Feb. 14, 1950 T. J. DAVIS ET AL 2,497,659

TUBING CLEANING DEVICE

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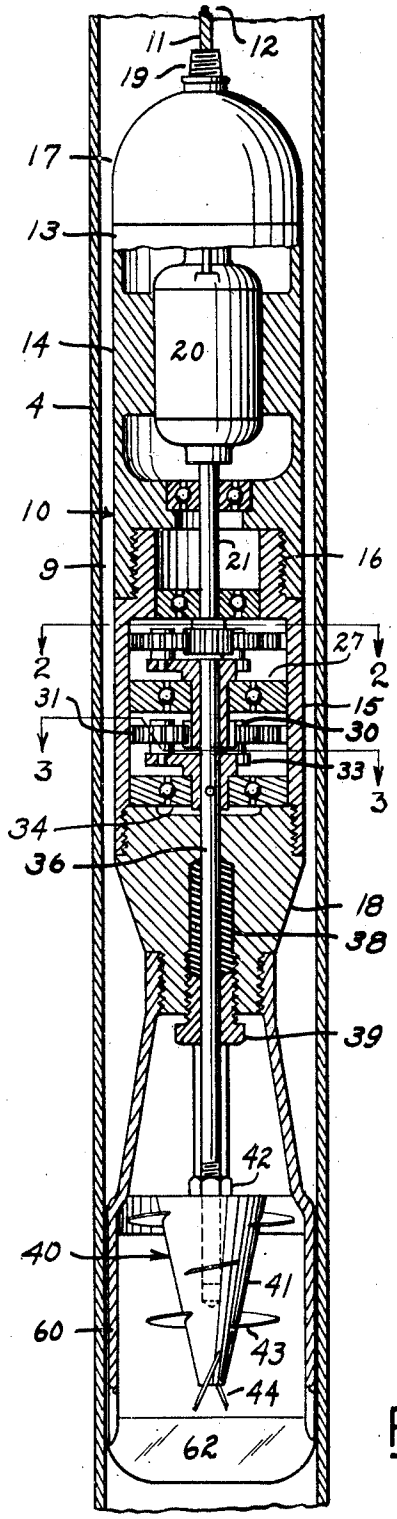

Fig. 1.

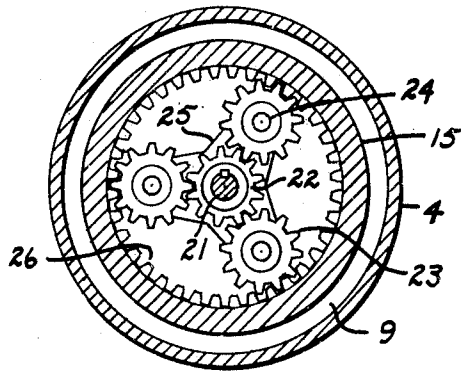

Fig. 2.

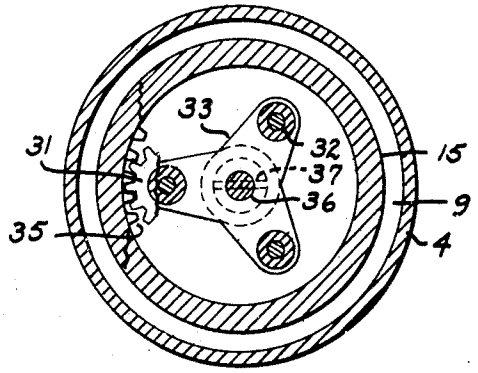

Fig. 3.

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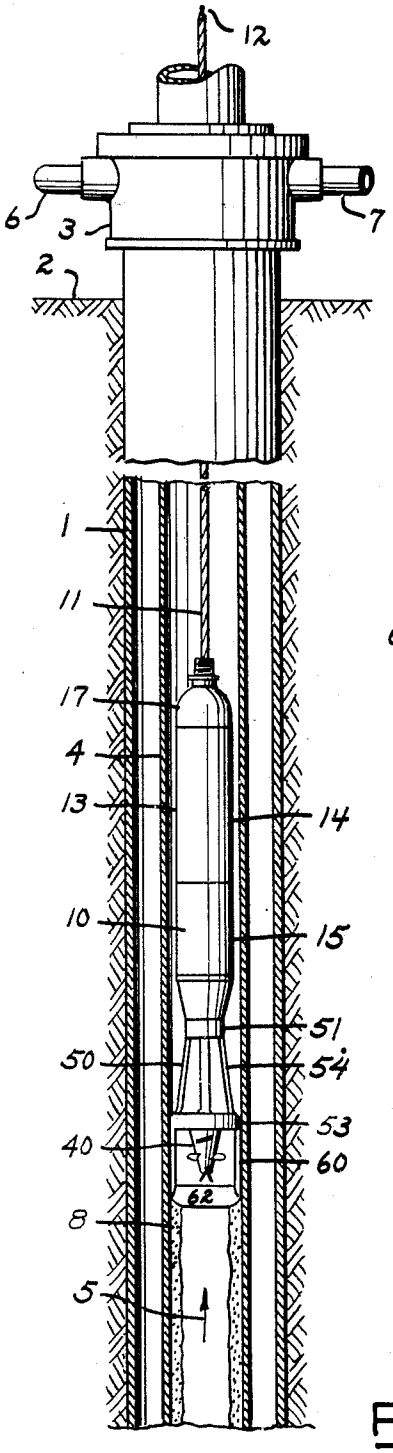

Fig. 7.

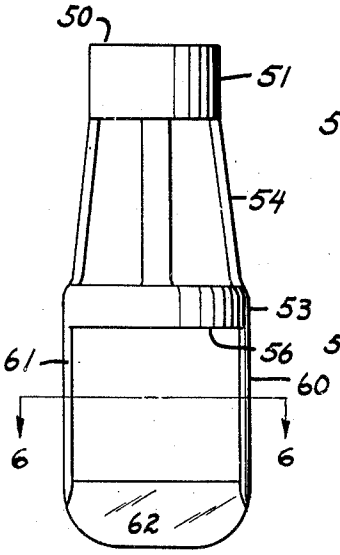

Fig. 4.

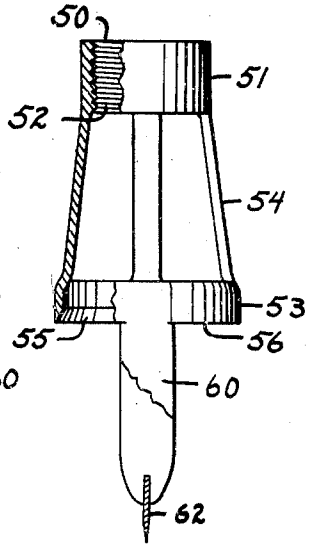

Fig. 5.

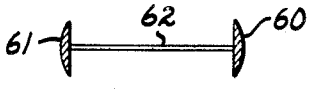

Fig. 6.

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TUBING CLEANING DEVICE

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5 Claims. (Cl. 166—18)

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This invention relates to the removal of deposits from the internal walls of pipe and is of particular utility in the removal of paraffin or other deposits from the interior of the flow string, or tubing, of oil wells. More particularly the invention relates to a method of, and an apparatus for, expeditiously and effectively removing deposited paraffin from the tubing in oil or gas wells.

It is well recognized that in some oil producing areas, the composition of the petroleum products produced, and other factors such as temperatures and pressures, are such that certain constituents, particularly paraffin, tend to accumulate on the interior of the tubing and will, in time, materially reduce production from the well. This accumulation is most pronounced proximate the surface where pressures and temperatures are lowest and usually occurs at depths of approximately two-thousand feet and less.

The primary object of the invention is to provide a novel method and instrumentality for removing this obstructing material from the tubing of oil wells.

It is also an object to provide a simple device that may be utilized effectively with a minimum of labor or other expense.

A more specific object is to provide a power device which is adapted to stabilize itself during movement within a well tubing and to simultaneously and progressively remove and comminute the deposit which has accumulated within the tubing.

Another object is to provide a device that may readily be utilized in tubings of different sizes.

Still another object is to provide a device which includes a cutter ring, or ring gauge, adapted to move in close proximity to the walls of tubing and progressively remove the deposits from the walls.

A further object is to provide an expeditious and inexpensive method of removing paraffin from wells without terminating production of the wells during the process.

A still further object is to provide a method and device for removing deposits from within a well tubing by progressively severing such deposits from the walls and comminuting the severed material whereby same is removed by fluids produced by the well.

The foregoing are illustrative objects which, together with additional objects, will be more fully apparent from the following description taken in connection with the accompanying drawings in which;

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Fig. 1 is an elevational view, partly in section, of one embodiment of the invention and its relative position within a tube being cleaned thereby;

Fig. 2 is a sectional view taken on line 2—2 in Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 in Fig. 1;

Fig. 4 is a side elevational view of the stabilizer which comprises an element of the device of the invention;

Fig. 5 is a view similar to that shown in Fig. 4, but taken at an angle of 90° thereto, and portions being cut away to more clearly show the structure of this element;

Fig. 6 is a sectional view taken on line 6—6 in Fig. 4;

Fig. 7 is a sectional view taken through a producing well in which a device embodying the invention is being lowered to remove paraffin from within the tubing.

In order to illustrate the utility of the invention and the general manner of attaining the objects above enumerated, reference is first made to Fig. 7 in which there is shown a well casing 1 which extends upwardly from the earth's surface 2 and is provided with a casing head 3. Interiorly of the casing 1 is the flow string 4 through which well fluids rise as indicated by the arrow 5. As is well known in the art, the well head 3 is provided with suitable outlets 6 and 7, the latter of which will be assumed to be the outlet from the flow string or tubing 4.

The device of the invention is generally shown at 10 suspended upon a conductor cable 11 having an insulated conductor or conductors 12 therein, whereby the cable serves the dual purpose of raising and lowering the device 10 and supplying electric power thereto for a rotatable cutter 40 within a stabilizer 50 all of which will be more fully described. It is intended that cutter 40 shall enter and comminute deposits 8 on the tubing 4 so that the comminuted material may move with well fluids through the annular space 9 between the body of the device and the tubing 4.

The device 10 comprises a power unit having a housing 13 with body portions 14 and 15 threadedly interconnected at 16 and closed at their ends by cap member 17 and plug or nose member 18. The cap member 17 is provided with a threaded projection 19 to which a sinker bar may be attached if desired.

Within the body portion 14 is assembled an electric motor 20 which, as already indicated, is supplied with electric power through the con-

ductor or conductors 12 from a source located at the point at which cleaning operations are controlled. The shaft 21 of the motor 20 is provided with a gear 22 (see Fig. 2) engaging planetary gears 23 mounted on pins 24 on spider 25. The planetary gears also mesh with teeth 26 on the interior of the body member 15. It seems apparent that, with the structure just described, rotation of the gear 22 causes the planetary gears to revolve upon their pins 24 and also to effect rotation of the spider 25 within anti-friction bearing 27.

The lower end of the downwardly extending portion of the spider 25 is in turn provided with a gear 30 which engages planetary gears 31 (see Fig. 3) rotatable upon pins 32 on spider 33 mounted in bearing 34. Planetary gears 31 engage teeth 35 on the interior of the body member 15.

A shaft 36 passes through axial bores in spiders 25 and 33. This shaft is rotatable within spider 25 which thus serves as a bearing at the upper end of this shaft. The shaft is, however, secured to spider 33 by pin 37 so that the shaft is driven by this spider.

The power unit above described is necessarily of relatively small diametral dimension since it is intended to operate within conventional flow lines and, as above explained, an annular space 9 must be provided about the unit. Hence, to provide adequate power to comminute the deposit material 8, the motor 20 is designed for relatively high speeds. In order that the cutter 40 be not driven at a greater speed than necessary, planetary gears 22—26 and 30—33 and 35 are provided. While the planetary type of gears is shown as used for this purpose, it is apparent that any suitable gear reduction means may be utilized.

The nose member 18 is counterbored to receive packing 38 through which shaft 36 passes to the exterior of the housing 13. A packing gland 39 is provided to maintain the packing 38 sufficiently impacted to prevent leakage of fluids along the surface of the shaft 36.

A cutter 40, comprising a body 41, is secured to the lower end of shaft 36 as by the threaded connection and lock-nut 42. This body is elongated and is preferably tapered, although other suitable configurations may be utilized. Blades 43 extend radially from the body 41 and extend at an angle to the axis of rotation so that materials comminuted thereby are urged upwardly as comminution takes place. The lowermost cutter blades 44 extend generally downwardly to assist in enlarging the bore within the deposit 8 of which removal is required.

It seems apparent that the application of power to the cutter 40 tends to rotate the device in a direction counter to the direction of rotation of the cutter. In order to prevent this counter rotation, and to serve other useful purposes, the stabilizer 50 is provided. This element comprises a collar portion 51 which is threaded internally at 52 for engagement with complementary threads at the lower end of the housing 13, already described. The stabilizer and housing hence form a rigid and unitary structure.

Below the collar portion 51 is a guide ring, or ring gauge, 53 and these elements are interconnected by ribs 54. The ring gauge 53 is of such diameter as to fit closely within the tubing 4 and has a flaring inner surface 55 whereby a lower edge 56 is formed. By virtue of this construction this gauge performs a stabilizing effect on the entire assembly when the gauge moves into engagement with a deposit to be removed from the interior of the tubing 4. It also serves to guide the assembly centrally of the tubing, to progressively sever deposits from the walls of the tubing and to displace the severed deposits inwardly toward the cutter 40 therein. To aid in this stabilizing action the stabilizer also includes arms 60 extending downwardly from the ring gauge 52 and are thus adapted to enter the deposits in advance of the ring gauge. These arms have arcuate outer surfaces 61 which move in close proximity to the walls of the tubing and hence likewise assist in guiding the device axially of the tubing. A transverse blade 62 interconnects the lower ends of the arms 60 and such blade also assists in restraining the unit from rotation.

As explained, the stabilizer 50 is intended to fit closely within the tubing to be cleaned. The cutter 40 is likewise of dimensions comparable to the interior of the stabilizer, the uppermost blades 43 moving in close proximity to the interior surface of the ring gauge 53. For this reason these two elements are detachable so that they may be replaced with like elements of a size suitable for use in the tubing to be cleaned. The device can therefore be utilized for cleaning any of various sizes of tubing by merely attaching a stabilizer and a cutter of the correct size.

The operation of the device embodying the invention, and above described as the preferred embodiment, is believed apparent from the preceding description. By way of summary it will be pointed out that the device, equipped with a stabilizer and cutter of appropriate size, will first be introduced into the upper end of a tubing string 4, the cable 11 passing through a suitable stuffing box, as is customary when lowering a cable device into a flowing well. The motor 20 is then energized and the entire unit is lowered and is guided centrally of the tubing by the stabilizer 50. Blade 61 and the arms 60 enter the deposits within the tubing and, at the same time, the ring gauge 53 progressively severs the deposits from the walls of the tubing and moves such deposits radially upwardly. The cutter 40 being driven at relatively high speed, engages the severed deposits and finely divides these deposits which then move upwardly with the well products and are ejected through the well outlet 7.

When the invention is used on flowing wells the comminuted deposits are suspended in the moving well fluids and removed from the well with such fluids. The invention is not, however, confined to the removal of deposits from flowing wells but may be used where well conditions are static. In such cases procedure varies slightly from that just described.

If static well conditions exist the device 10 is lowered a predetermined distance or until downward movement of the device terminates or may under certain circumstances be lowered throughout the distance in which deposits exist. Because of the clearance 9 about the unit and the fact that the severed deposits are finely divided and therefore do not dense'y impact within the tubing, the device is then withdrawn and swabbing is utilized for removal of the mixture of well fluids and cuttings.

By means of the method and apparatus above described, deposits 8 within the tubing 4 may be rapidly and effectively removed at required intervals. It is thus apparent that the objects of the invention are realized.

The invention claimed is:

1. A device for removing deposits from tubing in oil wells including an assembly adapted to be lowered upon a cable and including an electric motor operatively connected to the cable, a shaft driven by said motor, a rotatable cutter on said shaft, and a stabilizer attached to the housing of said motor and extending downwardly proximate the periphery of said cutter, said stabilizer comprising a cutter ring having an annular inwardly tapering surface whereby deposits severed thereby are moved inwardly to be comminuted by the cutter, and arms extending downwardly from the cutter ring alongside the cutter to engage the deposits in advance of the cutter in the tubing as the assembly is moved axially of the tubing, whereby the device is restrained from rotation as it is advanced.

2. In a device for removing deposits from the walls of tubes, a housing, a motor therein, a shaft driven by said motor, a rotatable cutter mounted on said shaft exteriorly of the housing, a stabilizer ring below the housing, ring supporting arms connected to the ring and housing, and passages between the arms, said stabilizer ring having an inwardly tapering surface so that deposits engaged by the ring are moved inwardly to be comminuted by the cutter, whereby said passages admit upward movement of the comminuted materials past the device.

3. In a device for removing deposits from the walls of tubes, a housing, a motor therein, a shaft driven by said motor, a rotatable cutter mounted on said shaft exteriorly of the housing, a stabilizer cutter ring below the housing and about said rotatable cutter, ring supporting arms connected to the ring and housing, and passages between the arms to admit movement past the device of materials comminuted by the cutter.

4. In a device for removing deposits from the walls of well tubing, a conductor cable, a housing attached to said cable, an electric motor within said housing and electrically connected to said cable, a shaft operatively connected to said motor and extending outwardly from within said housing, a rotatable cutter blade on said shaft, and a stabilizer ring below the housing to be moved proximate the wall of the tubing and operable to sever deposits from the walls of the tubing and thence move such deposits inwardly for comminution by the cutter blade, ring supporting arms connected to the ring and housing, and passages between the arms whereby materials comminuted by the cutter blade may move axially past the stabilizer ring.

5. In a device of the class described, a housing, a shaft extending outwardly therefrom, an elongated cutter on the shaft exteriorly of the housing, a stabilizer secured to the housing, surrounding said shaft and cutter and including a ring gauge surrounding said cutter proximate one end thereof, a plurality of arms extending longitudinally of the device alongside the elongated cutter, and a transverse blade interconnecting the outer ends of said legs.

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