June 6, 1961 J. O. MELTON 2,986,932

WEIGHT-SENSING MECHANISM

Filed Oct. 4, 1957

Fig. 1.

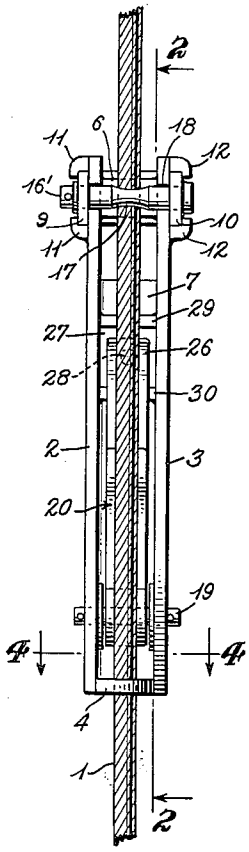


Fig. 2.

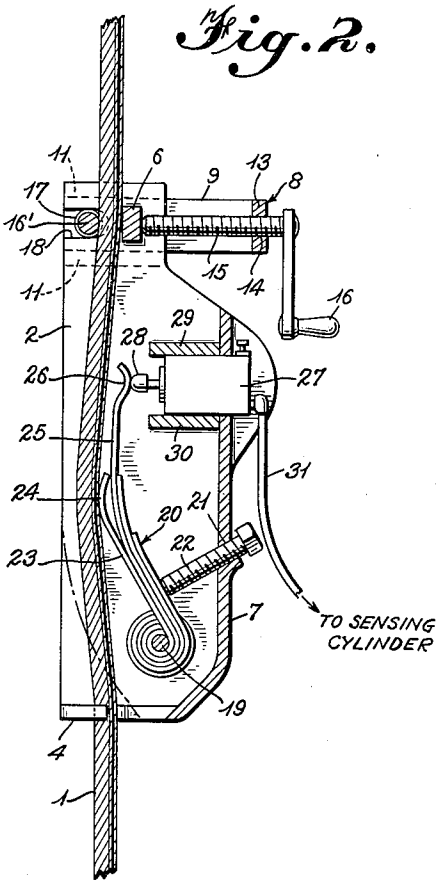


Fig. 4.

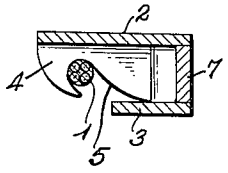
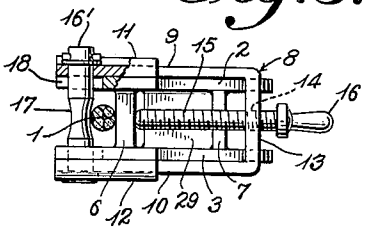


Fig. 3.



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WEIGHT-SENSING MECHANISM

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4 Claims. (Cl. 73—144)

The present invention relates to well-drilling equipment and more particularly to a weight-sensing mechanism for providing a continuous indication of the load or weight on the line supporting the drill string.

The rate of drilling, or the rate of penetration of the drill bit into the ground, will depend primarily upon the hardness of the earth layer which the bit engages; this drilling rate within certain limits, will also depend upon the load or weight exerted against the bit, which, in turn, depends upon the rate at which the drill string is permitted to descend. In practice, the feed or lowering rate of the drill string is correlated with the penetration rate of the drilling bit in order to achieve optimum drilling; the latter effect is accomplished by, first, measuring the load on the drill string and then by lowering the drill string a sufficient amount to maintain this measurement at a predetermined desired value.

In the past, many different devices and mechanisms have been proposed for determining the weight or load on the line supporting the drill string; perhaps the simplest of these devices is a mechanism which places a kink in the line supporting the drill string by means of an element which is resiliently urged against the line. The means for urging the sensing element resiliently against the line could be a spring means, a hydraulic means, or a pneumatic means. Then, as the weight on the line increases, there would be a tendency for the kink to straighten out with the result that the kinking means would either be moved or would provide a pressure increase, which, in either instance, could be used as a means for measuring the load or the change in the load. The principal disadvantage of the above-described weight-sensing mechanism is that the kinking means must be quite rugged since it bears the entire lateral thrust required to place and maintain the kink in the line. Such a rugged means, of course, would not be as sensitive as might otherwise be desired.

The present invention relates to a weight-sensing mechanism similar to the type described above wherein the initial deflection (or kink) in the load line is provided by a leaf spring; the sensing or indicatng element employed in the instant invention is a small hydraulic unit which operates against an extension of one of the leaves of this spring, such that the load imposed upon this sydraulic unit is but a fraction of the load absorbed by the entire leaf spring itself. Therefore, it should be apparent that the hydraulic sensing unit of the present invention need not be as large or as rugged as would formerly be the case; also, the indication provided by the sensing means would, in like fashion, be more sensitive.

Therefore, the principal object of the present invention is to provide a weight-sensing mechanism of the type described above wherein the weight-sensing element bears only a portion of the load required to deflect the line supporting the drill string.

Another object of the present invention is to provide a weight-sensing device which is relatively simple and, yet, which will provide a more sensitive weight indication than heretofore achieved.

Other and further objects and advantageous features of the present invention will hereinafter more fully appear in connection with a detailed description of the drawings in which

FIGURE 1 is a view in side elevation showing the relationship between the weight-sensing mechanism of the present invention and the cable or dead line to which it is attached;

FIGURE 2 is a sectional view taken along section line 2—2 of FIGURE 1 showing the details of the internal portion of the weight-sensing mechanism of the present invention;

FIGURE 3 is a fragmentary plan view of the weight-sensing mechanism of the present invention partly in section showing principally the details of the upper portion of the weight-sensing mechanism and its relationship to the cable to which it is attached;

FIGURE 4 is a horizontal section view taken along section line 4—4 of FIGURE 1 and showing the interfitting relationship between the bottom of the weight-sensing mechanism and the cable to which it is attached.

Referring to the drawings in detail there is shown section of a cable or "dead line" 1, the lower end of which would be secured to the frame in a conventional manner not shown. The upper end of this cable 1 would extend over the crown block and then downwardly to the traveling block. Thus, the weight exerted by the drill string on the crown block would be directly reflected in terms of longitudinal stress in the cable 1. The weight-sensing mechanism of the present invention which operates against the line 1 includes a pair of spaced vertical plates 2 and 3 which are connected at their bottoms by means of a short transverse plate 4. The cross plate 4 has a diagonal slot 5 into which the lower end of the cable 1, as it appears in FIGURES 1 and 2, is received. The upper end of the vertical plates 2 and 3 are connected by means of a cross bar 6. The right-hand side edge of plates 2 and 3, as they appear in FIGURES 2 and 4, are connected by means of a vertical strip 7 which extends from a point spaced from the top of these plates 2 and 3 downwardly to the bottom thereof.

At the top of the plates 2 and 3 a slidable clamp 8, having horizontally extending arms 9 and 10, is slidably received in guides 11 and 12 which are welded to the sides of plates 2 and 3, respectively. The short transverse end 13 of the slidable clamp 8 is provided with a threaded opening 14 through which passes a threaded bolt 15. The outer end of the bolt 15 is supplied with a handle 16 and the other end thereof bears against the cross bar 6. Adjacent the left-hand ends of the arms 9 and 10, as they appear in FIGURES 2 and 3, are a pair of oppositely aligned holes into which is received a short transverse rod 16 the center portion of which is inwardly curved as at 17. A pair of slots 18 in the plates 2 and 3 are provided to permit sliding movement of the rod 16 towards the cross bar 6.

Therefore, with the cable or line 1 passing between the cross bar 6 and the rod 16', as shown in FIGURES 2 and 3, if the handle 16 were turned so as to force the slidable clamp 8 towards the right, the cable would be securely gripped between these two elements, 6 and 16'.

Adjacent the lower end of plates 2 and 3, but spaced slightly upwardly from the bottom thereof, is a cross pin 19 which is received in suitable holes in the plates 2 and 3. A leaf spring 20 having a plurality of parallel leaves is arranged such that the leaves are curved at their lower ends surrounding the pin 19. The outer end of the spring 20 is caused to bear against the portion of the line 1 between the upper and lower ends of the instant device. An inclined threaded hole 21 is provided in the vertical strip 7 and a threaded bolt 22 is received therein. As shown in FIGURE 2, the threaded bolt 22 may be turned in one direction or the other to cause the spring 20 to bear against the line 1 with any desired spring pressure. In the spring 20, the leaf 23 which bears against the line

1 is curved away from the line 1 as shown at 24. The next adjacent leaf 25 of the spring 20 is considerably longer than the other leaves of the spring and projects vertically upward therefrom to an upper curved end 26 whose curvature is opposite from that of leaf 23. The remaining leaves of the spring 20 are substantially flat at their outer ends, as shown in FIGURE 2.

A hydraulic sensing device 27, consisting of a closed hydraulic circuit, is supported between the plates 2 and 3 in such a position that its sensing element 28 bears against the curved end 26 of the leaf 25. This sensing device 27 passes through a suitable hole in the vertical strip 7 and is secured in the frame of the mechanism by means of a pair of cross plates 29 and 30 which are connected between the vertical plates 2 and 3. The sensing device 27 can be one of several conventional types; however, the one illustrated in FIGURE 2 is preferably of the piston-and-cylinder type. A hydraulic pressure line 31 leading from the sensing device 27 is adapted to transmit pressure changes occurring inside of the sensing device 27 in response to the movement of the spring 25 and, hence, in response to the changes in tension in the line 1.

The pressure line 31 will lead to a pressure responsive device such as a bellows or a Bourdon tube which may then be connected to a deflection needle or a pen arm to provide either a continuous visual indication or a continuously recorded indication of the weight on the line 1. Also, the weight-indicating device of the present invention might be employed as the indicating device for use in conjunction with the control system employed in my copending application Ser. No. 682,052, filed on September 4, 1957, for Automatic Device for Controlling Drilling Apparatus.

If desired, two or more sensing devices, such as device 27, may be operated by the spring 20 to provide a plural indication of the tension in the line; one sensing device, for example, might be used to operate a controller, as indicated above, and another sensing device could be connected to a visual indicator, etc.

Whereas the present invention has been described in particular relation to the drawings illustrated herein, other and further modifications, apart from those shown or suggested herein, may be made within the spirit and scope of this invention.

What is claimed is:

1. A weight-sensing mechanism for sensing changes in the tension in a cable comprising an elongated and hollow casing for receiving therein a portion of the length of said cable, a clamp means secured in said casing and located adjacent one end thereof for securing said mechanism to one end of said cable portion, a slot adjacent the other end of said casing for slidably engaging the other end of said cable portion, a leaf spring pivotally mounted within said casing, means for urging the free end of said spring against said cable portion for causing a deflection in said cable, an extension on said spring, a sensing device forming a part of a closed fluid-pressure circuit secured within said casing and having a sensing element bearing against said extension, whereby, as the tension changes in said cable, said spring will be moved accordingly, and whereby, as said spring is moved in accordance with the changes in tension in said cable, said extension on said spring will cause a fluid pressure change in said sensing device, and a conduit leading from said sensing device to a suitable indicating device for providing a continuous indication of the tension in said cable.

2. A weight-sensing mechanism for sensing changes in the tension in a cable comprising a support through which a portion of the cable passes, a clamp means secured in said support for clamping said support to a first position on said cable, means attached to said support for slidably engaging a second and spaced position on said cable, a leaf spring having a plurality of leaves pivotally mounted at one end within said support, means for urging the other end of said spring means against the portion of said cable lying between said two points for causing a deflection in said cable, an extension on one leaf of said spring, and a sensing device forming a part of a closed fluid-pressure circuit secured to said support and having a sensing element bearing against said extension, whereby, as the tension changes in said cable, said spring will cause a fluid pressure change in said sensing device.

3. A weight-sensing mechanism for sensing changes in the tension in a cable comprising an elongated and hollow casing, a clamp means secured in said casing and located adjacent one end thereof for fixedly securing said mechanism to a first position on said cable, a slot adjacent the other end of said casing for slidably engaging a second position on said cable, a leaf spring having a plurality of leaves pivotally mounted within said casing, means for urging the free ends of said spring against the portion of said cable lying between said first and said second positions for causing a deflection in said cable, an extension on one leaf of said spring, a sensing device forming a part of a closed fluid-pressure circuit secured within said casing and having a sensing element bearing against said extension, whereby, as the tension changes in said cable said spring will be moved accordingly, and whereby, as said spring is moved in accordance with the changes in tension in said cable, said extension on said spring will move and cause a fluid pressure change in said sensing device, and a conduit leading from said sensing device to a suitable indicating device for providing a continuous indication of the tension in said cable.

4. Apparatus for sensing changes in the tension in a line comprising means for engaging said line at two spaced points, a leaf spring pivotally mounted at one end thereof within said apparatus, means anchored within said apparatus and bearing against said spring between its pivotally mounted end and its free end for urging the free end of said spring against said line at a point intermediate said two spaced points so as to cause a deflection in said line, an extension on said spring, and a sensing device forming a part of a closed fluid pressure circuit mounted within said apparatus and having a sensing element bearing against said extension, whereby, as the tension changes in said line, said spring will cause a fluid pressure change in said sensing device.

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