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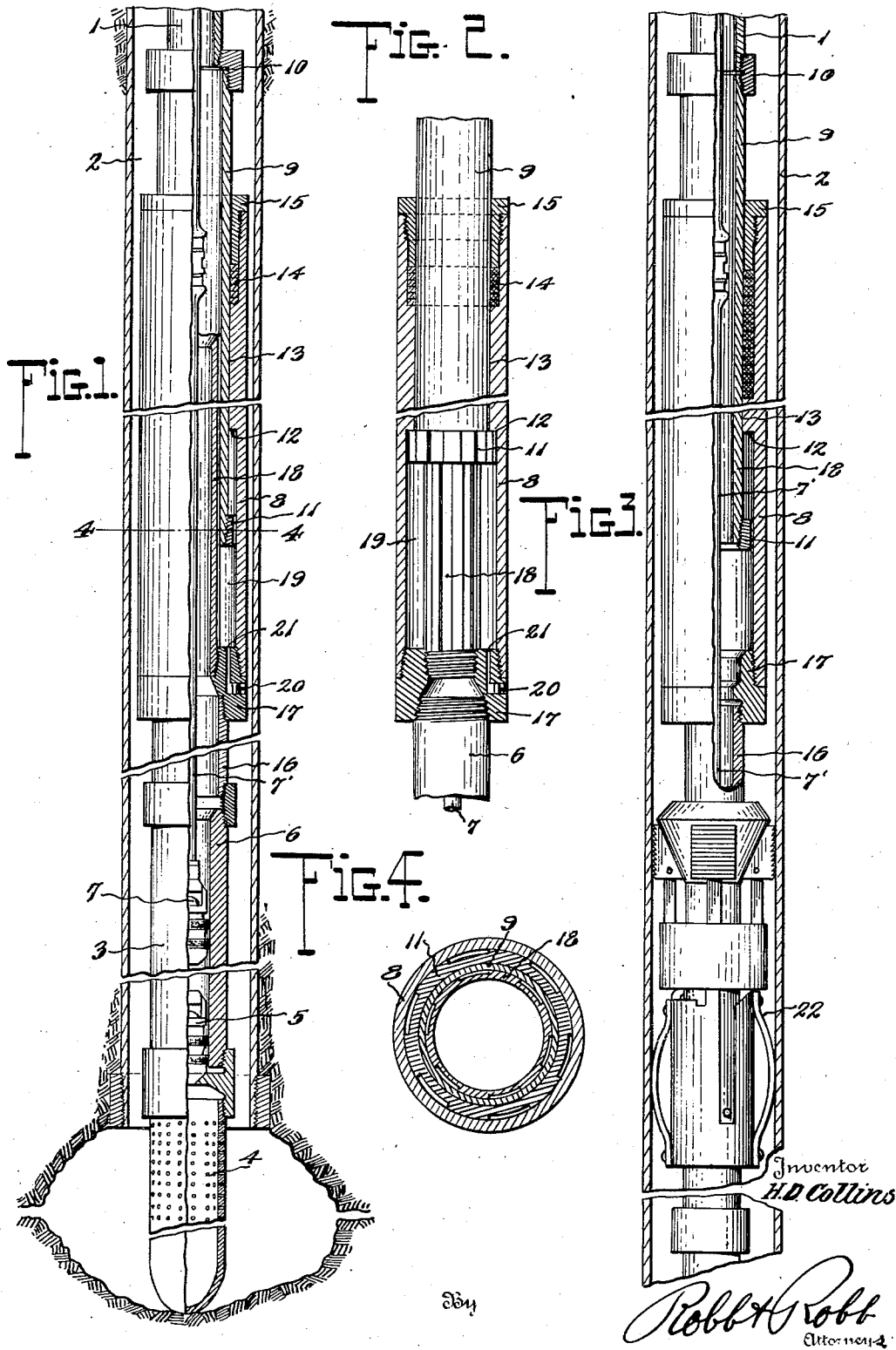
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TUBING FLUID LOAD DEFLECTOR

Filed March 23, 1937

2 Sheets-Sheet 1



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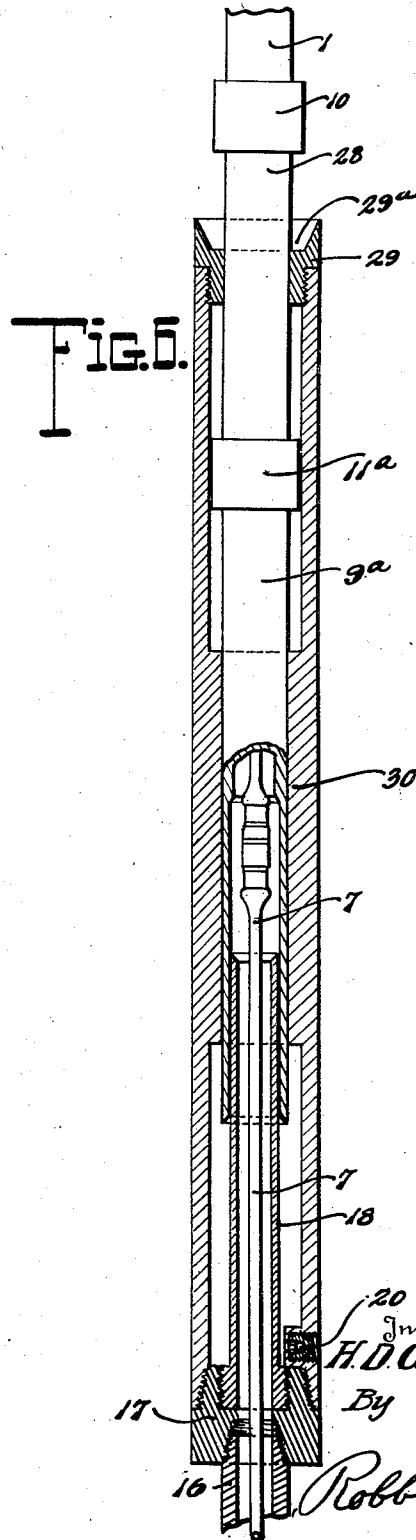
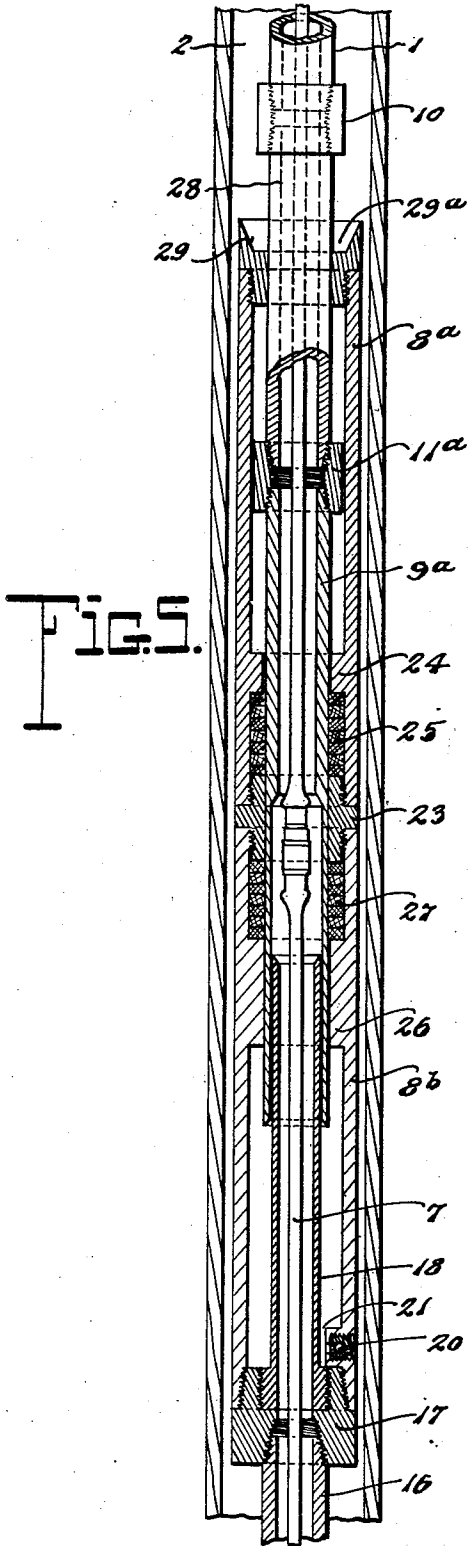
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2 Sheets-Sheet 2



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2,174,121

TUBING FLUID LOAD DEFLECTOR

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Application March 23, 1937, Serial No. 132,614

14 Claims. (Cl. 103—179)

The present invention relates to improvements in deep well pumping apparatus, and more particularly to what I term, for the purposes herein, a tubing fluid load deflector.

5 In order to best understand the objectives of my invention, it is desirable to note that it is standard practice at the present time to suspend a string of tubing through the well casing from the surface to the bottom of the drilled hole. At the bottom of this tubing is located the usual pumping instrumentalities or assembly, viz., the working barrel, valves, and plunger operable from the surface by a sucker rod connected with the walking beam assembly.

15 In the operation of such apparatus, each stroke of the plunger causes a change in vertical load on the suspended tubing, the plunger and rods taking the fluid load on each up stroke and the tubing taking the load on the down stroke of the plunger. This alternating load, caused by the reciprocating action of the plunger and alternate closing and opening of the valves in the stationary and traveling valves, causes failure in the threaded joints of the tubing string, resulting in the fall of the tubing into the well, thereby necessitating expensive fishing jobs and more expensive shut-downs. It will be understood that the magnitude of the varying loads depends upon the pumping depth and size of the plunger. In very deep wells, one thousand feet or more, the load differential from extreme up stroke to extreme down stroke amounts to as much as fifty thousand pounds, and, in some instances ninety thousand to one hundred thousand pounds have been recorded.

25 With this in view, it is the primary object of this invention to eliminate this injurious load on the tubing string and also prevent the tubing from buckling and bending when the mud or gas anchor is set on bottom or anchored in the casing, as by means of a tubing catcher anchor. To this end, I interpose in the tubing line above the pump assembly the load deflector or slip joint forming the essential feature of this invention, without interfering with the normal manner of running the pump assembly into the well with the tubing. The deflector, so-called, is composed of telescoping parts which allow for relative movement between the tubing and the pump assembly and prevent the tubing from buckling during the running in of the apparatus or operation of the same, while permitting the tubing to elongate and contract due to temperature changes in the well without disturbing the stationary position of the deflector unit.

A further object of my invention resides in the provision of a deflector unit so constructed and arranged that the vertical load stresses imposed by the fluid pumped are transferred to the lower section or pump assembly anchored at the bottom of the well, and the pumping stresses incident to pumping operation of the plunger are deflected to the pump assembly, so far as the down stroke of said plunger is concerned, and to the plunger itself, so far as the up stroke is concerned, rather than to the tubing string, as in the general practice at the present time.

A still further object in view is the provision of an effective seal between the slip joint or deflector unit members whereby the relatively movable parts may be lubricated and the corrosive well fluids shut out of the joint or prevented from escaping therefrom.

Other objects and advantages of the invention will be hereinafter set forth and the novel features thereof defined by the appended claims.

In the drawings:

Figure 1 is a vertical sectional view showing the preferred embodiment of my construction, parts being broken away and shown in section to disclose more clearly the details of construction.

Figure 2 is a fragmentary sectional view of the deflector unit section of the apparatus, showing the inner members of the unit in elevation and the position assumed by the parts in pulling the pumping apparatus from the well or running it into the same.

Figure 3 is a vertical sectional view of a modified form of my invention, and

Figure 4 is a horizontal sectional view on the line 4—4 of Figure 1.

Figure 5 is a vertical sectional view of another embodiment of my invention showing a modification as regards the arrangement of the means for pulling and running in the deflector unit along with the pump, etc., and

Figure 6 is a fragmentary sectional view showing the elimination of the connecting bushing provided in the form of Figure 5.

Like reference characters designate corresponding parts in the several figures of the drawings.

Specifically describing my invention, and referring first to the form shown in Figure 1, 1 designates a string of tubing which is suspended in the well in the casing 2, and 3 designates the standing valve unit which is anchored at the bottom of the well by the mud or gas anchor 4. This valve unit includes the standing valve 5,

and also includes the working barrel 6 in which the traveling valve and plunger 7 reciprocate under the actuation of the sucker rod 7'. The parts which have been described are conventional constructions, as will be understood from the preliminary statement regarding the invention. The deflector unit of this invention is interposed between the pump assembly or valve unit 3 and the tubing 1, and consists of an outer mandrel or tubular member 8 and a telescoping inner mandrel or tubular member 9. This last-mentioned member is connected to the lower end of the tubing by means of the bushing collar 10, and the lower end of said member is provided with a detachable collar or shoe 11 which is adapted to coast with the internal annular shoulder 12 formed on the outer member 8 when the tubing is raised or run into the well in the customary manner. Preferably these two tubes have a ground fit at 13 so as to prevent the escape of fluid from the joint, but preferably I may also employ the packing 14 seated in the top of the body 8 and held in place by the retaining bushing 15. Obviously, the packing may be extended sufficiently far to eliminate the necessity of providing the ground fit 13 above referred to. The unit at the lower end is adapted to be connected to the standing valve unit by means of the extension tubing 16 and the lower bushing collar or shoe 17.

In this preferred form of the invention I employ an inner protector tube 18 concentrically arranged within the deflector unit, and fixed to the lower section of the pumping assembly by means of the bushing member 17. This protector member 18 is spaced sufficiently far from the outer member 8 to provide a chamber 19 into which a lubricant may be introduced through the Zerk fitting 20 in the collar member 17. It will be noted that the lower end of the mandrel 9 extends into the lubricant chamber, and this arrangement effectively prevents the fluid being pumped and sand carried thereby from entering the chamber 19 or escaping from the deflector unit. The lubricant in the chamber will obviously provide the necessary lubrication for the sliding movements of the part 9. It will be understood that, when the pumping apparatus is run into the hole, the collar member 11 rests against the shoulder 12. When the mud or gas anchor strikes bottom, the deflector unit above described comes to rest and remains stationary, except for the inner mandrel 9 which is moved downwardly until the shoe or collar 11 is about midway between the shoulder 12 and the shoulder 21 of the lower shoe 17. The assembly, when so set, is in position for the pumping operation, and it will be obvious that relative movement may occur between the members 8 and 9 of the deflector unit either during the pumping action or when the tubing line expands or elongates and contracts due to temperature changes in the well.

When the pumping apparatus is started, the fluid is raised by the plunger in the normal manner, but instead of the tubing elongating and contracting with each stroke of the pump, the fluid load is carried within and on the stationary part of the deflector unit and pumping assembly below the deflector. In this manner, the many hundred feet of tubing above the deflector unit hang free in the well and is required to carry only its own weight and whatever stresses result from rod and fluid friction incident to the operation of the sucker rod and fluid passing through the inside of the tubing.

The deflector unit, in addition to eliminating the fluid load from the tubing, takes the vertical thrust of falling rods whenever a failure of the sucker rod occurs, which, without the deflector, frequently results in tubing failures.

It is important to note that the deflector unit has a larger cross section than the tubing. This large area is necessary to prevent the movement of the deflector with each up stroke of the pump plunger, if and when it should stick or freeze. The greater area acts as a large piston held in place by the fluid in the tubing, causing a greater downward thrust on the deflector unit than that exerted by the plunger on its upward movement.

It is to be understood that I do not wish to be restricted to the particular arrangement of the working barrel and plunger shown in the drawings, for it is possible that these parts may be arranged above the deflector unit rather than below the same so long as the standing valve unit is disposed at the bottom and anchored stationary in the well.

In Figure 3 I have shown a modified construction of the apparatus, somewhat simpler than that disclosed in Figure 1, and particularly desirable where installations are to be made in smaller casings or smaller holes. The primary difference between the two forms resides in the omission of the protector tube 18 and the use of a tubing catcher anchor 22 engaging with the well casing 2 in place of the mud anchor 4 shown in the preferred form. Since the construction of the remaining elements is the same as that in Figure 1, the corresponding reference numerals are used for this construction.

Under certain conditions, such as when small tubing working barrels are installed below the deflector or slip joint unit, it will be understood that said unit may be inverted, in which event the large cross section is turned upwards so that a large amount of static fluid load will be removed from the stationary or anchored connection below the unit where it is not needed when such small plungers are employed.

In Figure 5 I have illustrated a further embodiment modified in construction and arrangement of parts making for greater ease of assembly and repacking, when packing is used, of the deflector unit. The principle of operation, however, is the same as that of the preferred form.

Referring to this form, the outer cylinder or body of the unit is made in two sections, the upper designated 8a and the lower 8b connected together by a connecting bushing 23. The upper section is formed with an internal flange or collar 24 spaced from the lower end to provide a chamber or space to receive the packing 25 and the lower section of the body is correspondingly provided with the collar 26 and packing 27.

The tubing extension nipple 28 extends through the retainer bushing 29 into the upper body section 8a and connects with the inner deflector mandrel or sleeve 9a through the pulling collar 11a which, in the operating position of the device, will be positioned about midway between the bushing 29 and the shoulder 24, so as to permit freedom of movement of the inner mandrel in elongation and contraction, as described with reference to the preferred form. The remainder of the construction corresponds to that shown in Figure 1 and therefore needs no further repetition here.

It may be noted that the retainer bushing 29 is recessed or cupped at 29a to provide a means for catching scale, bolts, pieces of iron and the

like that may accidentally fall into the well hole.

In the operation of the form of invention of Figure 5, when pulling or lowering the pump, the collar coacts with the bushing 29 in a manner similar to the cooperation of the collar 11 with shoulder 12 in the preferred form.

I desire it to be understood that the packing 25, 27 may be eliminated, and a ground fit wall 30 substituted therefor, as shown in Fig. 6, to prevent fluid slippage or a combination of the two constructions may be employed.

Other changes in the details of construction may be made in the apparatus without departing from the spirit of the invention and within the scope of the claims appended hereto.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In well pumping apparatus, the combination of a line of tubing suspended in a well, a combined standing valve and working barrel unit supported in the lower part of said well and communicating with the tubing, and means in said unit for pumping fluid through said tubing, the tubing and unit aforesaid being movable longitudinally with respect to each other to maintain the tubing free of vertical load stresses of the fluid pumped and pumping pressure of the fluid pumping means.

2. In well pumping apparatus of the class described, the combination of a line of tubing suspended in a well, a standing valve and pump unit separately supported in the lower part of said well and having a slip connection with said tubing, and pump operating means movable relative to the tubing and valve and pump unit for pumping fluid through said standing valve and pump unit and the tubing.

3. In well pumping apparatus of the class described, the combination of a line of tubing suspended in a well from the top thereof, a standing valve and pump unit, means for anchoring said unit at the bottom portion of the well, means interposed between the valve unit and said tubing for connecting the same comprising a pair of relatively movable tubular elements having a fluid seal therebetween, and pumping means in the unit for pumping fluid through said tubing.

4. Apparatus as set forth in claim 3, wherein one of said tubular elements is stationary and the other of said tubular elements is movable under the elongation and contraction movements of the tubing.

5. Apparatus as set forth in claim 3, wherein one of said tubular elements is connected to the valve and pump unit to hold the same stationary and the other is connected to the tubing and telescopes the first-mentioned element.

6. In well pumping apparatus of the class described, the combination of a line of tubing suspended in a well from the top thereof, a standing valve and pump unit anchored in the bottom portion of the well, means for connecting the valve and pump unit and tubing comprising a pair of tubular members one of which is fixedly connected at one end to said unit and telescopically receives the end of the other tubular member, and a working barrel and plunger disposed in the valve and pump unit below the tubing and telescopic connection.

7. In well pumping apparatus of the class described, the combination of a line of tubing suspended in a well from the top thereof, a standing valve and pump unit, means for anchoring said unit in the bottom of the well to hold the same

stationary, a slip joint between the valve and pump unit and the said tubing comprising a tubular member connected to the valve and pump unit into which the end of said tubing extends and forming a fluid seal joint, and protective means associated with said joint for preventing the fluid pumped from contacting with the joint.

8. Apparatus as set forth in claim 7, wherein the protective means comprises an inner concentric tube between which and the tubular member connected to the valve element said other tubular member is slidably disposed.

9. A load deflector unit for use in deep well pumps having a pumping unit and a string of well tubing comprising a pair of spaced concentric tubular members, means for connecting the said members together and to the pumping unit, and a third tubular member telescopically arranged between said concentric tubular members and adapted to be connected to the lower end of the string of well tubing.

10. A load deflector unit for use in deep well pumps having a pumping unit and a string of well tubing comprising a pair of spaced concentric tubular members, means for connecting the said members together and to the pumping unit, a third tubular member telescopically arranged between said concentric tubular members and adapted to be connected to the end of the string of well tubing, and means for limiting the relative movement of said tubular members.

11. A load deflector unit for use in deep well pumps having a pumping unit and a string of well tubing comprising a pair of spaced concentric tubular members, means for connecting the said members together and to the pumping unit, a third tubular member telescopically arranged between said concentric tubular members and adapted to be connected to the end of the string of well tubing, and means on said tubular members for limiting the movement of the third tubular member relative to the concentric members.

12. In a device of the class described for deep well pumping apparatus, the combination with a well casing, of a standing valve unit at the bottom of said casing, means for anchoring said valve unit to the casing, a working barrel having a pump therein and a plunger connected to said valve unit above the same, a line of tubing suspended from the top of the well casing, a slip joint unit interposed between the end of the tubing and the working barrel and comprising telescoping tubular members of greater cross sectional area than the tubing, one of said tubular members being connected to the end of the tubing and the other of said tubular members being connected to the working barrel, and a sucker rod extending through the tubing, the slip joint unit, and connected to the plunger in the working barrel.

13. In well pumping apparatus, the combination of a line of tubing, a standing valve unit, a slip joint unit comprising an outer mandrel connected to said standing valve unit composed of upper and lower sections, a connecting bushing therebetween, and packing above and below the bushing, and an inner mandrel, said inner mandrel being connected to the tubing line by a pull collar, said outer mandrel having a bushing at its end with which said collar co-acts when pulling the tubing from the well.

14. A load deflector unit for deep well pumps comprising an inner tubular member and an outer concentric tubular member having a stop shoulder, common means for holding said tubular

members in spaced relation, an intermediate spaced concentric tubular sliding member extending into the space between the concentric tubular members aforesaid having a stop collar at the end thereof arranged to cooperate with said common holding means when in one position and

with the shoulder on the outer concentric tubular member when in another position, and means for introducing a lubricant into the space between the inner and outer concentric members.

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