

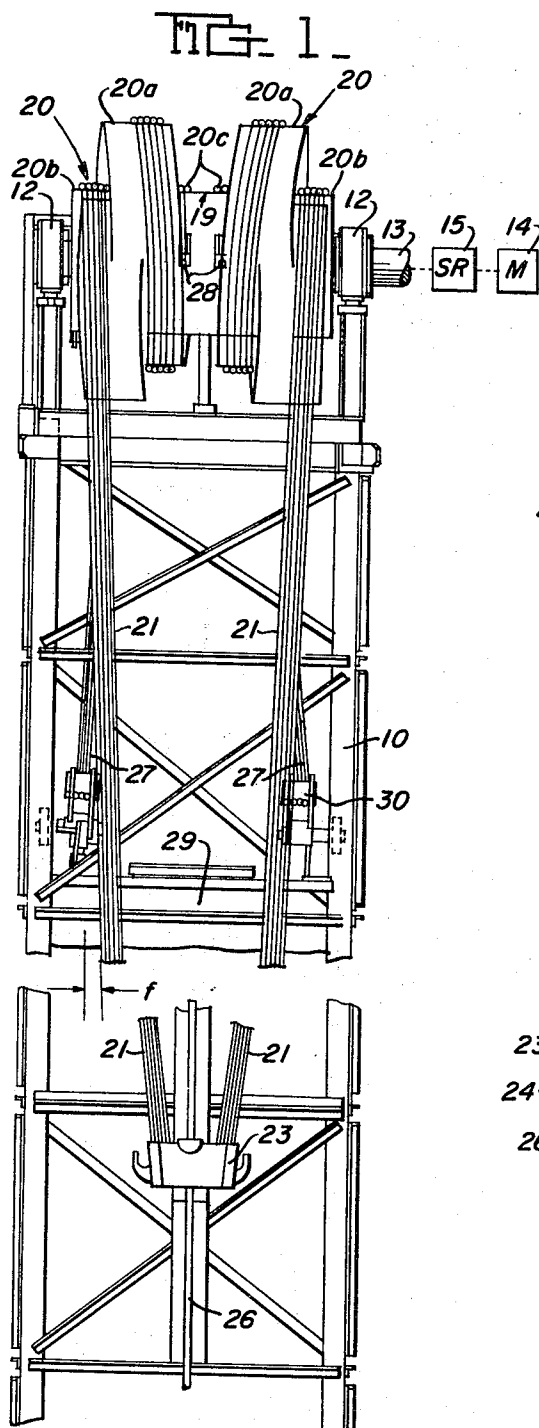
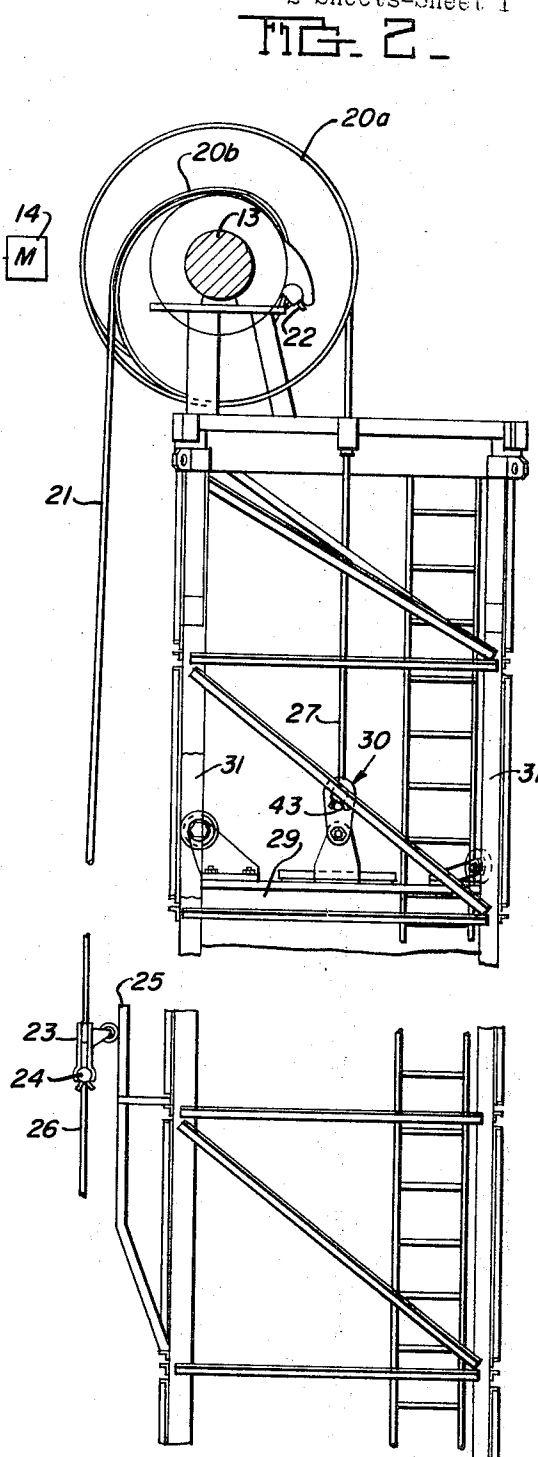
Sept. 15, 1970

J. P. KUHNS ET AL
WELL PUMPING APPARATUS

3,528,305

Filed Sept. 27, 1968

2 Sheets-Sheet 1



INVENTORS
JOHN P. KUHN
& MICHAEL L. RIZZONE
By *Matter P. Hood*
Attorney

Sept. 15, 1970

J. P. KUHNS ET AL

3,528,305

WELL PUMPING APPARATUS

Filed Sept. 27, 1968

2 Sheets-Sheet 2

FIG. 3

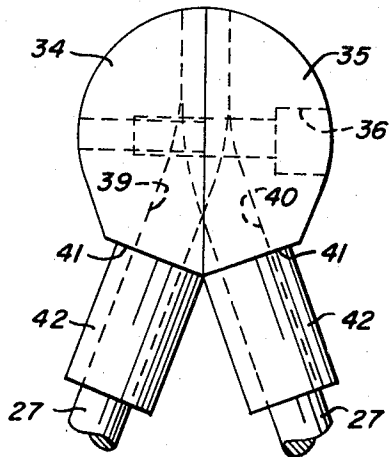


FIG. 4

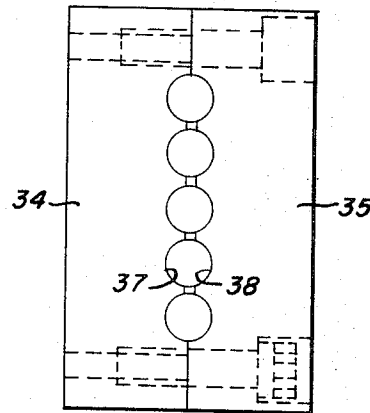
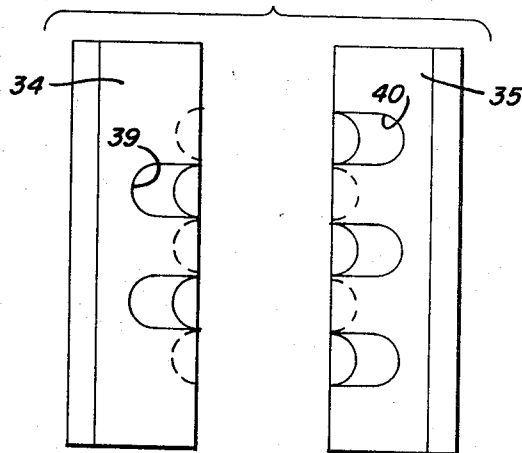


FIG. 5



INVENTORS
JOHN P. KUHNS
& MICHAEL L. RIZZONE
By *Halter P. Hood*
Attorney

1

3,528,305

WELL PUMPING APPARATUS

John P. Kuhns and Michael L. Rizzone, Dallas, Tex.,
assignors to United States Steel Corporation, a corporation of Delaware

Filed Sept. 27, 1968, Ser. No. 763,317

Int. Cl. F16g 9/00; B66d 1/74

U.S. Cl. 74—89.22

6 Claims

ABSTRACT OF THE DISCLOSURE

A long stroke well-pumping unit in which power is transmitted to a rod string and counterweight through a plurality of parallel small diameter cables. The drums which drive the cables have smooth circumferential faces; embodies novel anchors for attaching the cables. Otherwise, similar to an earlier Pat. No. 3,285,081 of the same parties.

This invention relates to an improved long-stroke well-pumping unit.

Our earlier Pat. No. 3,285,081 shows a pumping unit which has a cable and drum mechanism for driving the rod string up and down. The drums are mounted on a power driven shaft journaled at the top of a tower. A counterweight for the rod string travels in the opposite direction within the tower. The drums have helical grooves around their circumferences, and they have outboard and inboard eccentric portions. Near the end of each downstroke of the rod string, the cables which lead to the rod string unwind from an eccentric portion of the drum to shorten the moment arm. The power is shut off, whereby the parts coast to a stop. The counterweight cables now have longer moment arms, and the counterweight overbalances the rod string to start the next upstroke before the power comes back on. The reverse action takes place at the end of each upstroke of the rod string.

This pumping unit affords advantages of long slow pumping strokes and also of saving on power requirements, since it relies on momentum of the parts to move them through a substantial portion of each stroke. However, in practice we have observed the cables are subject to excessive wear. The pumping unit has large diameter wire cables to support the heavy rod string and counterweight. These cables pass over relatively small diameter drums, particularly on the eccentric portions of the drums. Dimensional variations in the carrier bar or drum grooves may cause the fleet angles between the cables and drums to change slightly. Both the unfavorable ratio of cable diameter to drum diameter and the variation in fleet angle tend to cause excessive wear. If a cable breaks, the rod string or counterweight may fall and cause serious damage.

An object of the present invention is to provide an improved pumping unit which utilizes the principles shown in our aforementioned patent, but overcomes the tendency of the cables to wear excessively.

A further object is to provide a pumping unit of the type described in which we obtain a more desirable ratio of cable diameter to drum diameter through the use of a plurality of parallel small diameter wire cables.

A further object is to provide a pumping unit of the type described in which the drums have smooth or ungrooved circumferential faces and the fleet angles are maintained constant.

A further object is to reduce wear on the cables by eliminating guide flanges on the drums and guiding the cables exclusively by the cable and anchor location.

A further object is to provide an improved anchor for

2

attaching multiple cables to a movable part and to utilize said anchor for attaching the cables in our pumping unit.

In the drawings:

FIG. 1 is a side elevational view of a pumping unit constructed in accordance with our invention;

FIG. 2 is an elevational view of the pumping unit from the right of FIG. 1;

FIG. 3 is a side elevational view on a larger scale of one of our anchors for attaching the cables to a movable part of the unit;

FIG. 4 is a top plan view of the anchors shown in FIG. 3; and

FIG. 5 is an exploded bottom plan view of the anchor with the cables removed.

Our pumping unit includes a tower 10 which is formed of metal structural members and is of considerable height, preferably 60 feet or more. The bottom of the tower is suitably supported offset from the center line of a well head, as shown in our earlier patent. The upper end of the tower has aligned bearings 12 in which we journal a horizontal shaft 13 offset from the vertical center line of the tower toward the side adjacent the well head. The shaft is driven in either direction by a reversible motor 14 connected thereto through a speed reducer 15. The motor and speed reducer per se and the connection to the shaft may be of conventional construction, and we have shown them only diagrammatically. The shaft carries a drum assembly 19 located between the bearings 12.

The drum assembly 19 includes two spaced apart drums 20, each of which has a concentric central portion 20a of relatively large diameter and eccentric portions 20b and 20c of smaller diameter outboard and inboard of its concentric portion. In accordance with our present invention, the circumferential faces of the drums are smooth or ungrooved. We attach a plurality of parallel wire cables 21 (five illustrated) to outboard eccentric portions 20b of both drums 20 with anchors 22. These cables lead downwardly to a carrier bar 23 to which their lower ends are attached with anchors 24. The carrier bar travels up and down along a vertical track 25 fixed to the outside of the tower. We attach a conventional polished rod 26 to the carrier bar, and a rod string (not shown) to the polished rod. We attach another plurality of wire cables 27 (five illustrated) to the inboard eccentric portions 20c of both drums 20 with anchors 28. The latter cables lead downwardly to a counterweight 29 to which their lower ends are attached with anchors 30. The counterweight travels up and down on tracks 31 within the tower. Preferably we apply coverings of plastic material such as polyurethane over the working faces of both drums 20 to cushion shock loads and equalize the loads on individual cables 21 and 27.

In common with the pumping unit shown in our earlier patent, cables 21 and 27 wind around drums 20 in opposite directions. When the drums rotate counterclockwise, as viewed in FIG. 2, cables 21 unwind and lower the carrier bar 23 for a downstroke of the rod string. At the same time cables 27 wind and raise the counterweight 29. The reverse action takes place when the drums rotate clockwise for an upstroke of the rod string. In either instance the cables meet the concentric portions 20a of the drums during most of each stroke, whereby the rod string and counterweight have equal moment arms. Near the end of each stroke, power to the shaft 13 is shut off, and the unwinding cables meet the eccentric portions of the drums, whereupon their moment arms become shorter. The parts coast to a stop. The cables which have the shorter moment arms are overbalanced, whereby the weight distribution starts the next stroke before the power comes on again.

Our use of a plurality of parallel wire cables in place

3

of the single cables shown in our earlier patent enables us to use individual cables of smaller diameter to support the same load. Consequently we obtain a more favorable ratio of cable diameter to drum diameter. For example, we may use $\frac{3}{8}$ inch diameter cables with drums which have minimum diameters of 45 inches in their eccentric portions. The allowable diameter ratio varies with the type of cable (number of wires per strand, number of strands, wire diameter, etc.). Nevertheless commercially available cables are readily used in our pumping unit within recommended diameter ratios. As the carrier bar 23 moves up and down, the locations on the drums 20 at which cables 21 meet the drum surface moves inwardly and outwardly. We proportion the dimensions so that this inward and outward movement is just sufficient to maintain a constant fleet angle f . The same is true with respect to cables 27. The constant fleet angle enables the cables to track properly on drums which have smooth or ungrooved circumferential faces, as already described.

FIGS. 3, 4 and 5 show details of one of our preferred anchors 22, 24, 28 or 30. The anchor illustrated is for use with five cables, but of course the number may vary and the anchor can be larger or smaller accordingly. We form the anchor of two halves 34 and 35 held together with bolts 36. The halves 34 and 35 have mating grooves 37 and 38 respectively of semicircular cross section extending from their upper faces to receive a set of cables, illustrated as the lower ends of cables 27. The half 34 has two passages 39 which extend obliquely downwardly from the lower ends of two of its grooves 37. Similarly the half 35 has three passages 40 extending from three of its grooves 38. In the assembled anchor passages 39 alternate with passages 40. The lower faces of the halves have flat faces 41, the planes of which are normal to the center lines of passages 39 and 40. Cables 27 extend through the passages beyond the flat faces and have collars 42 fixed to their lower end portions to secure them to the anchor. The lower end of each cable projects from the anchor in the opposite direction from the next cable to allow space for the collars. The anchor 30 is attached to the counterweight 29 with clevises 43 which engage the ends of the anchor outside the cable 27. Similarly the other anchors can be attached with clevises or U-bolts not shown in detail.

From the foregoing description it is seen that our invention affords a simple long-stroke pumping unit which overcomes problems encountered with the pumping unit shown in our earlier patent. At the same time we have retained the advantages of the former structure. If any one cable breaks, no serious damage is likely.

We claim:

1. In a long-stroke pumping unit, which includes:
 - a tower;
 - a rotatable shaft journaled to said tower near the upper end;
 - reversible drive means operatively connected with said shaft;
 - a pair of drums mounted on said shaft and each having a concentric central portion and eccentric portions outboard and inboard of the concentric portion;
 - flexible transmitting means connected to said drums;
 - and

4

a carrier bar and a counterweight suspended from said drums by said transmitting means;
rotation of said shaft and drums applying force with equal moment arms to both said carrier bar and said counterweight as long as said flexible means meets said concentric portions;
the moment arms becoming shorter when said flexible means meets one of said eccentric portions near the ends of a stroke;

an improvement which comprises:

said flexible means being formed as a plurality of parallel wire cables each of relatively small diameter to afford a favorable ratio of cable diameter to drum diameter.

2. A pumping unit as defined in claim 1 in which said drums have smooth circumferential faces.

3. A pumping unit as defined in claim 1 in which said cables have a constant fleet angle with respect to said drums.

4. A pumping unit as defined in claim 1 in which the working faces of the drums have plastic coverings.

5. A pumping unit as defined in claim 1 in which said cables are attached at their ends with anchors, each of said anchors comprising:

two halves bolted together and having mating semicircular grooves extending from one face;
each half having passages which extend obliquely from the inner ends of certain of its grooves with the passages in one half alternating with those in the other;

said cables extending through said grooves and passages; and

collars on the ends of said cables to retain them in said anchors;

said halves having flat faces normal to the center lines of its passages abutted by said collars.

6. An anchor for a plurality of cables comprising:

two halves bolted together and having mating semicircular grooves extending from one face;
each half having passages which extend obliquely from the inner ends of certain of its grooves with the passages in one half alternating with those in the other;

said halves having flat faces normal to the center lines of its passages;

said grooves and passages being adapted to receive wire cables and said flat faces to be abutted by collars on the cables.

References Cited

UNITED STATES PATENTS

72,496	12/1867	Hyre	187—27
1,007,579	10/1911	Lawson	187—27
3,168,287	2/1965	Parola	254—150
3,285,081	11/1966	Kuhns et al.	74—89.22
3,332,665	7/1967	Bruns	254—192

WESLEY S. RATLIFF, Jr., Primary Examiner

U.S. Cl. X.R.

187—27