Dec. 4, 1945. F. D. PETERS 2,390,324

AUTOMATIC LENGTH ADJUSTER

Filed April 11, 1942

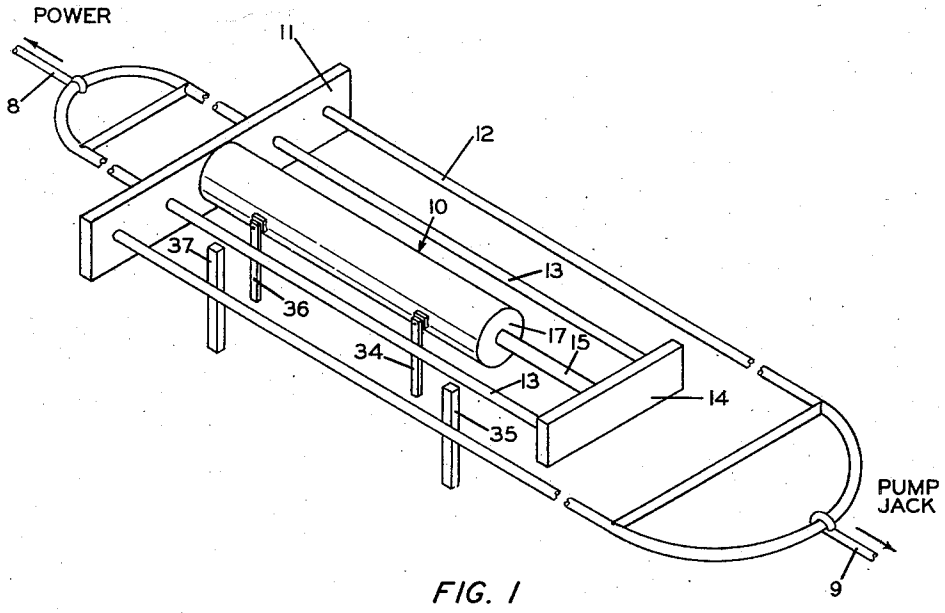


FIG. 1

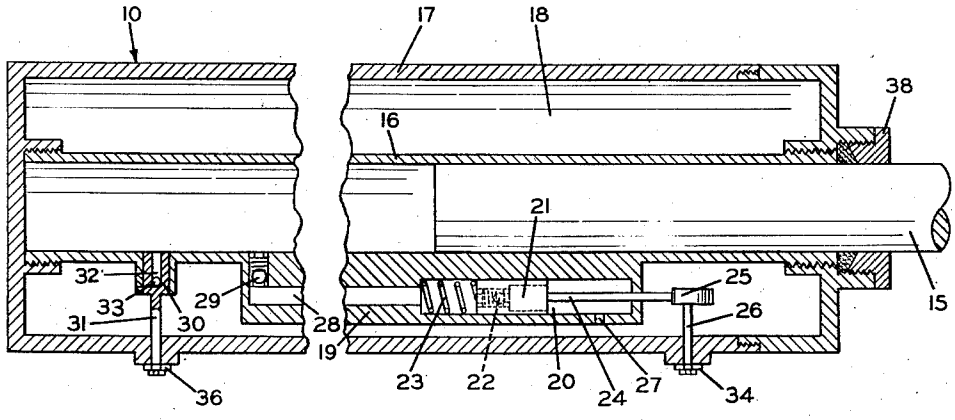


FIG. 2

INVENTOR
F. D. PETERS
BY Hudson, Young and Yungel
ATTORNEYS

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AUTOMATIC LENGTH ADJUSTER

Fred D. Peters, Webb City, Okla., assignor to Phillips Petroleum Company, a corporation of Delaware

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10 Claims. (Cl. 74—586)

This invention relates to apparatus for automatically adjusting the length of a reciprocating power transmitting mechanism to compensate for temperature changes. While the apparatus of this invention may be advantageously employed with various power transmitting mechanisms, it is especially useful to automatically adjust the length of reciprocating rod lines of oil well pumping systems to effectively offset variations in the length of said lines due to temperature changes and thereby maintain the overall length of the same substantially constant.

It is common practice in the petroleum industry to actuate the pump proper of each of a number of wells by means of a prime mover in a power plant which is located more or less centrally of the group of wells. A plurality of reciprocable steel rod lines, one for each well, extends radially from the power plant and each line is connected to the prime mover and to the pump jack of a particular well. As is often the case, the wells may be a considerable distance from the power plant, it not being unusual if one or more wells of a pumping system are as far as a mile from the power plant. It will be obvious that this necessitates the use of rod lines of corresponding length. In the course of each day, variations in the ambient temperature affects the overall length of the rod lines causing the same to increase or decrease in unit length, depending on whether there is a temperature rise or a temperature drop during an interval of time. The elongation or contraction per unit length of rod line is directly dependent on the coefficient of expansion of the metal of the line. It will be evident that even in rod lines having a relatively low coefficient of expansion, the increase or decrease in length of a complete line for various temperature changes may be and often is appreciable.

Experience has demonstrated that it is essential that provision be made to compensate for variations in the length of rod lines due to temperature changes, otherwise neither the jack nor the pump connected thereto will operate properly. This frequently results in damage or destruction of the jack and pump. This problem has been recognized for many years and numerous attempts have been made to rectify this condition. Various devices for maintaining the length of rod lines substantially constant notwithstanding temperature changes have been proposed, but none of them has proven entirely satisfactory. The rod line length compensator used almost universally in the petroleum industry at this time is the turnbuckle. The main disadvantage of the turnbuckle resides in the fact that it must be periodically adjusted manually. In the event that the attendant does not properly adjust the turnbuckle compensator or should he fail to make a necessary adjustment due to negligence or for other reasons, it will be evident that serious irreparable injury to equipment may occur.

My instant invention, on the other hand, eliminates many of the difficulties experienced heretofore, as it provides an automatic length adjuster which is dependable and efficient in operation. By the practice of my invention, there is no need for manual servicing or adjustment once the device is properly installed and regulated. The human element is thus removed, thereby resulting in labor savings and insuring trouble-free operations under a wide range of temperature conditions. The apparatus of this invention essentially comprises a fluid jack consisting of a cylinder within which a piston or plunger is permitted to reciprocate. The fluid jack is inserted at a convenient location across the rod line, the plunger being preferably connected to the end of the portion of the rod line coming from the prime mover while the piston is connected to the end of the portion of the rod line going to the pumping equipment. Means are provided whereby controlled volumes of a relatively non-compressible fluid are admitted into or withdrawn from the cylinder to thereby increase or decrease the fluid content of the cylinder and vary the position of the plunger therein. Said means are automatically actuated upon a predetermined lengthening or shortening of the rod line to maintain the overall length of the line substantially constant, and insure, under all conditions of temperature, an even and uniform stroke in the pumping equipment. By virtue of the construction indicated above, and set forth in detail further along in this specification, I am able to obtain a number of distinct operating economies and advantages which cannot be attained by the use of devices that are already known.

It is therefore the primary object of this invention to automatically adjust the length of a reciprocating mechanism to compensate for temperature changes.

This invention has for another object the provision of apparatus of the character indicated, which apparatus accomplishes its intended functions in an effective and dependable manner.

Another object of this invention is the provision of automatic length adjustment apparatus which is simple in design, rugged in construction, and relatively inexpensive to manufacture, install, and maintain.

These and other objects and advantages will be readily apparent to persons skilled in the art by reference to the following description and annexed drawing which respectively describe and illustrate a preferred embodiment of the invention, and wherein

Figure 1 is a perspective view of the invention employed in a rod line pumping system; and

Figure 2 is an enlarged central horizontal view,

partly in cross section, through the fluid jack of Figure 1, showing arms 34 and 36 as they are when actuated by stops 35 and 37 respectively.

Referring now to the drawing, and more particularly to Figure 1 thereof, the apparatus illustrated therein is adapted to compensate for changes in length of a pull rod line which is reciprocated by a source of power (not shown) to actuate a pumping jack which is coupled to a pump (also not shown) to raise hydrocarbon fluid from the bottom of a well bore to the surface of the ground. Reference numeral 10 generally denotes a fluid jack, employing a relatively non-compressible fluid and secured to a plate 11 which in turn is secured to a pair of rods 12 that are coupled to the portion 9 of the pull rod line that is attached to the pumping jack. A second pair of rods 13, slidable through plate 11, are coupled to the portion 8 of the pull rod line which extends to the source of power and are connected to a second plate 14 which is secured to a plunger or piston 15.

Turning next to Figure 2, it will be observed that fluid jack 10 includes an inner cylinder 16 disposed within and spaced from an outer cylinder 17 to form a chamber 18 therewith. Plunger 15 is reciprocable in inner cylinder 16. A pump housing 19 is preferably formed integral with cylinder 16 and is provided with a substantially central bore 20 that is adapted to receive a ported piston 21, having a check valve 22 for permitting fluid flow toward the left but preventing flow toward the right. A compression spring 23 is positioned within bore 20 for normally urging piston 21 toward the right. A stem 24 is connected to piston 21 and extends through housing 19, the free end of said stem bearing against the peripheral surface of a circular cam 25 which is secured eccentrically to a rotatable shaft 26 that projects through outer cylinder 17. Bore 20 communicates with chamber 18 by way of a port 27 and with the interior of cylinder 16 by way of a passage 28 which contains a check valve 29 that permits fluid flow from bore 20 into cylinder 16, but prevents flow in a reverse direction. A sleeve valve 30 is secured to a rotatable shaft 31 and contains a passage 32 which establishes communication between the interior of cylinder 16 and chamber 18 through a port 33 when shaft 31 is in the position illustrated in Figure 2, but cuts off communication when shaft 31 is rotated through a predetermined angle about its axis. It will be noted that shaft 26 carries an arm 34 which normally assumes a vertical position and which is adapted to engage an upwardly projecting stop 35 in the event the rod line 8 becomes elongated due to a rise in temperature. Likewise, shaft 31 carries an arm 36 which normally assumes a vertical position and which is adapted to engage a second upwardly projecting stop 37 in the event the rod line 8 contracts due to a drop in temperature. When arm 36 is in its normal vertical position, as depicted in Figure 1, sleeve valve 30 will have been rotated into closed position as distinguished from open position illustrated in Figure 2. A packing unit 38 surrounds plunger 15 and forms an adequate fluid seal between the plunger and cylinder 16. Stops 35 and 37 may be stakes driven into the ground.

In the practice of my invention, the above described device is inserted at a convenient location in a rod line of a rod line pumping system and reciprocates therewith. This location should be at or very near the pumping jack so that a maximum length of rod line will be between the prime mover or power and the length adjuster. Let us assume that fluid jack 10 contains a non-compressible fluid, such as oil or some other suitable liquid, and that the device is arranged to reciprocate so that arms 34 and 36 do not contact either stop 35 or stop 37. Let us assume next that a sufficient temperature drop occurs to appreciably shorten the overall length of the rod line 8. Rod line 9 is so short that no appreciable change in length occurs. The complete device, with the amount of oil then present in cylinder 16, will then have moved toward the left with respect to stops 35 and 37 with the result that arm 36 will engage stop 37 on the next stroke of the rods to the left, rotating shaft 31 and sleeve valve 30 to place passage 32 in alignment with port 33 (as shown in Figure 2) whereupon fluid within cylinder 16 flows into chamber 18. Plunger 15 simultaneously moves because of gravity pulling the sucker rods down the well and pulling line 9 to the right a short distance to the left relative to cylinder 16, decreasing the distance between plate 11 and plate 14 to thereby effect a corresponding increase in the overall length of the rod line 8 by adding to it a portion of rods 13. As the rod line 8 moves toward the right on its next stroke in that direction, arm 36 again assumes a vertical position due to gravity. The above outlined procedure is repeated on each successive complete stroke of the rods until the line is lengthened sufficiently to compensate for the decrease in length occasioned by the drop in temperature.

On the other hand, should the rod line 8 be caused to be lengthened due to a rise in temperature, lever 34 will engage stop 35, near the completion of the stroke to the right, whereupon shaft 26 is actuated so as to rotate eccentric circular cam 25. This rotation of cam 25 urges stem 24 and piston 21 toward the left against the action of spring 23, pumping fluid in bore 20 through passage 28, past check valve 29 and thence into the interior of cylinder 16 where the fluid urges 15 to the right. This results in plate 14 being moved a greater distance from plate 11 to thereby shorten the overall length of the rod line 8 by a corresponding amount. On the next stroke of the rod line to the left, spring 23 urges piston 21 toward the right and arm 34 again assumes a vertical position.

From the foregoing, it is believed that the construction, operation and advantages of my present invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus may be resorted to without departing from the spirit of the invention, as defined by the appended claims.

I claim:

1. Compensating length adjusting means for a rod-line interposed in the rod-line reciprocable therewith to transmit power therethrough, supported entirely by the rod-line and operable only upon a change of the rod-line length, comprising a coupling member having two telescoping sections with a fluid jack between the sections, said fluid jack including a cylinder and a plunger slidable in the cylinder, a fluid container and means mounted on the fluid jack responsive to stop means on the ground upon elongation of the rod-line due to temperature changes for transmitting fluid from the container into the cylinder to move the plunger with respect to the cylinder and thereby compensate for said elongation.

2. Compensating length adjusting means for a rod-line interposed in the rod-line reciprocable therewith to transmit power therethrough, supported entirely by the rod-line and operable only upon a change of the rod-line length, comprising a coupling member having two telescoping sections with a fluid jack between the sections, said fluid jack including a cylinder and a plunger slidable in the cylinder, a fluid container and means mounted on the fluid jack responsive to stop means on the ground upon lineal contraction of the rod line due to temperature changes for transmitting fluid from the cylinder into the container to permit movement of the plunger with respect to the cylinder and thereby compensating for said contraction.

3. Compensating length adjusting means for a rod-line interposed in the rod-line reciprocable therewith to transmit power therethrough, supported entirely by the rod-line and operable only upon a change of the rod-line length, comprising a coupling member having two telescoping sections with a fluid jack between the sections, said fluid jack including a cylinder and a plunger slidable in the cylinder, a fluid container, means mounted on the fluid jack responsive to stop means on the ground upon elongation of the rod line due to a rise in temperature for transmitting fluid from the container into the cylinder to move the plunger with respect to the cylinder and thereby compensate for said elongation, and means mounted on the fluid jack responsive to stop means on the ground upon lineal contraction of the rod-line due to a drop in temperature for transmitting fluid from the cylinder into the container to permit movement of the plunger with respect to the cylinder in an opposite direction to that hereinbefore set forth to compensate for said contraction.

4. Compensating length adjusting means for a rod-line interposed in the rod-line reciprocable therewith to transmit power therethrough, supported entirely by the rod-line and operable only upon a change of the rod-line length, comprising a coupling member having two telescoping sections with a fluid jack between the sections, said fluid jack including a cylinder and a plunger slidable in the cylinder, a fluid container surrounding the cylinder and concentric therewith, valved means permitting fluid flow only from the container into the cylinder, another valved means permitting fluid flow only from the cylinder into the container, means mounted on the container responsive to stop means on the ground upon elongation of the rod-line due to a rise in temperature for operating the valved means, permitting fluid flow only from the container into the cylinder to thus shorten the rod-line, and means mounted on the fluid container responsive to stop means on the ground upon lineal contraction of the rod-line due to temperature decreases for actuating the valved means, permitting fluid flow from the cylinder into the container, thus lengthening the rod-line.

5. An automatic hydraulic rod line length adjusting means comprising in combination with a relatively long reciprocating rod line and a relatively short reciprocating rod line, a hydraulic cylinder secured to the relatively short rod line, a piston longitudinally slidable in said cylinder and secured to the other of said rod lines, a substantially incompressible liquid positioning said piston in said cylinder, a chamber mounted on the cylinder, valve means mounted on the cylinder for venting said liquid from said cylinder to said chamber, said valve means normally being closed and including a normally vertically dependent operating arm, pumping means mounted on the cylinder for pumping liquid from said chamber to said cylinder, said pumping means being normally inoperative and including a normally vertically dependent operating arm, and stop means spaced on and secured to the ground so as to only contact the proper operating arm upon undue movement in one direction to vary the liquid in the cylinder so that the rod line length is adjusted.

6. An automatic hydraulic rod line length adjusting means comprising in combination with a relatively long reciprocating rod line and a relatively short reciprocating rod line, a body, a cylinder in the body, a chamber formed in the body, a piston in the cylinder, a cross head on the piston, a yoke secured to the body and to the relatively short rod line, a yoke secured to the cross head and slidably mounted relative to the body and secured to the relatively long rod line, a rotary valve communicating between the cylinder and the chamber, a dependent valve operating arm normally holding the valve in closed position, a stop positioned on the ground so as to only contact the arm and rotate and open the valve upon undue movement in the direction of the relatively long rod line, and means operable upon undue movement in the other direction to pump a substantially incompressible liquid from the chamber into the cylinder to move the piston outwardly whereby the rod line length is adjusted.

7. In an automatic hydraulic rod line length adjusting means the combination comprising a piston secured to a first rod the length of which is to be adjusted during reciprocation thereof, a cylinder receiving the piston secured to a second rod, a housing for said cylinder forming a liquid reservoir an incompressible liquid spacing the piston in the cylinder so that the cylinder partakes of the reciprocation of the first rod, and means to vary the flow of incompressible fluid between the cylinder and housing to vary the position of the piston relative to the cylinder comprising means to vent the fluid from the cylinder upon undue movement in one direction, and a pump comprising an eccentric circular operating member actuated upon undue movement in the other direction to pump said fluid into the cylinder.

8. Compensating length adjusting means for a rod-line interposed in and forming a variable length portion of the rod-line reciprocable therewith to transmit power therethrough, supported entirely by the rod-line and operable only upon a change of the rod-line length, comprising a coupling member having two telescoping sections respectively connected to a cylinder and piston forming part of a fluid jack between the sections, means forming the remainder of the fluid jack for supplying pressure fluid to and exhausting it from the cylinder, and control means responsive to contraction or expansion of the rod-line for actuating said last means to vary the telescoped position of said sections.

9. In the combination of claim 8, said control means including a venting valve for the cylinder and a pump connected to the cylinder.

10. In the combination of claim 8, a casing surrounding said cylinder and forming a fluid reservoir therefor.

FRED D. PETERS.