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AUTOMATIC WEIGHT CONTROL

Filed May 6, 1927

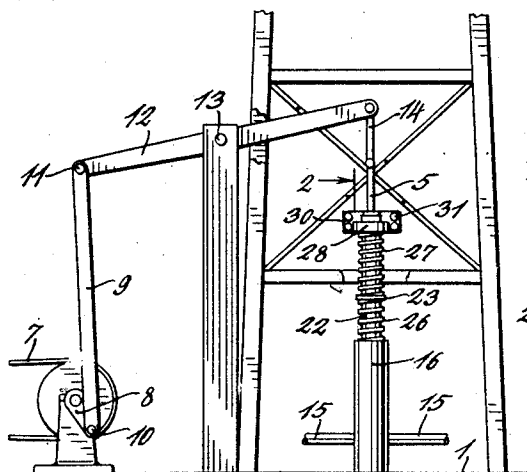


Fig. 1.

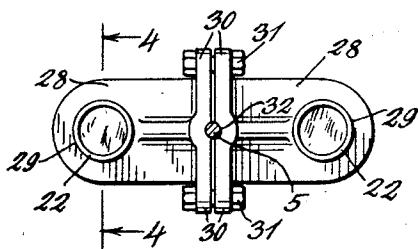


Fig. 3.

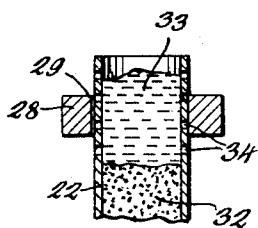


Fig. 4.

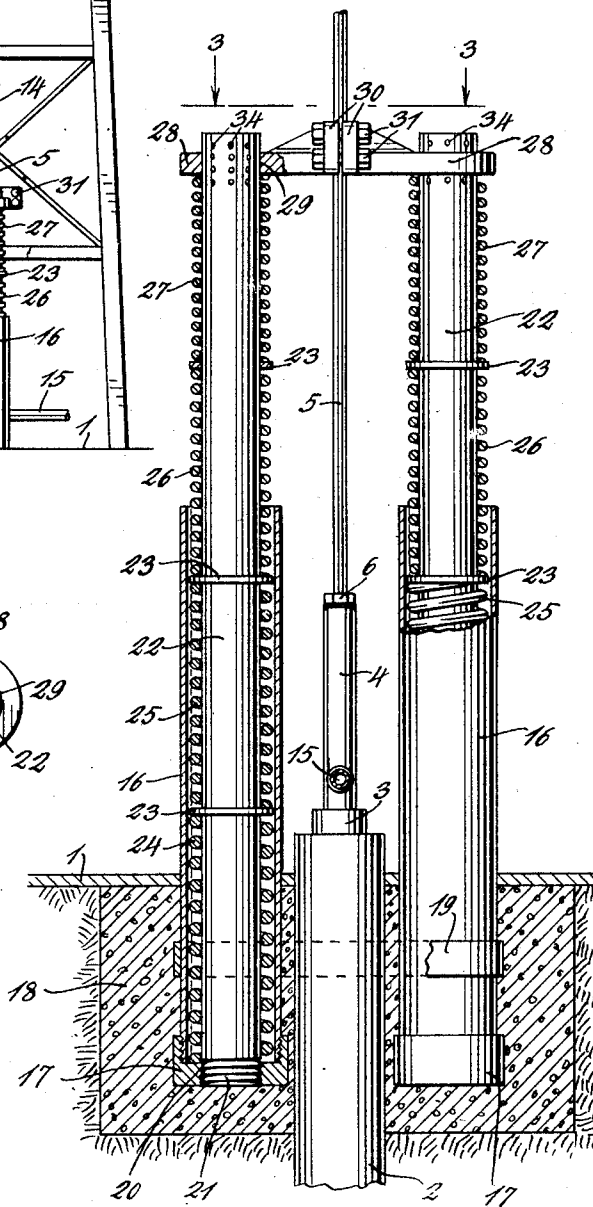


Fig. 2.

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AUTOMATIC WEIGHT CONTROL.

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This invention relates to improvements in compensating spring devices for oil well pumps.

Oil wells are, as a general rule, much deeper than wells for water and are quite frequently from one thousand to three or four thousand feet deep. When deep wells cease to flow the oil must be removed by means of pumps. Oftentimes the oil level will be more than a thousand feet below the surface of the ground and this long column of oil has a great weight and therefore it requires a great force to raise the pump piston and this column of oil. The force required on the up stroke may run up into several tons. On the down stroke the weight of the column of oil is sustained by the foot valve and therefore the force exerted on the lifting apparatus on the down stroke is merely the weight of the sucker and the sucker rods minus the friction.

It is evident that unless some device is employed for counterbalancing so as to compensate to some extent at least for the weight of the oil column that the pumping engine must be powerful enough to lift the oil column, the sucker rods, the sucker and to overcome the friction.

It is the object of this invention to provide a device consisting of springs which have one end held stationary with respect to the ground and which have their other ends connected with the polish rod and which exert a force tending to raise the polish rod with its attached sucker rods and sucker. The strength of these springs must be such that they give the maximum assistance to the engine during the operation of the pump.

The above and other objects that may become apparent as this description proceeds are attained by means of a combination and an arrangement of parts that I will now describe in detail, and reference for this purpose will now be had to the accompanying drawing in which the invention has been illustrated and in which:

Fig. 1 is a side elevation, partly broken away showing my invention applied to an oil well pump;

Fig. 2 is a vertical section taken on line 2—2, Fig. 1;

Fig. 3 is a top plan view taken on line 3—3, Fig. 2; and

Fig. 4 is a section taken on line 4—4, Fig. 3;

In the drawing numeral 1 represents the surface of the ground and numeral 2 the outside casing of the well, while numeral 3 indicates the inside casing of the well, which is usually a six-inch casing. The pump line has been designated by numeral 4 and a polish rod by numeral 5. The top of the pump line is provided with a stuffing box 6 through which the polish rod slides. During the operation of pumping it is of course necessary to reciprocate the polish rod as this is connected by means of the sucker rods to the sucker or piston which is located near the bottom of the well. The stroke of the pump varies for wells of different depths and may be anything from eighteen inches to four feet. In the ordinary installations the pump is operated by means of an engine which is connected by a belt 7 to a crank 8. A connecting rod 9 has one end pivoted to the crank pin 10 and the other pivoted at 11 to one end of the walking beam 12. The walking beam is mounted for oscillation about a central pivot 13 and has its other end connected to the polish rod 5 by means of a connecting rod 14. When the engine operates and rotates the crank 8, the walking beam will be oscillated, thereby reciprocating the polish rod in a manner quite apparent from Fig. 1. The pump line is provided with laterally extending pipes 15, a short distance above the top of the casing 3, for the purpose of conducting the oil to the reservoir or other storage place.

As above explained the total weight of the column of oil in pipe 4 and the weight of the sucker rods and sucker amounts to several tons which must be raised every time the pump makes an upward stroke. It is evident that if some means is provided for counterbalancing so as to compensate for some of the weight that is to be lifted, that there will be a great saving in power and in the wear and tear of the machinery.

For the purpose of providing a compensating device, the following mechanism has been produced.

Two sections of casing which have been indicated by numeral 16 have their lower ends provided with caps 17 and are embedded in a concrete block 18, so as to be held in vertical position, one on each side of the pump line 4. When these casing sections are put into place, and before the concrete is poured, they are held together by means

of a strap 19, which serves to space them the proper distance apart. In the preferred construction the casing sections 16 have an inside diameter of about ten inches. The caps 17 are provided with a central threaded opening 20, for the reception of the lower threaded ends 21 of the guide bars 22. These guide bars are usually formed of seven-inch casings and being concentrically arranged within the casing section 16, there is an annular space of one and one-half inches between the inner surface of the casing section and the outer surface of the guide bar. The guide bars extend upwardly substantially to twice the height of the spacing sections in the manner shown quite clearly in Fig. 2. Surrounding the guide bars are a plurality of sections of helical springs. In the embodiment shown four sections of springs have been employed. These sections are separated by washers 23. The lower spring section which has been designated by numeral 24 is preferably made from a one-inch steel bar wound with an inch space between adjacent turns and is twenty-four inches in length. The section directly above has been designated by numeral 25 and this is preferably constructed of seven-eighths inch steel and is twenty-two inches in length. The third section from the bottom has been designated by numeral 26 and is made from three quarter inch steel and is twenty inches in length. While the upper section which has been designated by numeral 27 is made from one-half inch steel and is eighteen inches in length. Slidably connected with the two guide bars 22 is a crosshead, which is made from two identically shaped sections 28 which are adapted to be assembled in the manner shown in Figs. 2 and 3. Each section 28 is provided with an opening 29 which is of such size that it will receive the guide bars 22 in the manner shown in Fig. 2. These sections are also provided with flanges 30 that are perforated for the reception of clamping bolts 31. The adjacent surfaces of the crosshead sections are provided with substantially semi-circular grooves 32, which are adapted to receive the polish bar 5, to which they may be securely clamped by means of the bolts 31.

From the above description it will be observed that the springs are each composed of several sections and that each section is made from a different size of material. Section 24 is, of course, a great deal more powerful than section 25, and section 27 is the weakest of all because it is made from one-half inch material, whereas the others are all made of larger material. It is evident therefore that if a load is applied which tends to compress the spring, that section 27 will compress a great deal faster than 26 and 26 will be compressed more than section 25,

while section 24 will be compressed the least. It is also evident that under the conditions stated, spring section 27 will be entirely compressed so that the coils will be in contact with each other before any of the other sections will be compressed to this extent. We therefore have a spring construction which is unique in this respect that the distance to which the different sections are compressed is greater for the upper sections and gradually diminishes towards the bottom of the spring structure. This peculiar construction of the spring results in an action in which each of the spring sections will be given a period of rest during each of the downward strokes of the pump. For example, when the pump rod 5 is moved downwardly, spring sections 27 will soon become completely compressed and will therefore be subjected to no further distortions as long as the load increases. The spring sections 26 will next be completely compressed, after which, if the movement and force is great enough, spring section 25 will be completely compressed. During the upward stroke the actions is reversed and spring sections 27 will remain completely compressed until the coils of spring section 26 have separated from each other to some extent. This, as above pointed out, gives sections 27 and 26 a period of rest during each stroke which greatly increases their life and which gives to the spring structure a quickness of action and a resiliency that, for the purpose for which it is used, is superior to what it would be if the spring was made from one single piece. There is also another advantage to be gained by making the springs of several sections, namely, that in case of breakage it is necessary to replace only the section that is broken. Whereas, if the springs were each made from a single piece, the entire spring would have to be replaced whenever a break occurred.

If one of the spring sections should break it can be readily replaced by unscrewing the bolts 31 sufficiently to permit the crosshead to be moved upwardly on the polish rod. After the crosshead has been moved to a position above the upper ends of the guide bars 22, it may be rotated and thereby make it possible to remove the spring sections by sliding them upwardly over the top of the guide bars. When the broken section has been replaced by a new one, the crosshead is rotated back into position and then moved downwardly so as to put the springs under the required compression after which the cross bar is again clamped to the polish bars.

I want to call attention to the fact that the connecting rod 14 which extends between the upper end of the polish rod and the corresponding end of the walking beam is a ridged member so that it can serve to exert

a downward pressure on the polish rod during the downward stroke of the pump. Since the weight of the column of oil in the pump line is supported on the foot valve the only weight that must be supported from the connecting rod 14 during the downward stroke of the pump, is the weight of the polish rod the sucker and the sucker rod minus the resistance due to friction and therefore is much less than the weight that must be raised during the upward stroke. It is evident therefore that it is impossible to employ springs of sufficient strength to compensate completely for the weights that must be raised on the upward stroke. For, if this were done the force required to compress the springs on the downward stroke would be excessive. The springs must therefore be adjusted to such an extent that the power required to operate the pump becomes the minimum within the limits made necessary by practical considerations of construction. On theoretical grounds the spring should be adjusted so that the tension in connecting rod 14 during the upward stroke is equal to the compression during the downward stroke. When adjustments are made as suggested the power required to operate the pump will be the minimum and the forces required for starting will also be the minimum, thereby reducing the strains on the machinery as well as decreasing the power required to operate the pump.

In order to obtain as easy operation as possible, the annular space between the casings 16 and the guidebars 22 is partially filled with lubricating oil. For the purpose of lubricating the surfaces between the springs and guidebars at points above the tops of the casings, the interior of the guidebars have been filled with sand to a point quite close to their upper ends. In Figure 4 the sand has been indicated by numeral

32 and the heavy oil or grease which is contained within the guidebars 32 has been designated by numeral 33. A plurality of openings 34 have been provided adjacent the upper ends of the guidebars for the purpose of permitting the grease or heavy oil to seep through to the outside so as to keep the outer surface of the guidebars properly lubricated.

From the above it will be apparent that I have produced a simple compensating device by means of which the heavy strains to which the pumping machinery would otherwise be subjected can be reduced to a minimum, and which is so constructed that it can be very easily installed and which can be readily repaired in case of breakage.

Having thus described the invention what is claimed as new is:

1. A weight control device for oil well pumps having a reciprocating polish rod, a guide bar located on each side of the polish rod, the axes of the guide bars and of the polish rod being parallel, a crosshead slidably connected with the guide bars and clamped to the polish rod, helical springs surrounding each guide bar, said springs being each composed of a plurality of sections, the several sections of each spring being of different strength and an annular washer-like member between the ends of adjacent sections.

2. A compression spring structure comprising, in combination, a casing, a guide bar located within the casing, said guide bar having an outside dimension which is smaller than the inside diameter of the casing, said guide bar being of greater length than the casing, a helical compression spring surrounding the guide bar and a crosshead slidable on the guide bar.

In testimony whereof I affix my signature.

EDWARD W. LYNN.