United States Patent [19]

Pridy

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[54] **OIL WELL TUBING CLEANER**

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[52] **U.S. Cl.** **166/72,** 166/77, 166/170

[51] **Int. Cl.** **F21b 37/02,** F21b 19/00

[58] **Field of Search** ..... 166/170, 175, 75, 166/77; 175/207; 15/104.1 R; 173/28

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[57] **ABSTRACT**

A power driven oil well tubing cleaner so operatively associated with a vehicle-supported tubing puller of the type that includes a vertically positionable mast that when a string of tubing is being sequentially moved upwardly in a well bore hole by the puller, each stand may have foreign material removed from the interior thereof by the cleaner prior to the stand being separated from the string.

6 Claims, 7 Drawing Figures

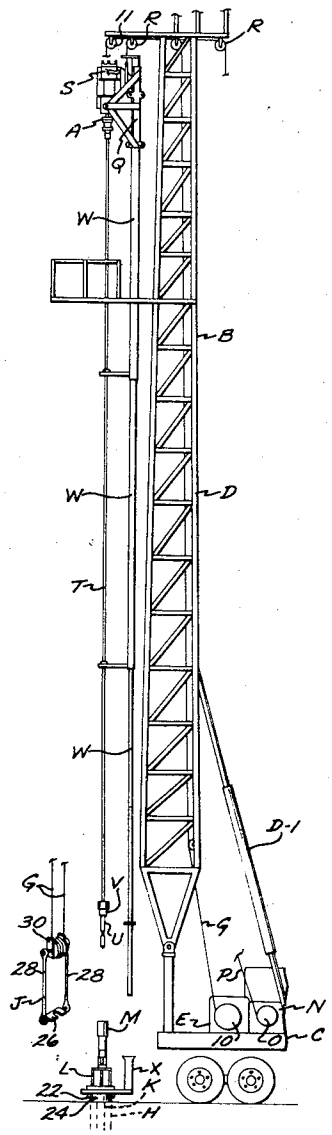


FIG. 1

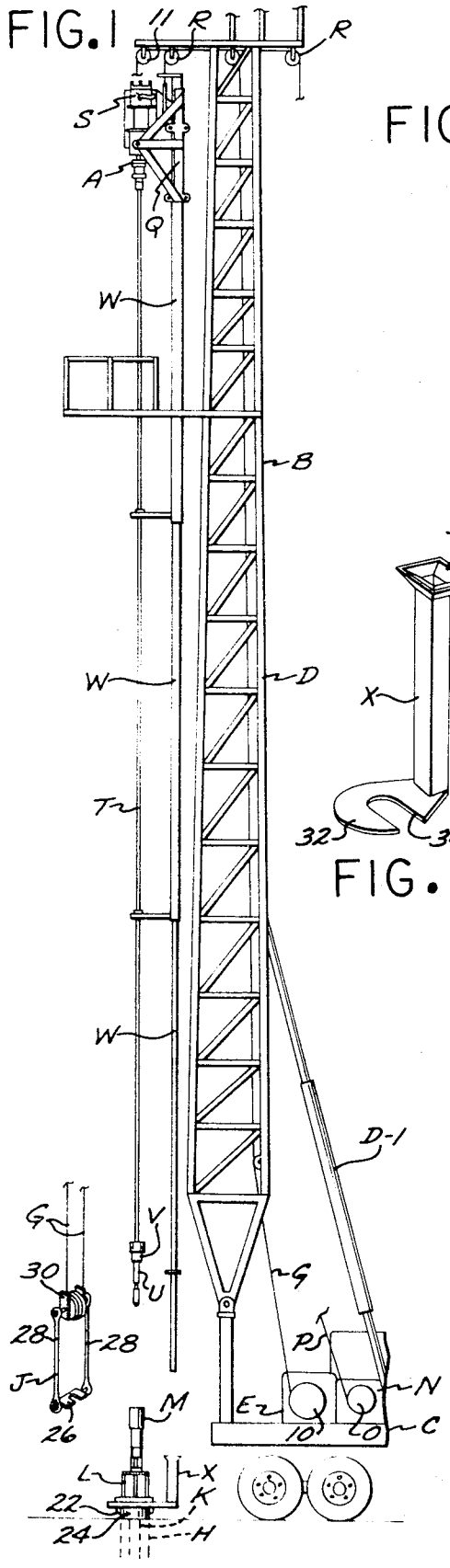


FIG. 2

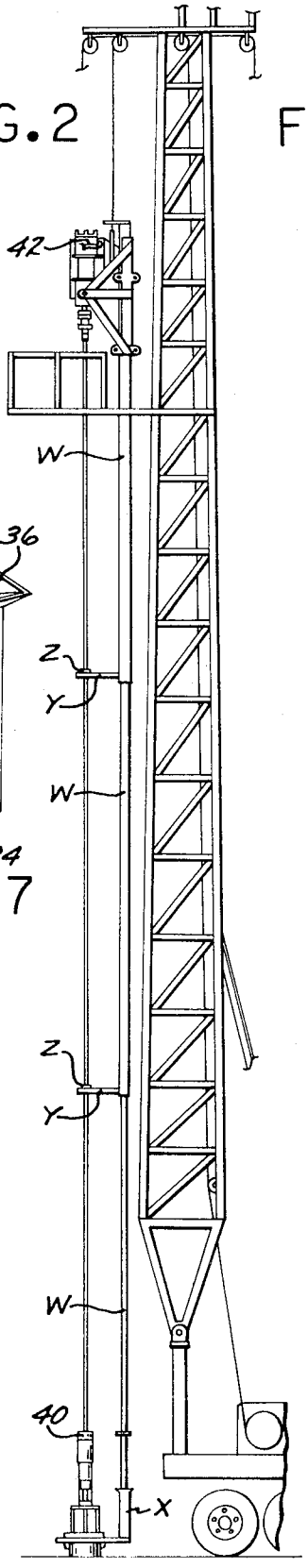


FIG. 3

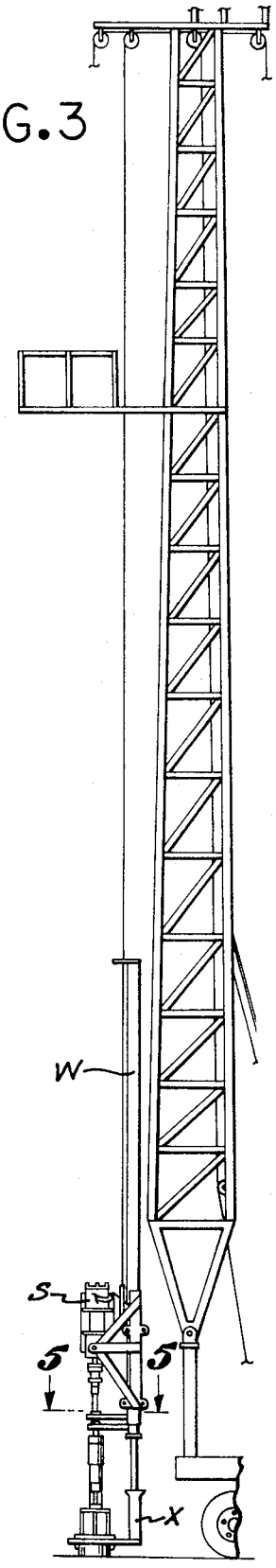


FIG. 7

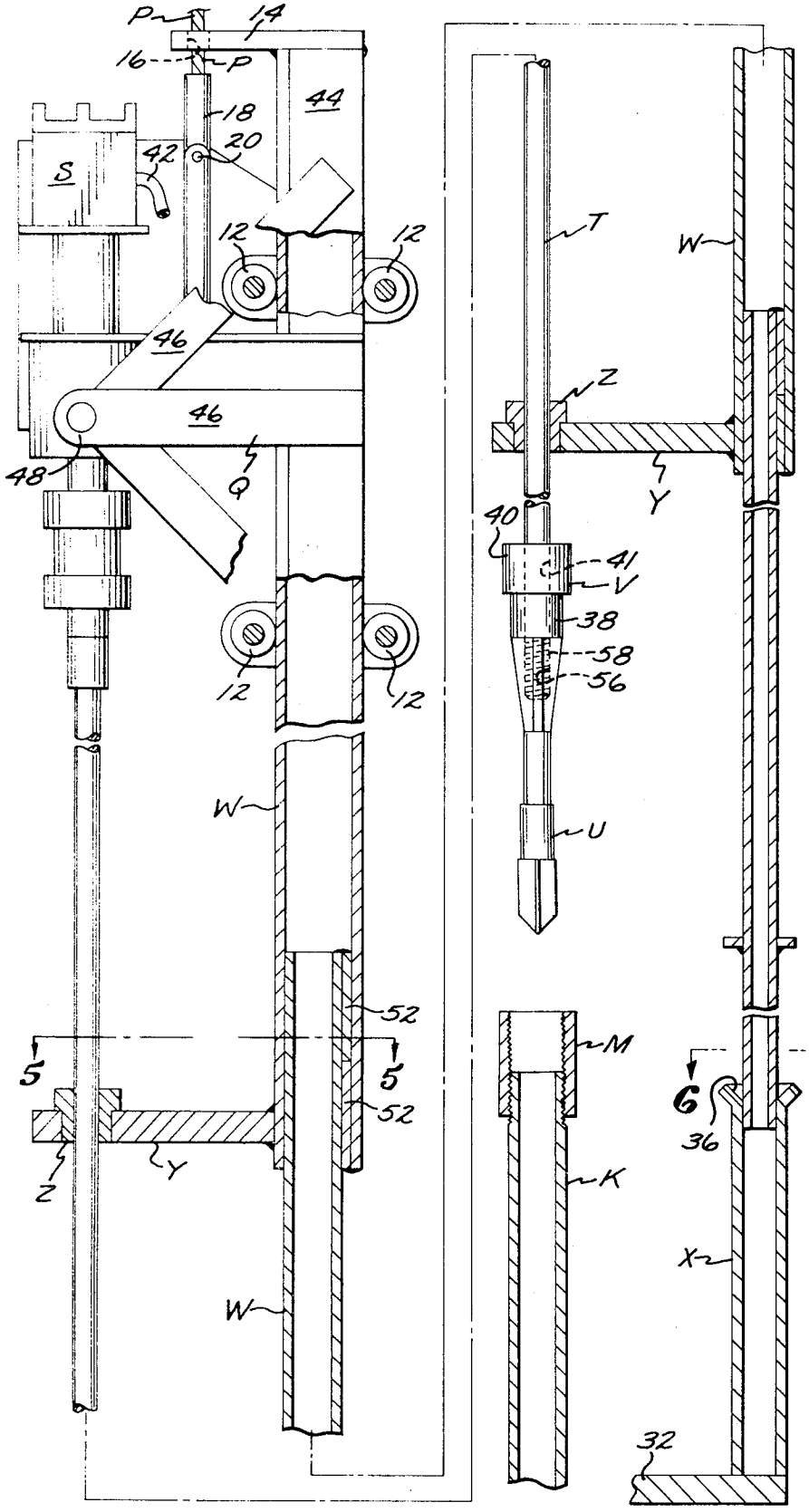


FIG. 4

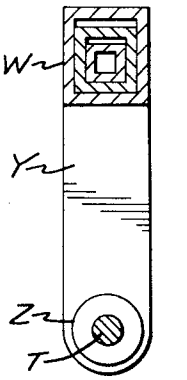


FIG. 5

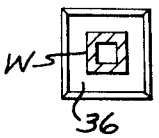


FIG. 6

OIL WELL TUBING CLEANER

BACKGROUND OF THE INVENTION

1. Field of the Invention

Oil well tubing cleaner.

2. Description of the Prior Art

In oil field operations the tubing strings that depend in the well bores are periodically removed therefrom for maintenance purposes. Frequently, it is found that all or a portion of a string has solid foreign material deposited on the interior surface thereof to the extent that the upward flow of fluid through the string is seriously impaired, and as a result the well cannot operate at peak efficiency. In the past, it has been common practice to pull the string of tubing and then ream out the solid material from the interior of the stands of tubing as they rest in horizontal positions on a rack. However, this is a time-consuming operation, as well as being relatively inefficient, and unduly increases the cost of maintenance work on an oil well.

The primary purpose in devising the present invention is to supply an oil well tubing cleaning device that is mounted on the same vehicle that supports a well tubing pulling mast and associated power operated equipment, and each tubing stand having solid material removed from the interior thereof prior to the stand being disconnected from the tubing string.

Another object in devising the present invention is to supply an apparatus that minimizes the time required in cleaning the interior of a stand of tubing, and also permitting this operation to be carried out at substantially less cost than with prior art apparatus used for this purpose.

SUMMARY OF THE INVENTION

The tubing cleaner of the present invention is operatively associated with a vehicle-mounted oil well tubing puller of the type that includes a vertically positionable mast. The vehicle has a first power operated winch mounted thereon that includes a first drum on which a first cable is wound. First pulley means are mounted on the upper end of the mast to engage the first cable. The free end of the first cable includes first means for engaging the uppermost collar on the string of tubing depending into the well bore. By actuation of the first winch the tubing string may be sequentially and intermittently moved upwardly out of the well bore to have stands of the tubing separated therefrom. Each stand of tubing, prior to being separated from the tubing string, has the interior cleaned of foreign material, if the latter is necessary, by the tubing cleaner that comprises the present invention.

The tubing cleaner includes a second power-operated winch that is mounted on the mast-supporting vehicle, with the second winch including a second drum on which a second cable is wound. A frame assembly is adjacently disposed to the mast and is vertically movable relative thereto. Second pulley means are mounted on the upper end of the mast. The second pulley means are engaged by the second cable, with the free end of the second cable being secured to the frame to permit the frame to be moved upwardly and downwardly relative to the mast by actuation of the second power winch. A power operated motor is supported from the frame assembly and drives a downwardly depending rigid member that has a cutter on the lower

end thereof. The cutter is of such size as to be capable of entering the interior of the tubing, and as the cutter travels therethrough, of removing substantially all foreign material from the interior of the tubing. A generally cylindrical guide plug is mounted on the elongate rigid member above the cutter, with the guide plug engaging the uppermost collar on the tubing suspended in the well bore, and the guide plug serving to maintain the rigid member in a centered position relative to at least the uppermost portion of the tubing as the cutter moves downwardly through the latter.

A number of telescopically engaging tubular guide members extend downwardly from a frame assembly, with the lowermost one of these guide members engaging an elongate cup-shaped member that occupies a fixed position relative to the upper end of the well bore. Each of the telescopically engaging members has a rigid arm extending outwardly therefrom, and each arm on the outer end thereof supports a tubular bushing that rotatably engages the elongate member as the latter is rotated by the motor. The telescopically engaging tubular guide members, the cup-shaped member, the plurality of rigid arms, and the bushings rotatably engaging the elongate member all serve to prevent the elongate member from whipping and deforming laterally as it is rotated by the motor. The telescopically engaging members have stop means operatively associated therewith to prevent longitudinal separation thereof, as the motor-supporting frame is moved to an uppermost position on the mast.

Second means are provided for holding the tubing cleaner in a position relative to the mast, where the tubing cleaner will not interfere with the tubing being raised from the well bore after the uppermost stand of the tubing has been cleaned by the tubing cleaner. The oil well tubing is supported in the well bore by slips or other conventional means to permit the well tubing to be intermittently raised after each uppermost stand thereof has been cleaned, with the stand that has been cleaned being separated from the string depending in the well bore by unscrewing the lower end of the stand from the uppermost collar on the string.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the rearward portion of a vehicle-supported well puller of the type that includes a vertically positionable mast, and illustrating the manner in which the well cleaner is supported by the mast above a tubing string that depends into a well bore;

FIG. 2 is the same side elevational view as shown in FIG. 1, but with a motor-supporting frame being lowered to dispose the cutter within the upper portion of the tubing string, the guide plug in removable engagement with the uppermost collar, and the lowermost of the guide rods partially in a cup-shaped member secured at a fixed position relative to the well bore;

FIG. 3 is the same side elevational view as shown in FIG. 2, but after the well cleaner has been lowered to clean foreign material from the uppermost stand of tubing in the string of tubing that depends into the well bore;

FIG. 4 is an enlarged combined side elevational and vertical cross-sectional view of the motor-supporting frame, the guide plug, cutter, driven elongate member, guide members, and the cup that is partially engaged by the lowermost of the guide members;

FIG. 5 is a transverse, cross-sectional view taken on the line 5—5 of FIG. 4;

FIG. 6 is a transverse, cross-sectional view taken on the line 6—6 of FIG. 4; and

FIG. 7 is a perspective view of the cup that is partially engaged by the lowermost one of the guide members.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The tubing cleaner A, as may best be seen in FIGS. 1 through 3, is used in conjunction with a tubing puller B. The tubing puller B is mounted on a power-drawn vehicle C, which vehicle pivotally supports a mast D that may be erected to a horizontal position by a hydraulically operated assembly D–1 of conventional design. The tubing puller B includes a first power-operated winch E that includes a drum **10** on which a first cable G is partially wound, with the first cable extending upwardly on the mast D to engage first pulley means **11**, with the first cable G then extending downwardly to support conventional tubing engaging means J on the lower free end thereof. A string of tubing K is supported in a well bore H by slips L, and the uppermost end of the tubing string K terminating in a collar M. The tubing cleaner A includes a second power-operated winch N mounted on the vehicle C, as shown in FIG. **1**, with the second winch including a second drum O that has a second cable P wound thereon, with the cable P extending upwardly on the mast D to engage second pulley means R. A downwardly depending end of the second cable P is secured to a frame assembly Q, as shown in FIGS. **1** and **4**.

The frame assembly Q supports a motor S that is adapted to drive and rotate a downwardly depending elongate member T. The elongate member T has a cutter U mounted on the lower end thereof. A centering guide plug V is slidably mounted on the elongate member T, and rests on the upper extremity of the cutter U when the elongate member T is positioned as shown in FIG. **1**.

A number of telescopically engaging elongate guide members W are provided, as shown in FIGS. **1** to **4**, with the lowermost one of these guide members capable of engaging an elongate, upturned cup X (FIG. **7**) that is held at a fixed position relative to the slips L by means later to be described. All but the lowermost one of the telescopically engaging guide members W have a rigid arm Y extending outwardly therefrom, with each arm on the outer extremity supporting a bushing Z that rotatably engages the elongate member T. The uppermost one of the telescopically engaging guide members W is at all times engaged by two sets of transversely spaced rollers **12**, as best seen in FIG. **4**, that form a part of the frame assembly Q. The uppermost one of the telescopically engaging guide members W has a horizontal stop **14** mounted on the upper extremity thereof, with the stop having a bore **16** in the outer portion thereof through which the second cable P extends downwardly to be secured to a rigid member **18** that is pivotally connected to the frame assembly Q by a pin **20**. The member **18** is of larger transverse cross section than the bore **16** to prevent frame assembly Q from being raised above stop **14**. The string of tubing K is held in a suspended position in the well bore H by slips L that are positioned above the flanged end **22** of casing **24**. The casing **24** extends downwardly into the well bore H. The string of tubing K is made up of a number of lengths of tubing that are joined end-to-end by collars M.

Tubing K extends upwardly through slips L with the tubing terminating on the upper end in a collar M. Tubing engaging means J of conventional design, as shown in FIG. **1**, include a slotted cross-piece **26** that can engage the underside of the uppermost collar M. Cross-piece **26** is supported by two side pieces **28** that are pivotally connected on their upper ends to a traveling block **30** that engages the first cable G. By actuating the first winch E, the first cable G and tubing engaging means J may be moved upwardly or downwardly to raise or lower a tubing string K into or out of the well bore H after the tubing string has been released by the slips L.

When it is desired to use the tubing cleaner A, the tubing puller B is moved to the position shown in FIG. **1** after the mast D is erected to substantially a vertical position by use of the hydraulic mechanism D–1. Cup X includes a lower, outwardly extending bracket **32** that has a slot **34** therein of sufficient width to engage tubing string K. The bracket **32** is gripped between the flanged end **22** and the slips L. The slot **34** is of sufficient width that the tubing string K and collars M can be moved vertically therethrough. Cup X has a tapered upper end **36**.

The centering guide plug V, as shown in FIG. **4**, includes a lower cylindrical body **38** of such size as to removably and snugly fit within the upper confines of the uppermost collar M shown in FIG. **4**. The guide plug V also includes an upper body **40** of somewhat larger transverse cross section than the lower body **38**. Bodies **38** and **40** have a longitudinal bore **41** extending therethrough that slidably engages elongate member T. Second winch N is actuated to permit second drum O to rotate in a direction to dispose the tubing cleaner A in the position shown in FIG. **2**, where the cutter U is in the upper portion of the tubing string K, and the lower portion of the lowermost one of the guide members W is in the cup X.

Motor S is preferably of the air driven type. Air under pressure is supplied to motor S through a hose **42**, with the flow of air through the hose being controlled by a valve (not shown), preferably located adjacent vehicle C

The frame assembly Q includes two vertical, laterally spaced legs **44** that support the two laterally spaced sets of rollers **12** that rotatably contact the exterior surface of the uppermost one of the members W. The upper ends of legs **44** are welded to stops **14**, as may be seen in FIG. **4**. Each of the legs **44** has three arms **46** extending outwardly therefrom to define an apex **48** at the outer ends thereof. Each of the apexes **48** has a pin **50** extending therethrough, with the inner end of each pin secured to the motor S for support purposes.

Each of the guide members W is preferably of rectangular transverse cross section. The members W are provided with stops **52** on the overlapping portions thereof, as shown in FIG. **4**. The stops **52** prevent longitudinal separation of the members W when the members are as shown in FIG. **1**. Motor S has a vertical reinforcing plate **54** secured to it and one of the legs **44**.

Cutter U, as may best be seen in FIG. **4**, is of elongate bladed shape and has a tapped bore **56** in the upper portion thereof that is engaged by a lower threaded end **58** of elongate member T. Cutter U is of such shape and size that substantially all foreign material is removed

from the interior of tubing K as the cutter is moved longitudinally therethrough. After the tubing cleaner A has been positioned as shown in FIG. **2**, the motor S is actuated to rotate the elongate member T and cutter U. The second winch drum O is rotated in a direction to permit the weight of motor S, frame assembly Q, and member T to be exerted in a downward direction on the rotating cutter U. The cutter U, as it rotates, removes foreign material (not shown) from the interior of the tubing string K, and due to the weight imposed on the cutter, it tends to move downwardly in the tubing string K.

As the cutter U moves downwardly in the tubing string K the members W telescope one into the other, until the uppermost member W is in the downward position, shown in FIG. **3**, where the lower end of what was previously the uppermost member W now rests on the upper end of the cup X. When the uppermost member W is so disposed, the frame assembly Q and motor S may move downwardly and longitudinally on this member to permit a maximum length of the tubing K to be cleaned of foreign material due to rotation of the cutter U.

After the frame assembly Q and motor S have moved to the maximum downward position, as illustrated in FIG. **3**, the second drum O is rotated by the second winch N in a direction to move the frame assembly Q, motor S, members W, elongate member T, and cutter U upwardly to the position shown in FIG. **1**, and whereby use of a cable that engages the lower end thereof, the above-named components may be moved out of vertical alignment with the tubing string K.

After the frame Q, members W, elongate member T, motor S and cutter U have been so moved out of vertical alignment with the tubing string K, the first winch E is actuated to permit the first drum **10** to rotate in a direction to permit the tubing engaging means J to engage the uppermost collar M. The direction of rotation of the first drum **10** is now reversed and concurrently the slips L are released to permit the tubing string K to be raised upwardly relative to the slips L to dispose the cleansed portion of the tubing string thereabove. The slips L are now actuated to grip the portion of the tubing string below the cleansed upper portion thereof. The cleansed stand of the tubing string K is now unscrewed from the portion of the string therebelow, leaving a collar M on the uncleaned portion of the tubing string K, in the position shown in FIG. **1**. Each cleansed stand of tubing (not shown) is stacked in a conventional manner adjacent the mast D.

The operation above described is repeated until all of the stands of tubing in the string of tubing K have been cleaned. Should it be desired, each uppermost stand of tubing in the tubing string K may be gauged by conventional means as to the thickness of foreign material deposited on the interior thereof, and those strings in which the thickness of the deposited material does not warrant it need not be cleaned. The stands of tubing after being cleaned are returned to their initial position in well bore H by using the puller B in a conventional manner.

The use and operation of the invention has been described previously in detail and need not be repeated.

I claim:

1. In combination with an oil well tubing puller of the type that includes a power-drawn vehicle, a vertically positionable mast mounted on said vehicle, first power means for raising said mast to and lowering said mast from a substantially vertical position, a tubing puller assembly, second power means for raising and lowering said tubing puller and a string of tubing engaged thereby into and out of a well bore, a device for cleaning the interior of said string of oil well tubing of foreign material when said tubing is removably supported in said well bore by slips that engage said tubing string under the uppermost collar thereon, said oil well tubing cleaning device including:

a. a power operated drum on said vehicle;

b. pulley means mounted on the end of said mast that is most upwardly disposed when said mast is in a substantially vertical position;

c. a cable that engages said drum and pulley means, said cable having a first end that is longitudinally movable relative to said mast;

d. a frame assembly adjacently disposed to said mast and longitudinally movable relative thereto when said mast is vertically positioned;

e. a motor supported by said frame assembly;

f. an elongate driven member that extends downwardly from said motor, said member having a first free end;

g. a cutter mounted on said first end of said member, said cutter when rotated and disposed in said tubing moving longitudinally downwardly therethrough to scrape foreign material from the interior surface of said tubing, with the transverse cross section of said cutter being slightly smaller than the interior transverse cross section of said tubing;

h. a plurality of telescopically engaging tubular guide members adjacently disposed to said mast;

i. stop means for preventing said tubular guide members from separating when said guide members are fully extended;

j. a horizontal rigid stop secured to the top portion of the one of said tubular guide members that occupies the uppermost position when said tubular guide members are fully extended, said stop having a bore therein through which said cable extends;

k. first means for securing said first end of said cable to said frame assembly;

l. second means on said frame assembly for movably engaging said uppermost one of said tubular guide members to maintain said frame assembly at a fixed lateral position relative thereto;

m. a plurality of rigid arms secured in normally disposed positions to said guide members, with each of said arms having a first free end;

n. a plurality of axially aligned bushings mounted on said first ends of said arms, said bushings being slidably and rotatably engaged by said elongate member, and said bushings preventing lateral deformation of said elongate member as the latter is driven by said motor;

o. third means for removably engaging the lowermost one of said guide members to hold said guide members at a predetermined fixed lateral distance from said well bore; and

p. fourth means for driving said motor to rotate said cutter, with said cutter when said drum is rotated in a first direction moving downwardly in said tubing string to scrape foreign material from the interior thereof, and said tubular guide members telescoping one into the other as said cutter moves downwardly into said tubing string until the lower

end of what was previously said uppermost tubular guide member rests on said cut, and said frame assembly and motor thereafter moving downwardly and longitudinally on what was previously said uppermost tubular guide member for said cutter to scrape the maximum longitudinal length of said tubing, and said power-operated drum after said tubing has been scraped rotated in a second direction to return said frame assembly, cutter and guide members to elevated positions where said cutter and guide members no longer engage said tubing and third means, with said oil well tubing cleaning device then capable of being moved laterally relative to said well bore to a position where said oil well tubing puller may raise said string of tubing to permit the stand thereof that has been cleaned to be separated therefrom.

2. An oil well tubing cleaning device as defined in claim **1** which in addition includes:

q. a guide plug slidably and rotatably mounted on said elongate member above said cutter, said guide plug removably engaging said uppermost collar to maintain said elongate member in a centered position relative to said tubing string as said cutter moves longitudinally therein.

3. An oil well tubing cleaning device as defined in claim **1** in which said first means is a vertically extending link having first and second ends, said first end pivotally connected to said frame, and said second end connected to said first end of said cable, with said link having a transverse cross section greater than that of said bore in said stop through which said cable extends.

4. An oil well tubing cleaning device as defined in claim **1** in which said second means are a plurality of spaced rollers rotatably supported from said frame that movably contact at least one of said guide members.

5. An oil well tubing cleaning device as defined in claim **1** in which said third means includes:

q. an elongate rigid, substantially vertically disposed cup having an upwardly and outwardly tapering upper end portion; and

r. means for removably supporting said cup at a fixed laterally spaced position relative to said bore at which position said cup is coaxially aligned with said guide members to permit a portion of the lowermost one of said guide members to be disposed in said cup.

6. An oil well tubing cleaning device as defined in claim **1** in which said motor is air actuated, and said fourth means is a flexible hose that extends from said motor to a source of air under pressure.

* * * * *