Aug. 25, 1931. W. W. HARTMAN 1,820,391

STABILIZER

Filed April 2, 1930

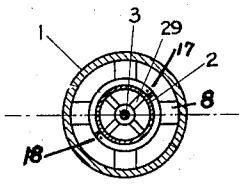


FIG. 3

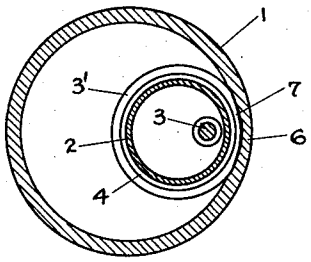


FIG. 4

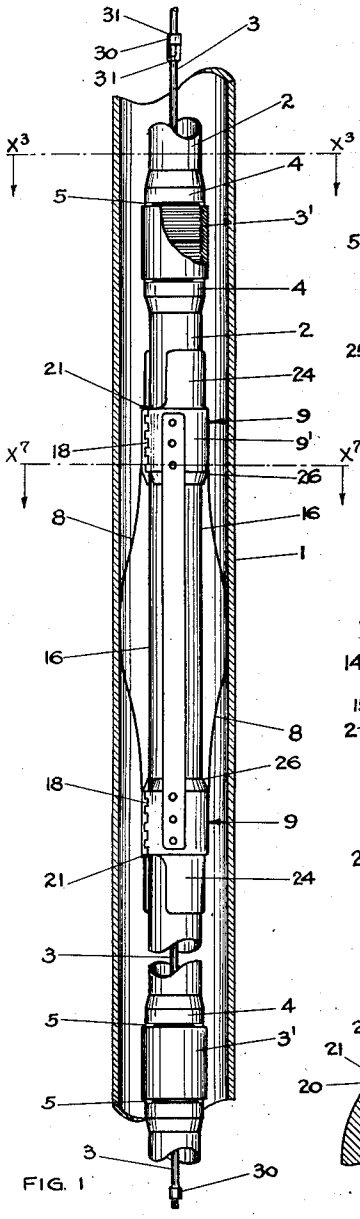


FIG. 1

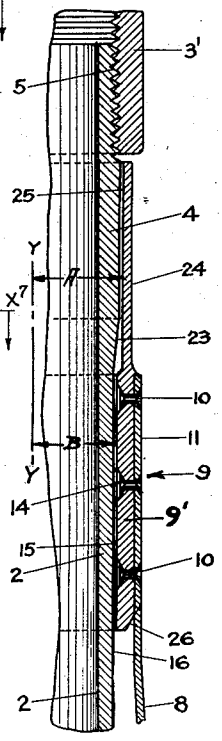


FIG 5



FIG. 6

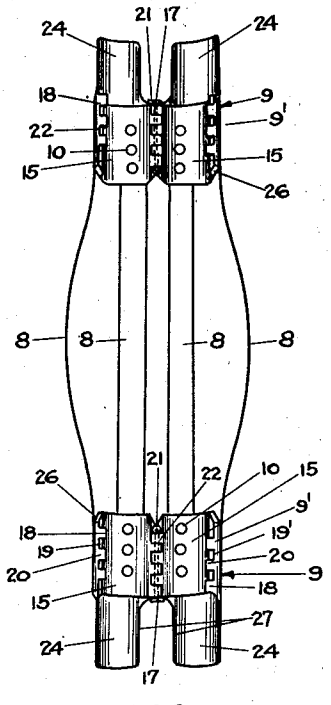


FIG. 2

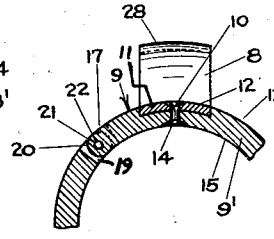


FIG. 7

WILLIAM WALTER HARTMAN
INVENTOR.

BY Robert A. Phipps
ATTORNEY

Patented Aug. 25, 1931 1,820,391

UNITED STATES PATENT OFFICE

WILLIAM WALTER HARTMAN, OF LOS ANGELES, CALIFORNIA

STABILIZER

Application filed April 2, 1930. Serial No. 440,975.

This invention relates to a device that is particularly useful in deep oil wells and has for its object to provide a good bearing and stabilizer for well tubing in well casing, and also,—in the smaller sizes,—a good bearing and stabilizer for the sucker rods in the well tubing.

In pumping deep oil wells it is the usual practice to run a long string of tubing down through the well casing into the oil, and through this tubing passes the string of sucker rods that reciprocate and transmit the pumping force from the surface of the earth to the pump which is located at the bottom of the tubing and sucker rods. The pump cylinder is carried and attached to the bottom end of the tubing, while the piston is attached to the bottom end of the sucker rods.

During the pumping operation the sucker rods not only move up and down in the tubing, this being the normal and intended pumping operation, but in addition there is an abnormal and unintended up and down movement of the tubing in the well casing, sometimes called breathing, this latter movement being small and almost imperceptible near the top of the well, but large and noticeable toward the bottom of the well, especially in deep wells where the depth of the pump is very great. This abnormal movement of the tubing is accounted for, among other things, partly by the back and forth slapping of the tubing in the well casing, and partly by the alternate stretching and unstretching of the long string of tubing as the weight of the rising oil column is alternately shifted from the foot-valve attached to the bottom of the tubing, to the piston, and back again, during the normal alterations of the pump stroke.

Since it is common for deep wells to be more crooked than is commonly supposed, with often several reversals of the crook on the way down, it follows that the well tubing will lean and press against the crooked well casing in the vicinity of each crook, and in the same vicinity the sucker rod will lean and press against the tubing because the latter is pushed into a crooked line by the crooks in the well casing. When the large number of such places at which the sucker rods press against the tubing and the tubing against the well casing, is considered in connection with the normal reciprocating movement of the sucker rods and the abnormal up and down movement of the tubing, and it is remembered that the weights and pressures of these parts against each other is very great, it is apparent that the wearing action at all these places of contact is large and that costly repairs and accidents naturally result therefrom.

As previously indicated, it is the object and purpose of this invention to eliminate, or at least greatly reduce, the trouble and expense arising from this source, and this is accomplished by providing an efficient bearing and centralizer which keeps the tubing off the well casing, and the sucker rods off the tubing, and by providing a very good bearing metal and surface at the places where the sliding and friction occurs, the wear on the well casing, well tubing, and sucker rods is reduced to a negligible amount.

The problem of constructing and using such a bearing and centralizer both on the tubing and sucker rods is complicated by the fact that these members are upset at the ends so that the bearings could not be slipped on over the ends in the usual manner, but this problem I have solved by splitting the entire device lengthwise along its axis so that its attachment to the tubes and rods can be made without impairing the good quality of bearing provided. My construction also makes it possible to very quickly attach and detach the device to the tubing, or rods, whenever necessary.

Other objects of invention, and benefits to be derived therefrom, will be made clear in the course of the following detailed description and claims, and by consideration of the appended drawings.

The drawings illustrate one form of my invention. Fig. 1 is a vertical section through the well casing showing my protector and bearing mounted on the well tubing in the casing. Fig. 2 shows my protector

and bearing detached from the tubing. Fig. 3 is a horizontal section along the line X^3—X^3, Fig. 1, looking in the direction of the arrows. Fig. 4 is a slightly enlarged view showing a condition that frequently arises in crooked wells, and sometimes even in fairly straight ones, where my invention is not in use. Fig. 5 is an enlarged vertical section through a portion of my device. Fig. 6 illustrates the cotter pin hereinafter referred to. Fig. 7 is a further enlarged fragmental view, taken as a horizontal section on line X^7—X^7, Fig. 1, looking in the direction of the arrows.

Referring to Fig. 1, reference numeral 1 represents the conventional well casing through which pass well tubing 2 and sucker rod 3, it being understood that these members continue into the earth to a great depth, often several thousand feet, although only a very small portion of the length is shown in these drawings. The various tubing sections are joined together by the conventional tubing collars or couplings 3′, and it will be noticed that near their ends, and for a substantial distance therefrom, the tubing sections are upset to enlarged diameter as indicated by reference numeral 4 in the drawings. This detail is best illustrated in the enlarged view, Fig. 5, and it is of course understood that the reason for the upset is to reinforce the tubing under the threads 5 where it screws into the coupling 3′.

Fig. 4 illustrates a frequent condition encountered prior to the advent of this invention. Owing to the crookedness of the well, the tubing 2 is over to one side of the well casing 1, the coupling 3′ actually bearing and pressing against casing 1. Because of the continuous up and and down movement of the tubing and collar, due to stretching as previously described, or other cause, and since both the casing and coupling are steel and therefore wear rapidly on each other, the casing wears thin as indicated at 6, and the coupling similarly wears thin as shown at 7. Should this wearing go further, the casing may be perforated with a hole, which might permit water to enter the well and spoil the oil. This is very serious because the well casing cannot be removed from the well to determine the location of the hole, and the patching of same is therefore very difficult. If the wear on the tubing coupling continues, several serious consequences may arise from this source also, such as loss of pumping production by leakage if the coupling is cut through, and even the parting of the tubing by excess weakening of the coupling, which would allow the tubing to fall to the bottom of the hole with possibly very serious damage.

My bearing and protector, which is best shown in Figs. 1 and 2, prevents or at least greatly reduces all this, and tends to hold the tubing central in the casing, or at least sufficiently so to prevent the tubing collar 3′ from wearing on casing 1.

My device comprises a plurality of metallic spring like members 8 and two end members 9. These end members 9 are preferably of sleeve-like construction, either short or long as I have shown them, and they must be held separated from each other, and in substantial axial alignment with each other. This can be done in many ways, but as a simple direct means of construction I like to accomplish it by fastening springs 8 direct to the end members by means of rivets 10, or any other suitable fastening. It will be noticed in Fig. 5, and in Fig. 7 that the springs 8 are set into grooves 11 in the end members so that the outside surface of the spring is flush with the outside surface of the end member as indicated by reference numerals 12 and 13, respectively, Fig. 7. It will also be noted that the inside head 14 of the rivet stops short of the inside surface 15 of the end member, for reasons that will presently appear.

When installed in the well as shown in Fig. 1, the end members slidably embrace the well tubing 2 between the upset or enlarged tubing ends 4 and couplings 3′. The spring arms 8 press out with suitable force against well casing 1, the friction between these springs and the casing being such that during the continuous up and down movement of the tubing 2, all or nearly all of the movement takes place between this tubing and the end members 9, and practically no movement occurs between the spring arms 8 and casing 1. Obviously my device centralizes the tubing in the well casing, thereby preventing conditions such as shown in Fig. 4, and all wear between the tubing 2, or coupling 3′, and casing 1 is eliminated which results in considerably benefitting the well in many ways.

Since the movement now occurs however between tubing 2 and my end members 9, I prefer to make these end members of some very good bearing material, especially some material that will wear well against steel. Various kinds of bushings and anti-friction arrangements could be inserted in the end members 9 for this purpose, but in practice I get good results by making these end members 9 of a good grade of bearing metal, preferably bronze because of its strength and excellent wearing qualities against steel. For the purpose of distinguishing it from other parts and features, one portion 9′ of end member 9 may be described as the bearing portion, for the reason that its internal cylindrical surface 15 is the place where the bearing friction is taken against the well tubing 2. I prefer to machine this surface 15 to give a nice bearing fit with the exterior surface 16 of tubing 2, and the tolerance or

clearance between surfaces 15 and 16 should be as little as practicable, as this naturally improves the life of the bearing. Since the rivets 10, usually of steel, do not come flush with the inner bearing surface 15, see Fig. 7, these rivets will not rub against the tubing, but will permit all rubbing to occur between the bronze surface 15, and the steel tubing surface 16 which will wear a very long time before the rivet heads 14 are reached. In extremely rare cases where trouble from the steel rivet heads may arise, bronze rivets, or other fastening, can be substituted for the steel rivets.

In view of this nice bearing relationship that is desired between my end members 9 and tubing 2, it is obvious that the upset enlarged end portions 4 of the tubing, create difficulties. If the cylindrical bearing surface 15 in my end members, were made large enough to pass over the upset ends 4 of the tubing, the value of the bearing against the normal sized tubing surface 16 would be seriously impaired, because the arc of bearing contact would be too much reduced, and the rate of wear would be much greater than with the construction which I have invented. For this reason, it is an important and essential feature of my invention that my bearing device should be in some way split in a lengthwise direction, so that my device can be in some way opened, or separated, to permit direct attachment over the normal tubing surface 16, instead of having to slide it down over the enlarged ends 4 of the tubing. This splitting of the dveice can be accomplished in various ways, either by splitting it down one side only, or by splitting it in two or more places, so as to produce two or more distinct parts which are entirely separable from each other. To accomplish this, I have obtained very good results with the construction shown in the drawings. I have split clear through the device, so that the end members 9 each comprise two separate parts to be fastened together at two separate places 17 and 18, respectively. Any suitable mode of fastening at these places could be used, and one type of fastening could be used at 17, and another kind at 18, but for purposes of simplicity I prefer to use the same sort of fastening at both places, and I have found a hinged construction as shown in the figures to be very satisfactory. This consists in forming the edge where the joint comes with alternate and interlocking grooves and lugs, 19 and 20 on the one side, and 19′ and 20′, respectively, on the other side. A cotter or other suitable pin 21 is then slipped through hole 22 so as to pin the lugs and grooves together. By removing the pin from one joint 18, from both end members, the device can be swung open to embrace the tubing, as indicated in Fig. 2, or if the pin were also removed from joint 17 as well as 18, then the two portions of the device could be completely separated from each other and placed around the normal tubing surface, being there re-fastened to each other by inserting pins 21 at both joints 17 and 18, in both end members. Ordinarily however I like to leave one joint fastened, say 17, and merely swing the device open as indicated in Fig. 2, and then close it again around the tubing, as this always keeps the two parts of the device together in an assembled unit, and prevents mixing up the parts as between different ones of my device as would probably occur if the parts were completely dissociated from each other. Of course the precise details of construction by which this opening and closing of the device can be procured, can vary extensively, without departing from the spirit of my invention.

In so far as my device is attached to the tubing at the surface of the earth, and must then be pushed down to considerable depth through well casing 1, it is obvious that there must be a good stop arrangement on the tubing so as to keep my device on the correct tubing joint, and prevent its slipping along from joint to joint. The upset end 4 of the tubing joint cannot be used as a satisfactory stop for the reason that it is tapered at the place 23, Fig. 5, where the upset blends down to the normal tubing surface 16. If it were attempted to use this tapered portion 23 as a stop, the bearing member 9 would tend too often to bind on this taper, and my device would ride up and down with the tubing, causing wear between springs 8 and casing 1, instead of carrying the friction where it is intended, namely in the bearing portion of the end members. To overcome this objection I use some sort of end stop member, or stop portion, in connection with either one or both of my end members 9, for the purpose of spanning over the enlarged upset tubing end 4, to make stop contact with the tubing coupling 3′. This stop portion of the end member can of course be of any suitable form of construction, and can either be an integral part of the end member, or can be attached thereto in some suitable manner. In the drawings this stop portion is designated by reference numerals 24. As indicated, I prefer to make this integral with the end members, but this is not essential, and good results can be obtained by other expedients, including for instance the extending of the springs 8 beyond the bearing portion of the end members sufficiently to serve as a stop against collar 3′. Whatever expedient is used, an essential feature of this stop is that the radial distance from the axis of the device Y—Y, see Fig. 5, to the inside contour 25 of the stop portion should be larger than the radial distance from this same axis Y—Y to the interior

cylindrical bearing surface 15 of the end member. In other words, referring to Fig. 5, the dimension A for the stop should be larger than the dimension B for the bearing surface 15. The object of this is to insure that the stop 24 will clear the enlarged tubing end 4 so as to contact as a stop against tubing collar 3'. I also like to make these stops 24 of somewhat curved or arched contour, approximately paralleling the cylindrical bearing surface 15 though larger, as this arch construction of the stop gives it increased strength.

In general it is desirable to keep all parts of my device, except the outwardly bowed portion of my spring arms 8, within a restricted external diameter not exceeding the external diameter of tubing coupling 3'. That is, excepting for the bowed part of my spring arms, I keep my construction such that when assembled on the tubing no part projects further from the center of the tube than the outside surface of tubing coupling 3'. This is because the clearance between tubing 2 and well casing 1 is often quite small, and occasionally a wash pipe must be slipped down through this casing for the purpose of dislodging sand or other obstruction that may in some way have gotten into this space near the bottom of the well to more or less cement the tubing into the well casing, which prevents pulling or removal of the tube and pump for repairs. When such wash pipe is let down, it is important that it should go past my bearing and centering device as freely as it passes the couplings 3', and this is practically insured by the construction indicated above. For the same reason I bevel off the ends 26 of the end members 9 so that the wash pipe can easily pass over same.

I leave a moderate space 27, see Fig. 3, between stop portions 24, so that easy access can be had to the cotter pin 21 during opening and closing of the device.

Also as indicated in Fig. 7, I prefer to give the spring arms 8 an external curved contour 28 to give fuller contact with well casing 1. From the same figure, it will also be noticed that my hinged joint 17 is effected without in any way increasing the radial thickness of the end members above the normal thickness at places beyond the joint. The same is of course also true for the other joint 18, which is substantially the same as 17. In other words, my method of jointing introduces no projections or obstructions that might interfere with the wash pipe. The springs 8 are of course resilient and will collapse clear down till they touch the tubing, if necessary. In other words if the well casing 1 should ever be collapsed while tubing 2 were in the well equipped with a series of my bearing devices, the tubing and bearings could be pulled up through the collapsed restriction, provided of course that the latter were not so great as to prevent the passage even of the tubing coupling 3'. In other words, my bearing device would set up no greater resistance than the couplings 3' when passing such restriction, because no part of my bearing device is of greater diameter than couplings 3', excepting my springs 8, and these will collapse till they touch the tubing if necessary.

Although the drawings show my bearing device attached only between the tubing 2 and well casing 1, it will of course be readily understood without detailed illustration in the drawings, that the same device, only smaller, can be attached as a bearing guide between the sucker rod 3 and tubing 2. Fig. 3 illustrates diagramatically the use of my device in this connection between the sucker rods and tubing, reference numeral 29 being used to indicate same. When applied to the sucker rod 3 however, the stop portions 24 are often found unnecessary for the reason that the upset ends 30 of the sucker rods, which as is well understood form their own box and pin coupling, are fairly square at the shoulders 31 so that a projecting stop member such as is shown at 24 is not required.

If only three centralizing arms 8 are used, instead of four or more, then two of these three arms may be rigid, and it is only necessary for one of them to have the resilient spring-like action as this is sufficient to perfectly centralize the bearing. Ordinarily I like to make all the spring arms 8 resilient however, as this more nearly insures that the device can be pulled up out of the well even though quite a serious collapse of the well may have occurred.

Quite apart from the usefulness of my device as a bearing to overcome wear, it is found in practice to produce another benefit from the mere fact that it stabilizes the tubing 2 in casing 1, and the sucker rods 3 in tubing 2. Naturally if my centralizers are not used, both the sucker rods and tubing slap around considerably between themselves and between the casing walls, and though this would have no noticeable detrimental effect in shallow wells, nevertheless in very deep wells it has the bad effect of considerably reducing the daily production of oil therefrom. For instance where there are several thousand feet of sucker rods and tubing between the surface of the earth and the pump barrel at the bottom of the tubing, the back and forth slapping of so much tubing and rod shortens the effective stroke length in the pump barrel at the bottom of the tube. This is on the obvious principle that the tortuous and curved path of the rods, set up by the slapping, shortens up the total depth that the same rods would reach to if they hung entirely straight without

slapping. In other words, if the stroke of the rods were fifty inches at the surface of the earth, the stroke of the pump piston actuated at the bottom of the rods might be reduced to only forty inches, or less, the reduction being represented by the slapping action referred to. In so far as my device has a distinct stabilizing action which tends to reduce this slap, it is found in practice that the installation of my invention in a well not previously equipped therewith occasionally results in a substantial increase in the daily production of oil, this increase sometimes being as much as 5% or more which of course is an important benefit in addition to the greater protection and durability to the well by reduced wear of the parts as described in detail above.

In view of the extensive description hereinbefore given, it is believed that the construction and mode of operation of my device is entirely clear.

Various modifications and rearrangements of the construction can of course be made without departing from the spirit of my invention, which is not limited except by restrictions found in the appended claims.

I claim:

1. In a device of the kind described, the combination of a plurality of spring-like metallic centralizing members, two bearing members spaced apart from and in axial alignment with each other, each of said bearing members presenting an interior substantially cylindrical bearing surface, said device also having an end-stop projecting beyond one of said bearing surfaces, the entire end-stop being at a greater distance from the axis of said device than the said bearing surface is from the axis of said device.

2. In a device of the kind described, the combination of a plurality of spring-like metallic centralizing members, two bearing members spaced apart from and in axial alignment with each other, each of said bearing members presenting an interior substantially cylindrical bearing surface, and each of said bearing members being fastened to said spring-like metallic centralizing members, said device also having curved end-stops projecting from said bearing members, the entire inside contour of said curved end-stops being at a greater distance from the axis of said device than the said bearing surface is from the axis of said device.

3. In a device of the kind described, the combination of a plurality of spring-like metallic centralizing members, two bearing members spaced apart from and in axial alignment with each other, each of said bearing members presenting an interior bearing surface and being made in two separable parts to permit the opening and closing of said device, and an end-stop projecting from at least one of said bearing members, the entire end-stop being at a greater distance from the axis of said device than said interior bearing surface of said bearing member is from ths axil of said device.

4. In a bearing and centralizing guide for a cylindrical member having a long normal cylindrical portion of smaller outside diameter than the outside diameter of the enlarged cylindrical end portion of said member, the combination of two bearing members spaced apart from each other and adapted to provide guiding and bearing support for said normal portion of said guided cylindrical member, a plurality of spring-like metallic centralizing members, and an end-stop for said guide, said end-stop being adapted to pass freely over the enlarged cylindrical end portion of said guided member.

In testimony whereof I have executed these presents.

WILLIAM WALTER HARTMAN.