Dec. 29, 1970 W. N. SUTLIFF ET AL 3,551,012

ROD SHOCK ABSORBER

Filed Dec. 23, 1968

FIG. 1

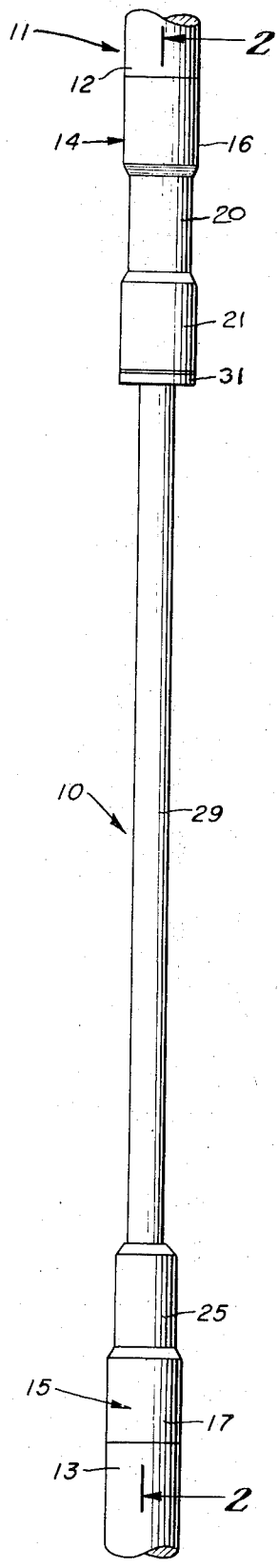


FIG. 2

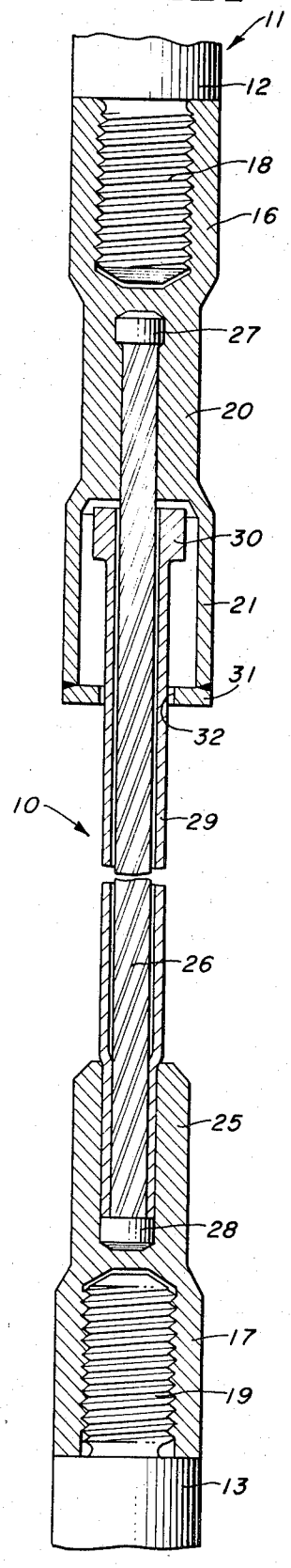
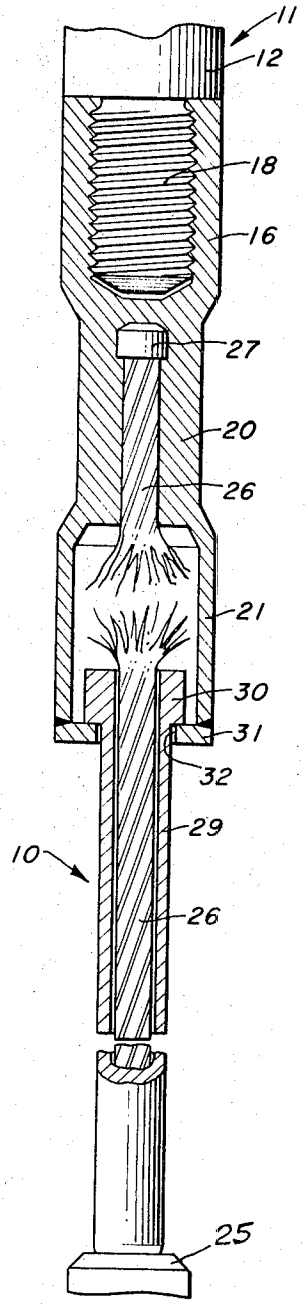


FIG. 3



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ROD SHOCK ABSORBER

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ABSTRACT OF THE DISCLOSURE

An elastic flexible cable forming a tension link inserted between an adjacent pair of deep well pump sucker rods, said link being enclosed in a tube which, in case the cable breaks, confines the cable strands, preventing their "bushing," said tube also providing a "safety" over-riding tension link which thereupon assumes the function of a solid link connecting said adjacent sucker rods.

BACKGROUND OF THE INVENTION

The deeper that wells are drilled, the greater the tendency is for the well bore to wander from vertical. Sucker rod strings are subject to high and complex strains when operating in such wells which results in frequent breaking of the string due to metal crystallization.

Many efforts have been made to alleviate this problem but without complete success. It is within this field of endeavor that the present invention offers a new solution to an old problem.

SUMMARY OF THE INVENTION

The theory on which the present invention operates is that sucker rod failure in deep oil wells often results from a solid steel rod member being simultaneously subjected to a complex of stresses, which, focusing repeatedly in a small area of the rod, break down the crystal structure of the metal and thus promote an early rod failure.

It is an object of the present invention to provide a means of distributing heavy strains more uniformly over the entire sucker rod string and particularly to prevent such strains becoming excessive due to sudden changes in direction at the top and bottom of each reciprocation.

Another object is to minimize in certain local areas the development of heavy repetitive tension or compression strains in conjunction with heavy bending strains.

A further object is to introduce into a conventional sucker rod string, the rods of which are made of solid steel, a link of equivalent tensile strength but having a higher capability of flexing without suffering damage to itself whereby said sucker rod string is enabled to fit around an angular change in the direction of a well bore without producing excessive strains in the structure of the sucker rod string.

A further object is to utilize for such a link, a heavy twisted steel wire cable in such a manner that this will add flexibility to the sucker rod string in an area where this link is allowed to function, and in addition, provide a substantial degree of resilience or capacity for elongation under tension, thereby absorbing sudden shocks ordinarily imposed on a very long string of rods.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a preferred embodiment of the rod shock absorber of the invention.

FIG. 2 is an enlarged fragmentary longitudinal sectional view taken on the line 2—2 of FIG. 1, and illustrates the invention in its normal operational condition.

FIG. 3 is a sectional view similar to FIG. 2 and illustrates the invention as it functions to hold adjacent sucker rods of a sucker rod string together following the breaking of the cable of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The rod shock absorber of the invention comprises a relatively flexible, elastic link **10** in a sucker rod string **11** which makes screw connections respectively at its upper and lower ends with sucker rods **12** and **13** of said string. The link **10** of the invention includes upper and lower subs **14** and **15**. These subs have respectively upper and lower pin boxes **16** and **17** into which threaded pins **18** and **19** of upper and lower sucker rods **12** and **13** respectively are screwed.

Formed concentrically with the upper pin box **16** of upper sub **14** and extending downwardly therefrom is a tubular cable mounting sleeve **20** from the lower end of which a relatively thin walled tubular apron **21** extends downwardly.

Formed concentrically with the lower pin box **17** of lower sub **15** is a tubular cable mounting sleeve **25**. A section **26** of heavy twisted steel wire cable (having heads **27** and **28** formed at its upper and lower ends) is provided with a housing tube **29** which encloses a substantial lower portion of the cable between the heads **27** and **28**. A heavy annular shoulder **30** extends outwardly from the upper end of tube **29**, and prior to the assembly of the device, a heavy steel washer **31** is shifted upwardly over the tube **29**. The lower end of cable **26** and the lower head **28** thereof and a lower end portion of tube **29** are now inserted downwardly in the cable mounting sleeve **25** of lower sub **15** and said cable and tube are permanently united with sleeve **25** by swedging the latter inwardly thereagainst.

With the tube **29** and cable **26** thus secured rigidly to lower sub **15**, a substantial upward portion of the cable **26** extends upwardly above the upper end of tube **29**. Said upper end portion of the cable and the upper end portion of the tube **29** are thus inserted upwardly into the apron **21** and the exposed portion of the cable is inserted into the tubular cable mounting sleeve **20** of the upper sub **14** and said sleeve is swedged inwardly against the upper portion of said cable to permanently unite the two together.

The heavy steel washer **31** is now shifted upwardly along the tube **29** into contact with the lower edge of the cylindrical apron **21** on upper sub **14**, and welded thereto, thus rigidly uniting this washer with said apron.

The fabrication of link **10** comprising the rod shock absorber of the present invention, having been completed as above described, and the pins **18** and **19** of sucker rods **12** and **13** having been screwed into the internally threaded boxes **16** and **17** of the upper and lower subs of said link, the sucker rod string **11** now functions in the following manner:

OPERATION

With the shock absorber operating in its normal condition as shown in FIG. 2, tensional strains imposed on the link **10** of the invention are assumed entirely by the cable **26**. Compressional strains imposed on said link are assumed entirely by cable housing tube **29**. There is a certain amount of linear resiliency displayed by a twisted cable such as the wire cable **26** when subjected to extremely high tensional strains and the presence of this cable in link **10** with the latter embodied in the sucker rod string **11** modifies any linear tensional shock which the string **11** is subjected to ordinarily by the whipping action with which a walking beam supporting the sucker rod string at the upper end of the well halts its downward movement and starts to lift the entire string upwardly on the return stroke, during which said rod must lift with it the entire weight of the column of pumped liquid then supported by the plunger of the pump which is sus-

pended on the lower end of the string **11**. The degree of resiliency thus imparted to the string **11** by the resilient cable link **10** introduced into the string by the present invention relieves the sucker rod string from the full severity of the strains normally otherwise imposed thereon by the rapid succession of whipping changes in direction which are normally inherent in the operation of a deep well pump through a string of sucker rods.

The rod shock absorber also relieves sucker rod string **11** from abnormal strains produced by the solid metal of the sucker rods being subjected to substantial bending moments coincidentally with the whipping action of alternate tensional and compressional forces applied in rapid succession in the reciprocation of the sucker rod string in performing its pumping function. This relief of the sucker rod is effected by the capacity of the link **10** of the invention to bend within the degree of liberty which the tube **29** has by its freedom to flex within the opening **32** of the washer **31** and by the relatively loose relationship between the cable **26** and the tube **29** housing the same. Whether this slight bending action afforded by the rod shock absorber at the location there of the apron **21**, takes place during a subjection of the sucker rod string to maximum tensional strains, as on the upstroke, or during maximum compressional strains, as on the downstroke, the flexibility of the cable **26** permits this flexing of the link **10** to take place without any damage being done to the structure of the link.

The invention embodies within it means for utilizing a cable as a flexible link between adjacent sucker rods in a sucker rod string for the protection of the sucker rods from crystallization and does this in such a manner that no danger is encountered due to the "bushing" of the strands of the cable in case, due to long wear or abnormal strains, the cable should break. This object is accomplished in the present invention by completely confining the cable of the link so that if it does break, the broken strands of the cable will be entirely confined by the cable housing tube **29** and the apron **21**.

The invention further provides that, should the cable thus break, the sucker rods **12** and **13** of the string **11** to which upper and lower ends respectively of the link **10** are connected will continue to be connected by the annular external shoulder **30** provided on the upper end of tube **29** coming into contact with the steel washer **31** of the apron **21** as shown in FIG. 3. This provides a flexible joint in the link **10** through which the pump may continue to be reciprocated through the sucker rod string **11** after the cable breaks and it will in any event permit the recovery of the portion of the sucker rod string **11** located below the link **10** after the cable of the link has broken.

While only one preferred embodiment of the present invention has been disclosed in the present application, it is to be understood that this disclosure is for illustrative purposes only and that the invention is not to be considered as limited to the specific details of this disclosure but is subject to various modifications and changes all within the spirit of the invention and in the scope of the appended claims.

We claim:

1. In a shock absorber for a string of sucker rods, the combination of:

upper and lower subs adapted to be connected respectively with an adjacent pair of sucker rods in said string;

a section of heavy twisted wire cable;

means for rigidly uniting upper and lower end portions of said cable respectively to said upper and lower subs, said lower sub and the rods therebelow being thereby suspended by said cable from said upper sub;

a cable housing tube surrounding said cable between said subs to act as a compression member for transmitting compressive forces from one of said subs to the other sub;

said lower sub having a central recess receiving lower end portions of said tube and cable which are retained concentrically therein by swedging; and

lost motion means flexibly connecting an upper end portion of said tube to said upper sub, including

a cylindrical apron extending downwardly from said upper sub to enclose said upper portion;

an annular external shoulder on said upper portion; and

an annular internal shoulder provided on the lower end of said apron and underlying said external shoulder on said tube;

said shoulders providing support for said tube only in the event of said cable breaking.

2. A flexible shock absorber for interposition in a string of sucker rods, comprising:

an upper sub;

a lower sub;

a cable united at its ends to said subs;

a tube housing said cable and rigidly united at one end to said lower sub,

the other end of said tube being spaced axially a short distance from end-to-end contact with the upper sub when said cable is taut;

an apron provided on said upper sub and extending downwardly over but radially spaced from and loosely enclosing the upper portion of said tube;

an external annular shoulder on the said other end of said tube and radially spaced from said apron; and

an internal annular shoulder extending inwardly from said apron and radially spaced from said tube, said shoulders overlapping radially but being spaced axially from each other and allowing said tube freedom to swing through a substantial angle out of alignment with said upper sub to accommodate flexing of said string of rods;

said shoulders interengaging upon said cable breaking, to maintain a connection between said subs.

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