United States Patent

Gault

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[54] **OIL WELL PUMPING UNIT HAVING TRAVELING STUFFING BOX**

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[73] Assignee: **Bethlehem Steel Corporation**

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[52] **U.S. Cl.** **166/72**, 166/84, 277/17

[51] **Int. Cl.** **E21b 33/03**

[58] **Field of Search** 166/72, 84; 277/17, 18, 19; 74/89.22

[56] **References Cited**

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[57] **ABSTRACT**

An efficient long-stroke pumping apparatus for oil wells. This apparatus comprises the combination of a low and relatively inexpensive supporting structure, an upright stroking wheel or sheave mounted thereon and driven near the ground level, and below-ground counterweight and traveling-seal means for actuating a pumping string. Said seal means reciprocate vertically in a polished pipe fixed within the well tubing, and provide protection against corrosive well fluids to the pumping cable actuated by the stroking wheel.

2 Claims, 3 Drawing Figures

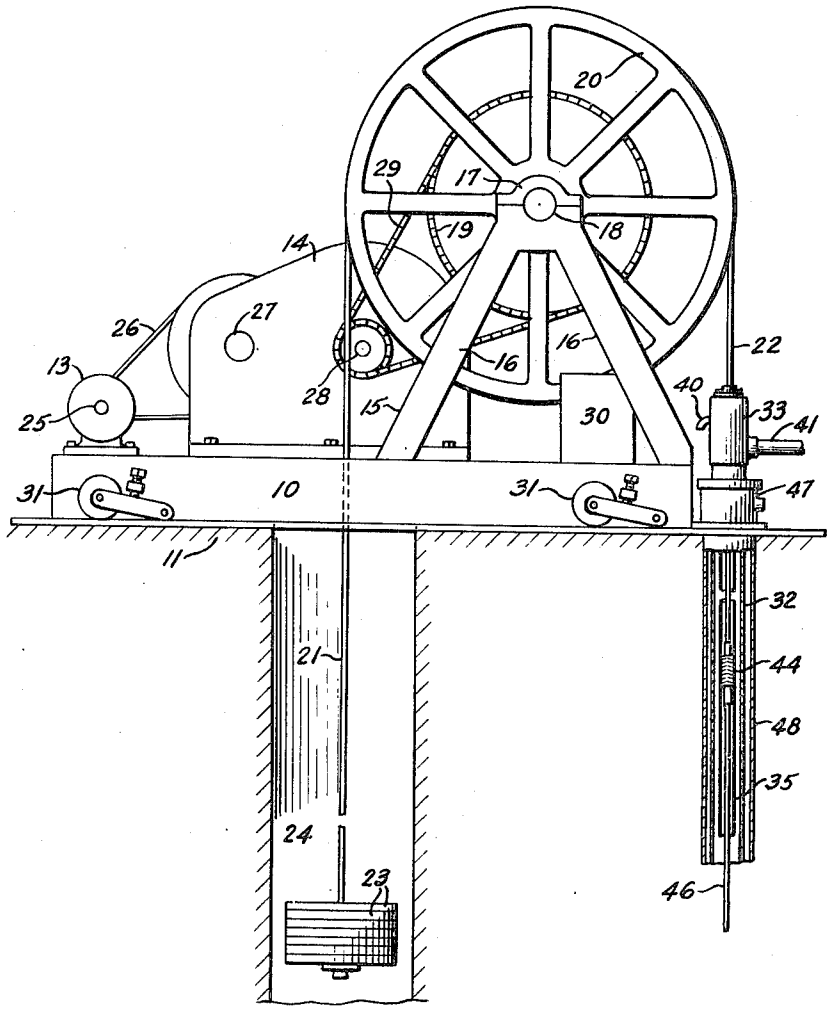


FIG. 2

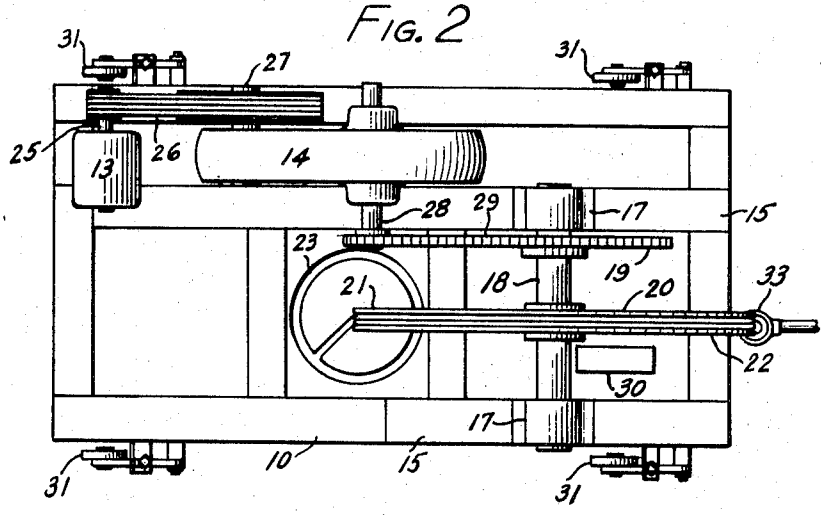


FIG. 3

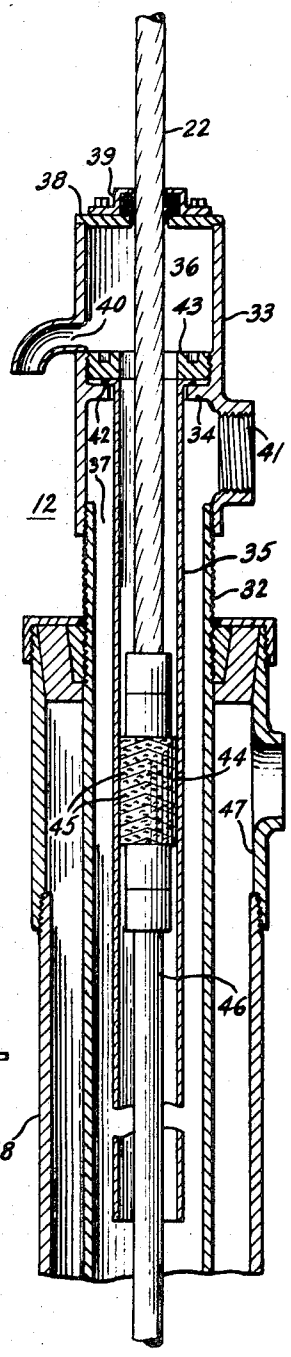
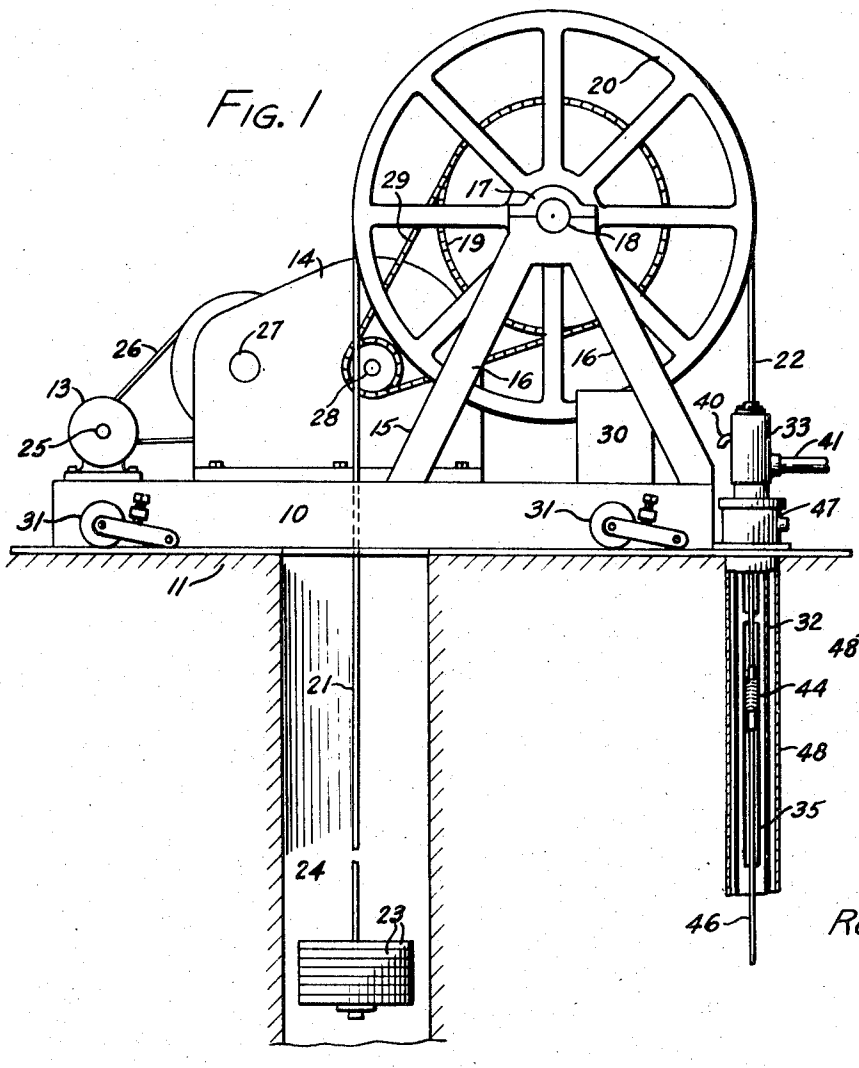


FIG. 1



INVENTOR

Robert H. Gault

OIL WELL PUMPING UNIT HAVING TRAVELING STUFFING BOX

BACKGROUND OF THE INVENTION

Field of the Invention

The field of art to which my invention pertains is that of a long-stroke piston type of oil well pump which eliminates prior excessively high, expensive, and obstructive supporting structures without any sacrifice in efficiency.

Particular features of my invention include the following:

1. The direct entry of a flexible pumping member into the well tubing through the utilization of a traveling sealing member and a sealing tube inserted inside the well tubing, thereby eliminating the need for a tall polished rod when the pumping stroke is long.

2. The placement of counterbalance means below ground throughout the period of effective use.

3. The location of the sheave or stroking wheel near ground level enabling the gear reducer to be attached directly or with chain or gear drive to the shaft of the stroking wheel or sheave, being therefore without need for long power transmission cables, pulleys or cogs either to or from said stroking wheel, or for unduly tall structures to support the same.

Description of the Art

An old type of apparatus for lifting a liquid such as oil or water from the bottom of a deep well is a piston which is operatively connected by a string of sucker rods or a cable and a polish rod to a source of vertically reciprocating power at the surface.

One conventional but limited and clumsy surface arrangement which serves to convert continuous rotational motion from a rotary prime mover into reciprocating motion for pumping utilizes a crank, pitman arm and walking beam.

A better solution than a walking beam to the problem of providing a reciprocating power source is to wind a wire rope or a chain around a drum or sheave of fixed diameter, attach a counterweight by a second line, and use either a reversing motor or a motor with a reversing clutch to reverse the direction of rotation at regular intervals. However, the drum or sheave is generally required to be mounted in a high tower or derrick.

The wellhead also conventionally carries a raised fixed stuffing box, through which the polish rod projects upwardly to a considerable height above ground level when the pumping string is at the highest point of its stroke. In periods when the pump is not operating, the exposed exterior of the polish rod is subject to rapid corrosion in most environments.

Perhaps the greatest disadvantage of the two latter arrangements is that they necessitate a very heavy and expensive steel skeleton framework or derrick structure which is strong and rigid enough to be able to support rotating elevated drums, reels, or sheaves, and also is high enough to protect and accommodate the necessary ranges of vertical movement of a polish rod, reciprocating cables, and a heavy counterweight, during their respective strokes. The longer are said stroking motions, the higher and more costly normally is the framework. At some locations, such a framework may actually be high enough to constitute a serious hazard to low-flying airplanes or helicopters. The great weight of the prime mover and gear reducer must usually be kept at ground level, from whence the power is conventionally transmitted to the reels through a long drive cable or other like connecting means. Such latter means are obviously apt to be wasteful of power.

DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

FIG. 1 is a side elevational view of a preferred embodiment of my invention;

FIG. 2 is a top plan view of said embodiment; and

FIG. 3 is an enlarged side elevational view, partially in section, of the traveling stuffing box and seal tube portion of the same embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, in a preferred embodiment of my invention, a portable platform or skid base **10** is offset on the ground **11** a suitable distance from a wellhead **12** from which the oil or other liquid is to be pumped. Upon said skid base **10** is mounted a suitable prime mover **13**, a speed reducer **14**, and a low upright supporting frame **15**. Said frame **15** may consist of a pair of parallel-spaced A-frames **16** having aligned bearings **17** wherein is journaled a large horizontal shaft **18**. On said shaft **18** are mounted a driven sprocket **19** and a stroking wheel or sheave **20**, both being positioned between the bearings **17**.

In helical grooves (not shown) peripherally encircling said sheave **20** are respectively wrapped in opposite directions a counterweight cable **21** and a pumping cable **22**. The inner ends of these cables are suitably anchored in place on said sheave **20**. Depending upon the actual circumference of the sheave **20** and the length of pumping stroke desired, a single turn of the cable **22** around the sheave or wheel **20** can be sufficient, although more grooves and turns of the cable can obviously be added to create a longer stroke. The counterweight cable **21**, being wound in the opposite direction on the sheave **20**, supplies a countervailing force to the action of the pumping cable **22**, as the outer end of the cable **21** holds in suspension a plurality of individually adjustable and removable counterweight members such as the metal plates or discs **23**. Said latter members **23** will descend into a suitably lined vertical underground pit **24** which is of adequate depth for clearance at the bottom end of the stroke of the counterweight cable **21**, but not too deep to hinder recovery in case of cable breakage.

A suitable reversible drive for the shaft **18** which actuates the pumping cable **22** includes an appropriate motor serving as the prime mover **13**, the output shaft **25** of which is operatively connected as by belt means **26** to the input shaft **27** of the speed reducer **14**. The output shaft **28** of said speed reducer **14** is similarly connected as by chain **29** to the sprocket **19** on the outer end of the shaft **18**. A synchronous motor can operate in either direction, depending on which way an initial torque is applied, but a unidirectional type of motor with a reversing clutch can obviously also be used in its place. A control box **30** including switches (not shown) for the prime mover **13** may conveniently be mounted on one of the A-frames **16** adjacent to the sheave **19**. For increased portability, the skid base **10** may also optionally be provided with a plurality of vertically adjustable casters or rollers **31**. It would also be possible to provide the A-frame which supports the stroking wheel with pivotable legs to provide wellhead clearance.

Seated upon the top of a regular oil well casing **32** is a short upright tubular head member **33** having a circumferential inner flange **34** which together with the polished pipe **35** divides said head member into an upper chamber **36** and a lower chamber **37**. Upon the upper chamber **36** is secured a flat cap member **38** supporting a fixed stuffing box **39** which creates a fluidtight top seal through which descends the pumping cable **22**. Said upper chamber **36** also includes discharge outlet **40** to drain fluid which leaks by the traveling stuffing box and collects above its packing element. The lower chamber **37** contains an oil discharge outlet **41**. The oil and associated fluids will pass between the polished pipes and the tubing and be discharged from this outlet **41**.

The interiorly polished pipe **35** has its upper end formed horizontally outward into a radially extending lip **42** which is sealed to the flange **34** by a threaded bushing **43** and is arranged to project downwardly and concentrically in spaced relation within the tubing **32** for a distance somewhat greater than the pumping stroke. A traveling stuffing box **44** carrying a plurality of packing discs **45** of rubber or fibrous material, or a close-fitting metal plunger or a combination of metal plunger and packing material, is positioned in fluidtight relation within said polished pipe **35**, and is interposed vertically

and secured by clamping means between the lower end of the cable **22** and the upper end of a string of sucker rods **46** or like connecting means. This packing element can also be slipped over a continuous cable when such cable is used as a pumping means, with suitable clamp to rigidly attach packing element to the cable. The sucker rods **46** or cable will be understood as extending downwardly inside the tubing **32** to the pump piston or plunger (not shown), which is near the bottom of the well inside the well tubing. Such tubing is suspended from a casing head **47** which is attached to the well casing **48** at the top of the well. The spaced concentric polished inner pipe **35**, however, need not be appreciably longer than the length of the stroke of the traveling stuffing box therein.

In operation, the apparatus described will lift the well fluid until the upstroke is almost complete. The prime mover **13** is then turned off (or a clutch disengaged). The inertia of the moving masses will allow them to coast to a stop and then start to fall back. At this point the prime mover **13** will start in a reverse direction (or a reverse clutch will be engaged), and will start lowering the rods back into the well by lifting the weight of the counterbalance **23**. As the pumping string nears the bottom of the wellhole, the prime mover **13** will again be turned off (or declutched), allowing the system to coast to a stop and start to reverse itself. The prime mover **13** will again be started to begin the upstroke.

The well fluid is pumped upwardly in the outer space between the adjacent walls of the casing **32** and the polished pipe **35**, and is then discharged from the outlet **41** to a point of storage or transport. Inasmuch as many such fluids include much brine or other substances which are highly corrosive to a pumping cable, the traveling stuffing box **44** excludes such fluids from any direct contact with the cable **22** above said traveling stuffing box **44**. Also, if desired, a special preservative or corrosion resistant compound or lubricant can be maintained around the lower end of said cable **22**, simply as an added precaution against corrosion.

When the traveling stuffing box **44** wears sufficiently to require repairs or replacement, it can be raised above the upper end of the polished pipe **35**, and it can then be easily repaired or replaced.

One of the most important requirements for proper operation of the above-described arrangement is the smooth reversal of the system. Proper setting of the reversing switches (or clutches) is particularly important. This allows the inertia of the moving masses acting against opposite well load conditions to cause the system to coast to a stop and initiate the reversal. A super high slip (30–40 percent slip) electric motor which has limited torque could be used effectively as the prime mover **13** in order to control acceleration values at the points of stroke reversal.

I claim:

1. In a pumping unit for an oil well, the combination comprising:

a. casing in said well,
b. tubing suspended in said casing in said well,
c. a base adjacent to said well,
d. an upright stroking wheel mounted on said base,
e. reversible means for reciprocating the stroking wheel,
f. first and second flexible members fastened to said wheel and trained in opposite directions over said wheel,
g. counterbalance means connected to said first flexible member,
h. an underground chamber receiving said counterbalance means,
i. a vertical pipe having an interiorly polished surface within said tubing but sealed therefrom,
j. a traveling stuffing box within said interiorly polished pipe and suspended from said second flexible member, and
k. a string of pumping members connected to the lower end of said traveling stuffing box.

2. In a pumping unit for an oil well, the combination comprising:

a. casing in said well,
b. a string of well tubing suspended at the top from said casing surmounted by a head member,
c. a skid base adjacent said wellhead member,
d. a reversible prime mover and a speed reducer mounted on said skid base,
e. an upright supporting frame also mounted on said skid base,
f. a pair of aligned bearing means on said supporting frame,
g. a shaft journaled in said bearing means and operatively connected through the gear reducer to the prime mover,
h. a stroking wheel carried by said shaft,
i. a pair of flexible members fastened to said wheel and trained in opposite directions over said wheel,
j. the first such flexible member having a free end,
k. a counterweight attached to said free end,
l. an underground chamber receiving said counterweight in the lowered portion of its stroke,
m. the second flexible member also having a free end,
n. a vertical pipe having a polished inner surface,
o. said pipe means being fastened concentrically within the well tubing and extending downwardly in spaced sealed relation therein,
p. a traveling stuffing box with fluidtight packing means sealing off said pipe from ascending well fluid,
q. the free end of the second flexible member connected to the upper end of said traveling stuffing box,
r. a string of pumping members connected to the lower end of said traveling stuffing box, and
s. means for separately discharging the well fluid as pumped.

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