. At the same time the interaction of ratchet wheel 22 and pawl 23 slowly rotates the production tubing with respect to the wire line 17. Since the stuffing box 16 does not rotate and passes freely about the wire line 17, the latter is neither reciprocated nor rotated at any time.

The reciprocating and/or rotating action of the production tubing 11 causes the wire line 17 to act as a cutting means or knife, scraping any paraffin from the interior wall of the production tubing 11 at it forms thereon. Since, as a practical matter, an oil well is never perfectly straight, the production tubing 11 will generally be at some small angle to the vertical which will cause the wire line 17 to rest against the wall of the tubing 11 as it reciprocates, thus scraping off the paraffin. Since certain portions of the wire line 17 scrape along the low side wall of the inclined production tubing 11, other portions of the wire line in tension are caused to vibrate in a manner so as to cut away sufficient amounts of paraffin accumulations over the entire length of the production tubing 17, thus permitting the free flow of oil therethrough. The vibrating wire line also tends to agitate the flow stream in the production tubing 11 whereby particles of paraffin in the flow stream are maintained in suspension rather than settling out onto the wall of the production tubing. For cleaning production tubing in the above manner, it has been found that especially good results have been obtained by employing a wire line having sharp longitudinal edges, such as a line made of flat ribbon steel, rather than a round wire.

If desired, in addition to the production tubing being continuously rotated, the wire line 17 may be slowly reeled up out of the well casing 12 onto the drum by means of the ratchet wheel 39 and its actuating device 40. During the travel of the sinker bar 43 from the bottom to the top of the well casing, the knives 44 on the sinker bar 43, as well as the wire line 17, scrape along the inner wall of the production tubing and remove paraffin accumulations therefrom. The sinker bar may be returned to the bottom of the well casing in any suitable manner. For example, when the sinker bar has been raised to the top of the production tubing 11, any increase in tension on the wire line may automatically release or reverse in well known manner the ratcheting device 40 and allow the wire line 17 to unwind from the drum 36 and return the sinker bar 43 to the bottom of the production tubing again. The well in the meantime is being continuously pumped as it is cleaned.

In Figure 3, the present paraffin scraper is shown in a flowing well to remove paraffin accumulations from the interior of a production tubing 51 positioned within a well casing 52 which is closed at the top in a fluidtight manner by a suitable closure means such as a stuffing box 53 mounted above the wellhead 54.

As shown in detail in Figure 4, the stuffing box 53 may comprise a cylindrical housing 70 having an annular bearing support 71 fixedly secured to the inner wall of said housing. A bearing 72 is mounted on said annular support 71 and a slip bowl 73 is positioned on the top plate of bearing 72, rotatably therewith. A plurality of wedge-shaped slips 74 fit slidably within the slip bowl 73, said slips having toothed or serrated surfaces for gripping the production tubing 51 which passes therethrough. The top of the housing 70 is closed in a fluidtight manner by packing rings 75 adapted to be compressed by a gland 76 and screw-threaded gland nut 77.

The production tubing 51 extends through the stuffing box 53 and is closed at the top in a fluidtight manner by a seal or gland 55 adapted to pass a wire line 56 therethrough.

Below gland 55, the production tubing 51 is provided with a T 57 and conduit 58 for discharging fluid from the tubing. A swivel 59 is located in the tubing 51 whereby the portion of the tubing below said swivel 59 may be rotated

while the portion of the tubing above said swivel remains stationary. A suitable drive wheel or gear 60 is affixed to the outside of the production tubing 51 at any point below the swivel 59. Any suitable mechanical, electrical, pneumatic or hydraulic prime mover means 61 may be connected through suitable transmission means, as through a worm gear 62, to drive gear 60 and rotate the production tubing 51.

The wire line 56 is suspended in the well in a manner similar to that described with regard to the embodiment of Figure 1. In the embodiment shown in Figure 3, a platform 63 is mounted on the wellhead and in turn supports the prime mover 61 and a mast 64. The wire line is reeled on a drum 65 which is secured to the mast, said wire passing over a pulley 66 at the top of the mast and down into the production tubing 51. Tension is maintained on the wire line 56 by a sinker bar 67 secured to its lower end, said sinker bar being equipped with paraffin cutter knives 68, if desired. Thus, it is seen that the wire line 56 remains substantially stationary while the production tubing 51 is rotated so that the relative movement between the tubing and the wire line scrapes the paraffin from the inside of the tubing. In operation, the production tubing 51 is rotated very slowly, for example, one or more revolutions a day depending upon the well conditions. Alternatively, the scraper wire line may be mounted so that it is driven by a motor and rotates while the production tubing remains stationary. Paraffin removed by the scraping wire line is carried up the production tubing by the fluid below.

Rather than maintaining an excess of wire line 56 stored on a drum 65 with the wire line passing over pulley 66 and through gland 55 as shown in Figure 3, a predetermined length of wire line, sufficient to position the bar 43 at a level below that at which deposition of paraffin begins, may be employed, as shown in Figure 5. In this embodiment, the production tubing 51 is mounted for rotation by prime mover 61 in the manner described with regard to Figure 3.

In the embodiment of Figure 5, the wire line is fixedly secured in a closed hanger head 80 which is immovably positioned above T 57. As shown in Figures 6 and 7, the hanger head 80 may comprise a cylindrical body member 81 having a portion of its bore 82 tapered to form an annular shoulder 83. A wire line 84 is fixedly secured, as by rivets 85, to a block member 86 of a size adapted to fit within the bore 82 of the body 81 and seat on the internal shoulder 83. Preferably, the wire line 84 is a length of steel ribbon tape affixed to the block 86 to one side of its vertical axis in a manner such that both edges of the ribbon tape scrape along the wall of the production tubing 51 as the latter is rotated. The top of the cylindrical body member 81 may be closed by a screw-threaded plug 87 which may be provided with a raised portion 88 adapted to fit a wrench or clutch. The block 86 may be provided with a threaded hole or keyway 89 to facilitate its removal from body 81.

It may be readily seen, as shown in the embodiment of the present apparatus illustrated in Figure 8, that a scraper wire line may be mounted for rotation in a production tubing 91 which is suspended in a well casing 92 in a stationary position. The production tubing 91 passes up through a well head 93 and tubing head 94 to a T 95 where the oil produced is lead off through a conduit 96. A swivel joint 97 is secured to the top of the production tubing 91 with a wire line hanger head 98 being mounted above the swivel joint 97.

The hanger head 98 is similar to the one described with regard to Figures 6 and 7. In this embodiment, the clutch jaw 99 at the top of the hanger head 98 is adapted to fit in a drive clutch 100 secured to the end of a shaft 101 by a motor 102 through a reduction gear mechanism 103. The motor 102 and reduction gear mechanism 103 are mounted on a suitable platform 104 above the well head 93. In operation the motor 102 rotates shaft 101 and hanger head 98 whereby the wire line suspended from the hanger head 98 within the stationary production tubing 91 is rotated around the inner wall of the production tubing so that any paraffin accumulations are scraped therefrom.

In the embodiment of Figure 8 the tubing head 94 may be constructed in a manner illustrated in Figure 9 wherein the head 94 comprises a tubular body 105 having an annular shoulder 106 formed on the inner wall thereof. A plurality of wedge-shaped slips 107 are seated on shoulder 106 to hold the production tubing 91 in a fixed position. The top of the tubular body 105 may be closed by rings of packing 108, a gland 109 and a gland nut 110.

I claim as my invention:

1. An apparatus for removing deposits from the inside of a well tubing, said apparatus comprising a wire line in suspension within said well tubing, sealing means closing the upper end of said well tubing and supporting the wire line therein, a weight secured to the lower end of said wire line to maintain a predetermined tension thereon, swivel means connected into said tubing permitting relative rotational movement between the tubing sections above and below said swivel means connection, gear means exteriorly affixed to said production tubing below said swivel means, and prime mover means for actuating said gear means and rotating said lowering tubing section to cause relative movement of said wire line with respect to said tubing, whereby the displacement of said wire line around the inner walls of said production causes the wire line to scrape any deposits therefrom.

2. An apparatus for removing deposits from the inside of a well tubing, said apparatus comprising slip means for supporting said well tubing within a wellhead, bearing means positioned within said wellhead below said slip means for rotatably mounting said tubing in said wellhead, a wire line in suspension within said well tubing, sealing means closing the upper end of said well tubing and supporting the wire line therein, a weight secured to the lower end of said wire line to maintain a predetermined tension thereon, swivel means connected into said tubing permitting relative rotational movement between the tubing sections above and below said swivel means connection, gear means exteriorly affixed to said production tubing below said swivel means, and prime mover means for actuating said gear means and rotating said lowering tubing section and causing relative movement of said wire line with respect to said tubing whereby the displacement of said wire line around the inner walls of said production causes the wire line to scrape any deposits therefrom.

3. An apparatus for removing deposits from the inside of a well tubing, said apparatus comprising a wire line in suspension within said well tubing, said wire line having the shape of an

elongated steel ribbon tape, sealing means closing the upper end of said well tubing and supporting the wire line against the inner wall thereof, a weight secured to the lower end of said wire line to maintain a predetermined tension thereon, swivel means connected into said tubing permitting relative rotational movement between the tubing sections above and below said swivel means connection, gear means exteriorly affixed to said production tubing below said swivel means and prime mover means for actuating said gear means and rotating said lowering tubing section and causing relative movement of said wire line with respect to said tubing whereby the displacement of said wire line around the inner walls of said production causes the wire line to scrape any deposits therefrom.

4. An apparatus for removing deposits from the inside of a well tubing, said apparatus comprising a wire line in suspension within said well tubing, said wire line having the shape of an elongated steel ribbon tape, sealing means closing the upper end of said well tubing and supporting the wire line against the inner wall thereof, a weight secured to the lower end of said wire line to maintain a predetermined tension thereon, swivel means connected into said tubing permitting relative rotational movement between the tubing sections above and below said swivel means connection, discharge fluid conduit means in communication with said tubing below said swivel means, and prime mover means mounted above the sealing means of said well tubing and operatively connected thereto to rotate said upper tubing section causing relative movement of said wire line with respect to said lower tubing section whereby the displacement of said wire line around the inner walls of said tubing causes the wire line to scrape any deposits therefrom.

5. An apparatus for removing paraffin deposits from a well production tubing having a stream of oil flowing therethrough, said apparatus comprising sealing means at the top of said well tubing adapted to pass a wire line therethrough into the bore of said tubing, a wire line suspended in said tubing, means adjacent the top of said tubing supporting said wire line, a weight affixed to the lower end of said wire line for maintaining said wire line in tension, a reciprocating pumping assembly positioned adjacent the upper end of said tubing, swivel means connected into said tubing permitting relative rotational movement of the tubing sections above and below said swivel means connection, means connecting said pumping assembly and said tubing permitting rotation of said tubing on one side of said swivel means with respect to the tubing on the other side, and means positioned adjacent the upper end of said tubing below said swivel means for rotating said tubing about said wire line, whereby said wire line is caused to scrape the walls of said tubing to remove paraffin deposits therefrom.

6. An apparatus for removing paraffin deposits from a well production tubing having a stream of oil flowing therethrough, said apparatus comprising sealing means at the top of said well tubing adapted to pass a wire line therethrough into the bore of said tubing, a wire line suspended in said tubing, means adjacent the top of said tubing supporting said wire line, a weight affixed to the lower end of said wire line for maintaining said wire line in tension, a reciprocating pumping assembly positioned adjacent the upper end of said tubing, means connecting said pumping assembly and said tubing for reciprocation of said tubing, swivel means in said tubing permitting rotation of said tubing on one side of said swivel means with respect to the tubing on the other side, and tubing-actuating means positioned adjacent the upper end of said tubing below said swivel means for rotating said tubing about said wire line, whereby said wire line is caused to scrape the walls of said tubing to remove paraffin deposits therefrom, said tubing actuating means comprising a ratchet wheel affixed to said tubing below the swivel means, pawl means engaging said ratchet wheel for the actuation thereof, and cable means secured between said pawl means and the pumping assembly whereby said pawl means and cooperating ratchet wheel are actuated on each stroke of the pumping assembly.

7. An apparatus for removing deposits from the inside of a well tubing, said apparatus comprising a wire line in suspension within said well tubing, sealing means closing the upper end of said well tubing and supporting the wire line therein, a weight secured to the lower end of said wire line to maintain a predetermined tension thereon, swivel means connected into said tubing permitting relative rotational movement of the tubing sections above and below said swivel means connection, and prime mover means positioned adjacent said well tubing above said swivel means and operatively connected thereto to rotate said upper tubing section for causing relative movement of said wire line with respect to said tubing, the displacement of said wire line around the inner walls of said tubing causing the wire line to scrape any deposits therefrom.

8. An apparatus for removing deposits from the inside of a well tubing, said apparatus comprising sealing means for closing the upper end of said well tubing, a wire line passing vertically through said sealing means into said well tubing, means adjacent the top of said tubing supporting the wire line therein, a weight secured to the lower end of said wire line to maintain a predetermined tension thereon, swivel means connected into said tubing permitting relative rotational movement between the tubing sections above and below said swivel means connection, and prime mover means positioned adjacent said well tubing below said swivel means for rotating said tubing section below said swivel means for causing relative movement of said wire line with respect to said tubing, the displacement of said wire line around the inner walls of said tubing causing the wire line to scrape any deposits therefrom.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
982,652	Wiechmann	Jan. 24, 1911
1,662,984	Scott et al.	Mar. 20, 1928
2,179,814	Conaghan	Nov. 14, 1939
2,182,680	Rugg et al.	Dec. 5, 1939
2,278,067	Emery	Mar. 31, 1942
2,294,061	Williamson	Aug. 25, 1942
2,383,934	Crake	Sept. 4, 1945
2,471,198	Cormany	May 24, 1949
2,552,939	Condra	May 15, 1951

FOREIGN PATENTS

Number	Country	Date
703,369	France	Feb. 3, 1931