Nov. 28, 1944. J. E. LUCAS 2,363,603

WELL PUMP

Filed Feb. 3, 1944 2 Sheets-Sheet 1

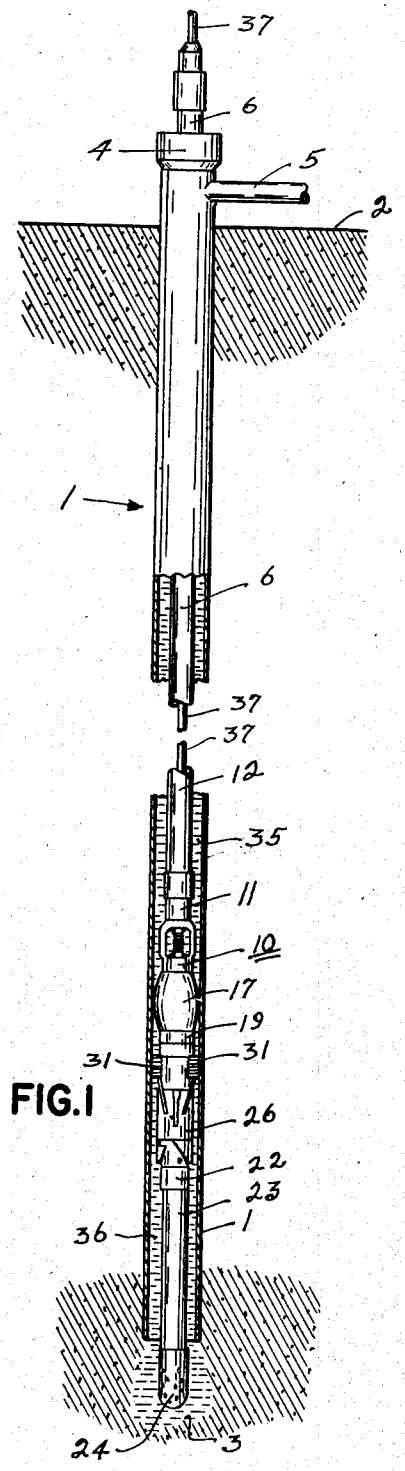


FIG. 1

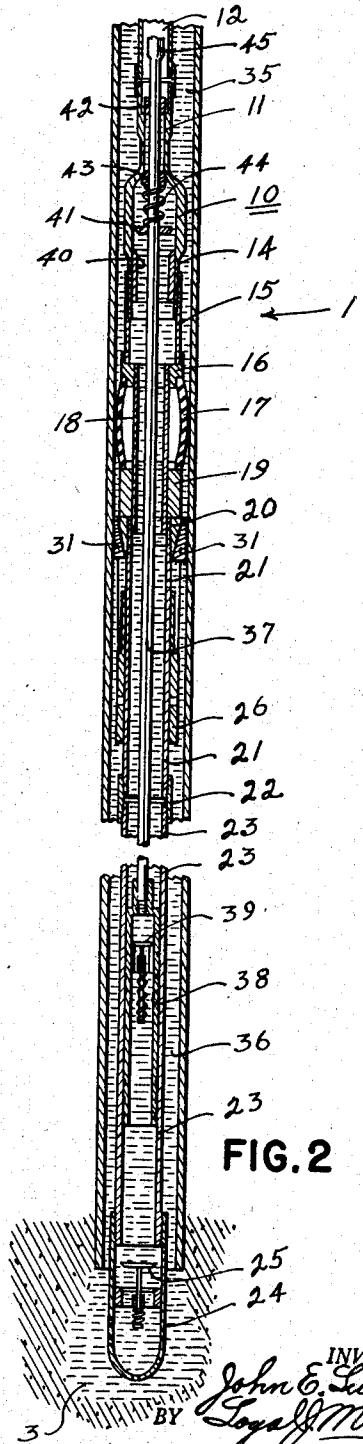


FIG. 2

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WELL PUMP

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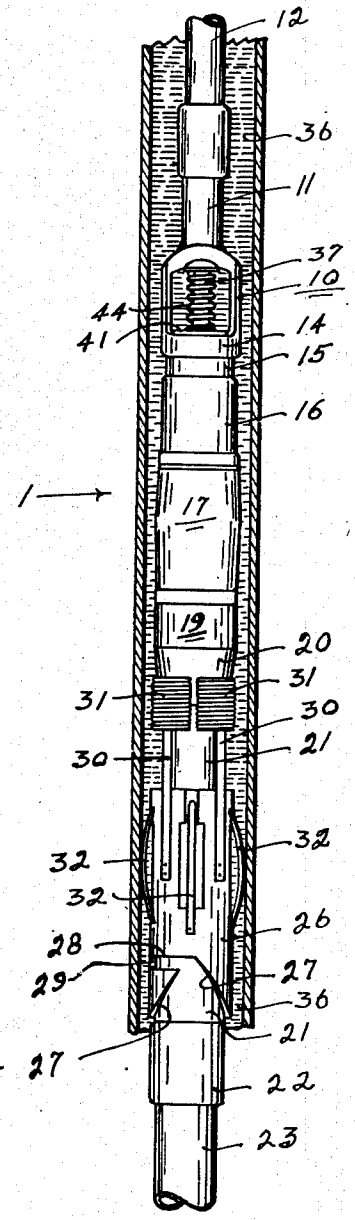


FIG. 3

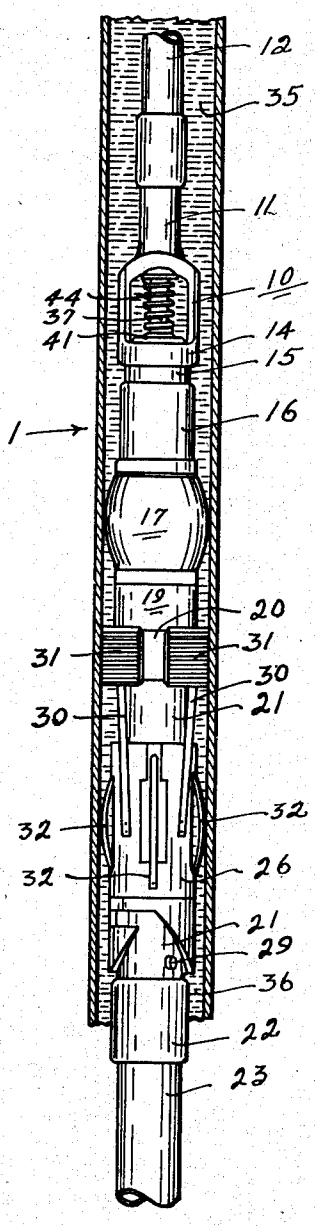


FIG. 4

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2,363,603

WELL PUMP

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Application February 3, 1944, Serial No. 520,989

2 Claims. (Cl. 103—179)

My invention relates to well pumps, and more particularly to reciprocating pumps for oil wells operated from the earth's surface by a sucker rod string.

One object of the invention is to provide a pump of this class which produces through the well casing, in contradistinction to those which produce through a string of well tubing within the casing.

A further object is to provide an oil well pump adapted to be lowered into the well on a tubing string, to be set by manipulation of the tubing string, and in which the tubing string acts as a sucker-rod guide for eliminating "side-slap" or "whip" in the sucker-rod string.

Another object is to provide a reciprocating oil well pump and associated tubing string, which will eliminate a large portion of the present day rod fatigue which is usually caused by the distortion of the rod string in the tubing on the down stroke.

A still further object is to reduce the wall friction on the upwardly travelling column of oil, since its velocity is reduced when the oil is discharged from a comparatively small area pump piston chamber to a larger area well casing.

Other objects and advantages will be apparent from the following description when taken in connection with the accompanying two-sheet drawings, wherein:

Figure 1 is an elevational view, partially in vertical section, of a cased well, the device of the present invention being shown operatively installed therein;

Figure 2 is a vertical sectional view of the device operatively installed in a well casing, the operating parts being shown as they appear at upper end of the pump stroke;

Figure 3 is an elevational view of the device within a well casing, the parts being shown as they appear while being lowered into the well, or before the packer has been set in the casing; and,

Figure 4 is a view similar to Fig. 3 with the device set in the casing and the packer expanded.

Like characters of reference designate like parts in all the figures.

In the drawings:

The reference numeral 1 indicates, as a whole, a usual well casing extending from the earth's surface 2, to an oil producing stratum 3 therebelow. The lower end of the casing is ordinarily cemented in place, but for the present purpose, this feature has not been shown. The upper end of the casing 1 has a suitable head 4, and therebelow is a lateral outlet pipe 5 for oil. The pump structure per se is lowered through the casing 1 to a point above the producing stratum 3 by being attached to the lower end of a tubing string 6. The tubing string 6, at its upper end, passes through and extends above the head 4.

The pump structure per se and its associated packer mechanism consists substantially of a head 10 (Fig. 2) the upper tubular end portion 11 of which is threadedly engaged with the lower section 12 of the tubing string 6. The lower end portion 14 of the head 10 is also tubular in form and is exteriorly threaded to receive the upper end of a sleeve 15. The lower end of the sleeve 15 is threadedly engaged with a comparatively heavy metal packer-head 16 about which is firmly attached the upper end of an expandable packer sleeve 17 made of suitable material, for instance canvas, rubber or a combination thereof. The packer head 16 is annular in form and its bore is threaded to receive the upper end of a tubular sleeve 18 which extends downwardly through and below the packer sleeve 17.

The lower end of the resilient packer sleeve 17 is firmly attached to the upper end of a suitable slip expanding mandrel 19 having a conically tapered exterior lower end portion 20. The mandrel 19 is also tubular in form, and its bore slidably receives the lower portion of the above mentioned sleeve 18. The exterior diameter of the sleeve 18 and the diameter of the bore of the mandrel 19 are such that the sleeve 18 has a bare working fit in the mandrel.

The lower end of the bore of the mandrel 19 has a threaded wall which receives the upper end of the tubing section 21 which extends therebelow any desired distance. There may be any desired number of tubing sections attached together below the section 21, in which case the lowermost one would be attached by a coupling 22 to the upper end of a conventional pump barrel 23. In the present instance (Fig. 2), the barrel 23 is shown as attached by the coupling 22 to the tubing section 21.

Below the barrel 23 and attached to the lower end thereof, is a plurality of perforated mud-anchors 24 having therein a conventional downwardly closing check valve 25 commonly termed as a "foot-valve."

Slidably disposed about the tubing section 21 is a conventional J-tool sleeve 26 having a suitable J-slot 27 in its lower end. The J-slot 27 has a laterally extending portion 28 within which

may be engaged an outwardly projecting stud 29 carried by the lower portion of the tubing section 21. When so engaged (Fig. 3), the J-tool sleeve 26 is held against longitudinal movement with relation to the section 21.

The J-tool sleeve 26 has a plurality of radially spaced upwardly projecting spring arms 30, and the upper end of each arm 30 carries a conventional segmental pipe slip 31 which is exteriorly toothed as shown.

When the stud 29 is engaged within the laterally extending portion 28 of the J-slot 27, the slips 31 are held in a position below the tapered portion 20 of the mandrel 19 (Fig. 3).

The J-tool sleeve 26 is also exteriorly equipped with a plurality of radially spaced springs 32 which are bowed outwardly intermediate their ends to frictionally engage the inside surface of the well casing 1.

When it is desired to set the packer structure in the casing, the tubing string 6 is rotated toward the left hand. The frictional engagement of the springs 32 with the casing 1 prevents a similar rotation of the J-tool sleeve 26; and consequently the stud 29 out of the lateral portion 28 of the J-slot 27 (Fig. 4). When this is done, the tubing string is lowered slightly, the J-tool sleeve 26 remaining stationary due to the action of the springs 32. Downward movement of the tubing string 6 permits the tapered portion 20 of the mandrel 19 to enter the slips 31 and expand them into positive gripping engagement with the casing 1 (Fig. 4).

Further downward movement of the tubing string 6 moves the packer-head 16 toward the mandrel 19 and, through compression, expands the packer sleeve 17 into sealing engagement with the casing 1. During this downward movement, the tubular sleeve 18 which depends from the packer-head 16 slides downwardly through the mandrel 10.

Since most oil wells have sufficient natural bottom hole pressure to cause the oil to rise some distance in the casing 1, the packer will preferably be set at some desired point below the surface of the column of oil normally standing in the casing, and when expanded, the packer will separate the upper and lower portions of this column. The separated upper and lower portions of this oil column are indicated respectively (Figs. 1, 2 and 4) by the reference numerals 35 and 36.

As a means for pumping oil from the lower oil column portion 36 to a point in the casing above the packer sleeve 17, and for delivering the pumped oil into the upper oil column portion 35, the following described elements are provided.

A usual sucker rod string 37 extends downwardly from above the earth's surface through the casing head 4, tubing string 6, head 10, sleeve 15, packer head 16 and sleeve 18, tubing section 21, coupling 22, and into the pump barrel 23. A suitable hollow pump piston 38 is provided within the barrel 23, and this piston is provided with a conventional downwardly closing check-valve 39, commonly termed the "traveling valve." The piston 38 is moved upwardly and downwardly in the barrel 23 by vertically reciprocating the sucker rod string by conventional power driven apparatus, not shown, which is connected to its upper end.

Within the lower portion 14 of the head 10 is provided a rigidly mounted tubular valve seat element 40, and surrounding the sucker rod string 37 within the head 10 is provided a downwardly closing check valve 41. The check valve 41 has a working fit around the sucker rod string, and that section of the rod string which passes through the valve 41 is accurately machined so as to have a perfect working fit with the valve.

The central portion of the body 10 just above the valve seat 40 has two open sides which permit pumped oil to exhaust from the body 10 into the casing 1 and commingle with the oil column portion 35 therein.

The upper tubular portion 11 of the body 10 has resilient packing elements 42 and 43 around the sucker-rod section passing therethrough, so that no oil will enter the lower end of the tubing string 6. The packing elements 42 and 43 may be of any usual type, and should be arranged in connection with common and well known packing gland thrust nuts, not shown. A helical spring 44 surrounds the sucker rod within the head 10, and bears against the valve 41 to normally urge it toward a sealing position upon its valve seat element 40.

In operation, the parts of the pumping and packing mechanisms are assembled together as shown in Fig. 2, and the assembly is lowered into the well casing 1 on the lower section of the tubing string to a desired position. The packer is expanded in the manner above described herein. The portion of the sucker rod string shown in Fig. 2 will be lowered with the assembled apparatus, and tubing sections and sucker rod sections will be consecutively added to the respective strings at the earth's surface as the lowering process continues.

During the lowering operation, the pump piston 38 will be at the upper end of its stroke, and the valves 25, 39 and 41 will all open to permit downward passage of the apparatus through the oil column in the casing.

After the packer has been set, the rod string will be dropped to the lower end of its stroke and the foot valve 25 will thereby be closed. Subsequent upper movement of the sucker rod string and pump piston 38 will cause the traveling valve 39 to close, and oil in the pump barrel thereabove will be raised. The oil thus being raised will force the upper valve 41 open, and the oil will be discharged from the open sides of the head 10 into the casing 1, above the packer. The suction created by the upper stroke of the piston will open the foot valve 25 so that the pump barrel 23 will be filled beneath the piston.

It is not considered that there is anything new in the packer and its setting mechanism, nor in the pump barrel, the piston and the two valves 25 and 39 since this structure is old in the oil well pumping art. However, the results obtained by combining these parts with structure lying above the sleeve 15 have been found to reach the objects set forth hereinabove.

It is pointed out that the rod section which passes through the head 10 may be equipped with a suitable and well known releasable connecting element 45 so that the rod string thereabove may be released by a partial rotation thereof. Such a connection is commonly used in sucker rod strings.

It is further pointed out that by discharging the pumped oil from the relatively small area valve seat element 40 into the larger area casing 1, the wall friction of the column 35 is materially reduced below that normally present in pumping apparatus which produces through a tubing string.

Also, that since no oil is produced through the present tubing string **6**, it can be made of smaller diameter than standard production tubing. This is possible because it is not necessary in the present structure for oil to pass upwardly in the tubing string past the enlarged rod couplings.

Attention is further called to the fact that by more closely surrounding the sucker rod string, the tubing string **6** can more competently guide the sucker rod string, and consequently much of the normal "side-slap" is eliminated.

It might be found desirable to plurally perforate each section of the tubing string so that it can fill up with oil for lubricating purposes.

I claim:

1. In pumping apparatus, the combination with a pump unit adapted to be positioned in a well, packer means adapted to form a seal between the unit and the well walls, and with a pump actuating sucker rod string extending from the earth's surface downwardly through the packer means to the pump unit, of: a head above the packer having openings for discharging pumped fluid from the pump unit into the well; an annular valve seat in said head below said openings; a downwardly closing valve surrounding a section of the rod string and adapted to close upon said seat; a tubing string surrounding said rod string and extending from said head to the earth's surface; and packing in said head around said rod section above said openings for preventing entry of said fluid into the tubing string.

2. In pumping apparatus, the combination with a pump unit adapted to be positioned in a well, packer means adapted to form a seal between the unit and the well walls, and with a pump actuating sucker rod string extending from the earth's surface downwardly through the packer means to the pump unit, of: a head above the packer having openings for discharging pump fluid from the pump unit into the well; an annular valve seat in said head below said openings; a downwardly closing valve surrounding a section of the rod string and adapted to close upon said seat; and a tubing string surrounding said rod string and extending from said head to the earth's surface.

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