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PUMPING UNIT FOR MULTIPLE WELLS

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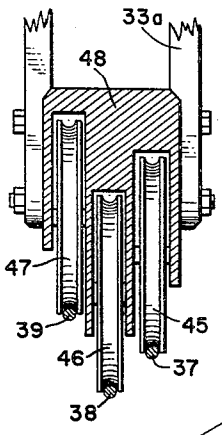


FIG. 3.

FIG. 1.

FIG. 2.

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PUMPING UNIT FOR MULTIPLE WELLS

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The present invention concerns a multiple sucker rod pumping unit.

In recent years, in an effort to reduce the cost of drilling and completing oil and gas wells, many wells have been completed in two or more producing horizons or zones and the production conducted to the surface through two or more parallel spaced-apart tubing strings.

In the case of dual oil wells requiring artificial lift for at least two of the producing zones, the pumping equipment many times limits the ability to produce the allowable of these zones and additionally, the cost of the surface equipment may be a limiting factor in the economic feasibility of multiple completions.

To provide complete flexibility of operation, it has been a practice to set independent multiple beam pumping units, each having its own prime mover. This arrangement generally referred to as head-to-head pumping has the advantage of independent adjustment of speed, stroke length, counterweight, and pumping schedule; however, it has the disadvantages of high initial cost and difficulties encountered because of the close clearances between the horse heads and carrier bars.

It is an object of the present invention to provide in one pumping unit driven by one prime mover the flexibility of multiple independent units with a resultant reduction in the cost of the initial installation and without, at the same time, encountering close clearance problems.

In brief, the invention comprises apparatus for pumping multiple zones of a multiply completed well comprising a plurality of spaced-apart rod strings extending from the well, a frame, a walking beam pivotally mounted on said frame, means for moving one end of said walking beam vertically, a plurality of flexible connectors interconnecting each of said rod strings and the other end of said walking beam, a multiple sheave block mounted on said frame, each flexible connector being reaved about a different sheave, said sheave being arranged such that said flexible connector extends vertically from the sheave to the sucker rod connection, and means for adjusting the position of the flexible connector on the walking beam. To provide the desired spacing of the sheaves so that the flexible connectors extend vertically and provide straight line alignment between the sheaves and the rod strings, the sheaves may be offset or various diameter sheaves may be used as seen in the figures.

The above object and other objects of the invention will be apparent from a more detailed description of the invention taken in conjunction with the drawing wherein:

FIG. 1 is an isometric view of the invention;

FIG. 2 is a fragmentary view of one portion; and

FIG. 3 is a top view of a modified arrangement of the sheaves shown in FIG. 1.

Referring to the drawing in greater detail, in FIG. 1 is shown a wellhead **10** through which extends three tubing strings **11**, **12** and **13** to which are connected, respectively, production conduits **14**, **15** and **16**. Polished rods **17**, **18** and **19** extend into the upper end respectively of tubing springs **11**, **12** and **13**. Positioned adjacent wellhead **10** is a skid or base **20** upon which is arranged a frame **21**. An API twin crank pumping unit gear reducer **22** to which is connected a drive, not shown, is mounted on skid **20**. Two cranks, **23** and **24**, having counterweights **25** and **26**, respectively, are connected to and are driven by

gear reducer **22**. Wrist pins **27** interconnect the lower ends of pitmans **28** and the cranks. The upper ends of pitmans **28** connect to an equalizer **29** which is mounted on one end of a walking beam **30** on a beam pitman bearing **31**. Walking beam **30** is pivotal on a saddle bearing **32** arranged on frame **21** which includes a portion extending to adjacent the end of walking beam **30** nearest wellhead **10** and which has arranged thereon a block **33** to which is connected a plurality of rotatable sheaves **34**, **35** and **36** (shown in dotted lines) of different diameters. A plurality of cables or flexible connectors **37**, **38** and **39** connect rod strings **17**, **18**, and **19**, respectively, to walking beam **30**. Flexible connector **37** wraps around sheave **34** to align the flexible connector **37** with the sucker rod **17**. Similarly, flexible connectors **38** and **39** wrap around sheaves **35** and **36**, respectively, to align the lower portions of flexible connectors **38** and **39** with rod strings **18** and **19**, respectively. The upper ends of flexible rod connectors **37**, **38** and **39** connect to adjustable bridles **40**, **41** and **42** arranged or mounted on walking beam **30**, as shown more clearly in FIG. 2.

Although various diameter sheaves are shown and described with regard to FIG. 1, instead of using various diameter sheaves, sheaves of the same diameter may be offset to achieve the desired alignment of the flexible connectors and the various rod strings. Thus, as seen in FIG. 3, three equal diameter rotatable sheaves **45**, **46**, and **47** are mounted on a head **48**, to which is connected a block **33***a*, which in turn is arranged on frame **21** (not shown). Flexible connectors **37**, **38**, and **39** wrap about sheaves **45**, **46**, and **47**, respectively.

In operation, walking beam **30** reciprocates through reciprocation of pitmans **28** operated by the prime mover, not shown, through the gear reducer **22**. As walking beam **30** reciprocates, the rod strings **17**, **18** and **19**, are reciprocated by vertical movement of the flexible rod connectors **37**, **38** and **39**, respectively, which traverse sheaves **34**, **35** and **36**, respectively, of stationary block **33**. The stroke of each individual polished rod **17**, **18** and **19** may be varied by changing the position of the bridles **40**, **41** or **42**, respectively, on the walking beam **30**. The maximum stroke is effected at the end of the walking beam and the minimum stroke is near saddle bearing **32**.

Having fully described the elements, operation, and objects of my invention, I claim:

1. Apparatus for pumping a plurality of zones penetrated by a well in which are arranged a plurality of spaced-apart tubing strings comprising:
- an individually movable, spaced-apart rod string extending into each of said tubing strings;
- a frame;
- a walking beam pivotally mounted on said frame;
- means for moving said walking beam on said pivot for reciprocating the ends of said walking beam;
- a plurality of sheaves mounted on said frame; and
- a plurality of flexible connectors, each flexible connector connecting one end of said walking beam with each of said rod strings such that reciprocation of said one end of said walking beam reciprocates said flexible connectors, said flexible connectors engaging said sheaves in a manner such that straight line alignment of each flexible connector is formed between the sheave with which each engages and the rod string to which it is connected.

2. Apparatus for pumping a plurality of zones penetrated by a well in which are arranged a plurality of spaced-apart tubing strings comprising:
- an individually movable spaced-apart rod string extending into each of said tubing strings;
- a frame;
- a walking beam pivotally mounted on said frame;

means for moving said walking beam on said pivot for reciprocating the ends of said walking beam;

a plurality of sheaves mounted on said frame;

a plurality of flexible connectors, each flexible connector connecting one end of said walking beam with each of said rod strings such that reciprocation of said one end of said walking beam reciprocates said flexible connectors, said flexible connectors engaging said sheaves in a manner such that straight line alignment of each flexible connector is formed between the sheave with which each engages and the rod string to which it is connected; and

said one end of said walking beam to which said flexible connectors are adapted to connect being provided with a plurality of spaced-apart openings to permit lengthening and shortening of the stroke of each of said rod strings by connecting said flexible connectors to different openings.

3. Apparatus for pumping a plurality of zones penetrated by a well in which are arranged a plurality of spaced-apart tubing strings comprising:

an individually movable, spaced-apart rod string extending into each of said tubing strings;

a frame;

a walking beam pivotally mounted on said frame;

means for moving said walking beam on said pivot for reciprocating the ends of said walking beam;

a plurality of sheaves mounted on said frame and rotatable on a common axis; and

a plurality of flexible connectors, each flexible connector connecting said one end of said walking beam with each of said rod strings such that reciprocation of said one end of said walking beam reciprocates said flexible connectors, said sheaves being of different diameters and said flexible connectors engaging said sheaves such that straight line alignment of each flexible connector is formed between the sheave with which each engages and the rod string to which it is connected.

4. Apparatus for pumping a plurality of zones penetrated by a well in which are arranged a plurality of spaced-apart tubing strings comprising:

an individually movable, spaced-apart rod string extending into each of said tubing strings;

a frame;

a walking beam pivotally mounted on said frame;

means for moving said walking beam on said pivot for reciprocating the ends of said walking beam;

a plurality of sheaves mounted on said frame; and

a plurality of flexible connectors, each flexible connector connecting one end of said walking beam with each of said rod strings such that reciprocation of said one end of said walking beam reciprocates said flexible connectors, said sheaves being of the same diameter and offset one from another and said flexible connectors engaging said sheaves such that straight line alignment of each flexible connector is formed between the sheave with which each engages and the rod string to which it is connected.

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