

Nov. 17, 1942.

G. L. KOTHNY

2,302,330

APPARATUS FOR ORIENTING TOOLS

Filed March 6, 1942

2 Sheets-Sheet 1

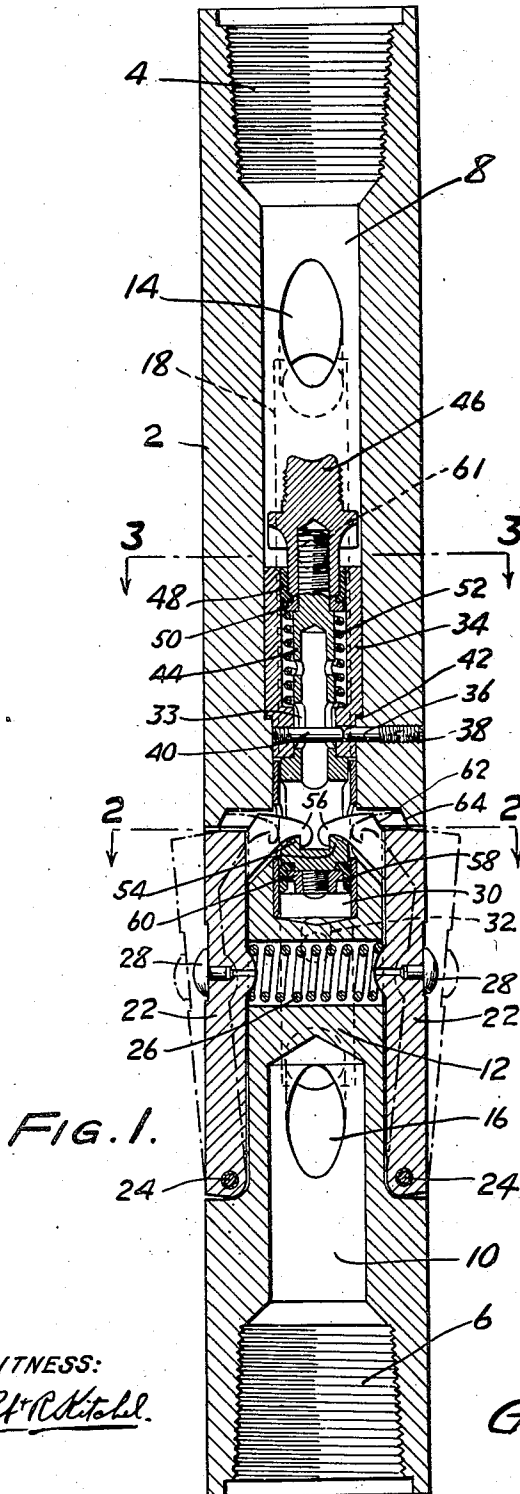


FIG. 1.

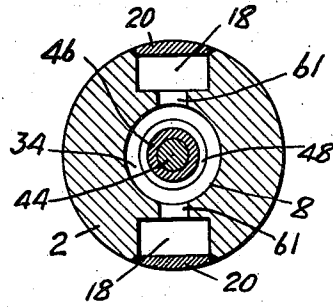


FIG. 3.

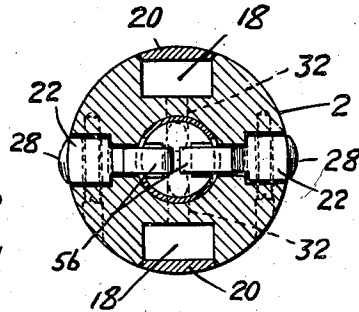


FIG. 2.

WITNESS:

R. C. Kitchell

INVENTOR

Gottfrank L. Kothny

BY *Bussan & Harding*
ATTORNEYS.

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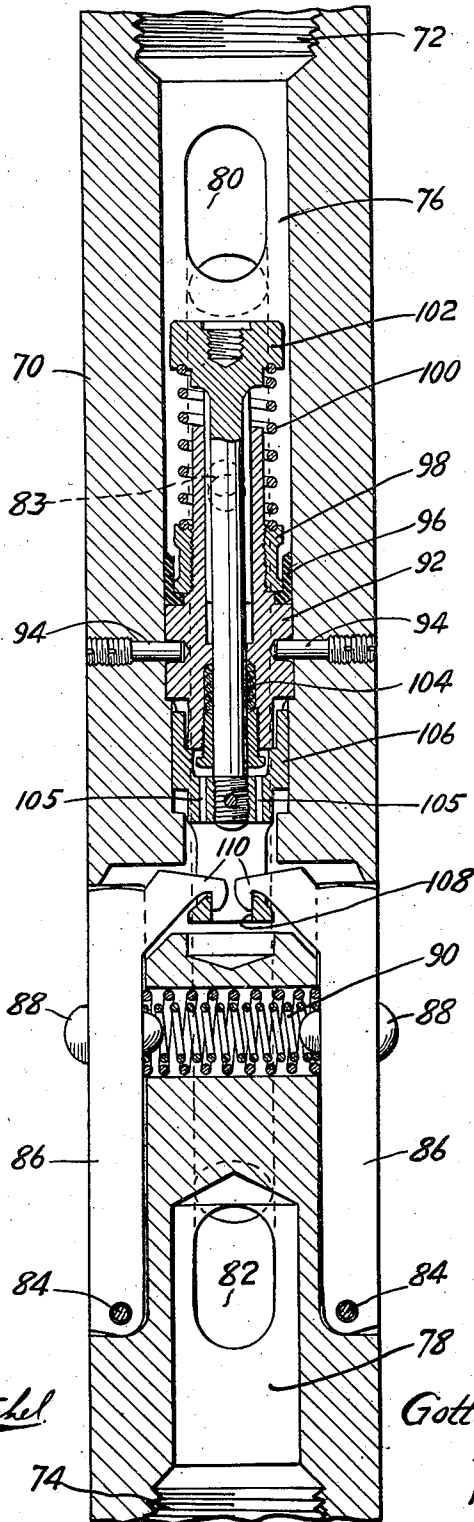


FIG. 4.

WITNESS:

R. P. Mitchell

INVENTOR

Gottfrank L. Kothny

BY

Bueser & Harding
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,302,330

APPARATUS FOR ORIENTING TOOLS

Gotttdank L. Kothny, Strafford, Pa., assignor to
Sperry-Sun Well Surveying Company, Philadelphia, Pa., a corporation of Delaware

Application March 6, 1942, Serial No. 433,559

5 Claims. (Cl. 294—95)

This invention relates to apparatus for orienting tools in a bore hole and in particular to means adapted both for effecting orientation and for the removal of a tool from the hole.

In my prior application Serial No. 366,113, filed November 18, 1940, there is described a method and apparatus for orienting tools in a bore hole, this application comprising certain improvements in the matters of various prior patents and applications, for example, Patents 2,107,420, 2,234,438 and 2,261,393, and application Serial No. 355,881, filed September 9, 1940. Briefly stated, these various patents and applications relate to the setting of a whipstock or other tool in oriented position within a bore hole with provision for drilling directionally and subsequent removing of the tool such as a whipstock from the hole. For accomplishing this purpose there is provided, in the case of whipstock setting, a sub above the collar or other element of the drill stem to which the whipstock is secured by means of a shear pin, which sub is provided with outwardly movable members designed to engage the whipstock following a drilling operation to remove it from the hole. In a preferred type of operation as described more particularly in said application Serial No. 366,113, referred to above, the members which are adapted to remove the drill stem perform the additional function of taking a rotational load as the whipstock is rotated by means of the drill stem not only for finally adjusting it to orienting position, but during a period of removal of an orienting surveying instrument and the determination of the proper setting.

The present invention relates to improvements in a retrieving sub construction adapted for the practice of essentially the method described in the aforesaid application.

One of the objects of the invention is the provision of a sub in which wear on the operating parts by abrasive mud is prevented during use.

A further object of the invention is the provision of means for insuring proper operation despite possible failure of jamming of a spring.

Still another object is the provision of controlling means in the form of a single, easily replaceable unit.

These and other objects of the invention, particularly relating to details of construction, will become apparent from the following description, read in conjunction with the accompanying drawings, in which:

Figure 1 is an axial section through one form of the improved retrieving sub;

Figure 2 is a transverse section taken on the plane indicated at 2—2 in Figure 1;

Figure 3 is a transverse section taken on the plane indicated at 3—3 in Figure 1; and

Figure 4 is an axial section of a modified form of retrieving sub.

Referring first to Figures 1 and 2, the retrieving sub comprises a cylindrical body 2 provided with threads 4 and 6 for attachment to other parts making up the drill string. At 4, for example, there may be secured either the lower end of the drill string or an orienting sub which is in turn connected to the drill string, the orienting sub, for example, being of the type illustrated in Hyer Patent 2,120,670, for the purpose of orientation. To the lower end of the sub 2, there may be secured a drill collar and/or bit to which the collar of a whipstock may be secured by means of a conventional shear pin. In such case, the upper end of the collar desirably embraces the lowermost portions of the sub to give rise to an assembly of the character indicated in Figure 8 of said application Serial No. 366,113. Since the present invention relates primarily to construction of the sub, which is used as described in said application, this known method of association of the sub with a whipstock is not shown herein.

Provision for mud circulation is made through the extension of the socket 4 in the form of a bore 8 in the upper portion of the sub 2. At the lower portion of the sub, a bore 10 communicates with the socket 6, being closed at its upper end by the solid metal, as indicated at 12. Openings 14 and 16 are provided extending from the bores 8 and 10 to side channels 18, as indicated in Figure 2, which take the form of grooves milled or otherwise formed in the sides of the sub 2 and closed by members 20 welded thereto. Pivoted loosely at 24 on pins extending across slots in the opposite sides of the sub are engaging members 22 which are urged outwardly by a strong spring 26 located in a transverse bore in the sub. These engaging members 22 are provided with soft metal rivets 28 formed of copper or the like which extend slightly beyond the cylindrical boundaries of the sub as indicated in the drawing.

In the lowermost portion of the bore 8 there is provided a metal sleeve, indicated at 30, the region in the lower end of which communicates through openings 32 with the channels 18. In a section of the bore 8 above the sleeve 30 and seated, with suitable intermediate packing, upon a seat in this bore, is another sleeve 34, which is held in fixed position by means of a set screw

36, preferably engaged by a locking screw 38, both threaded through the wall of the sub. A pin 40 threaded in the sleeve 34 projects across an opening therein through slots 42 in a plunger member 44. On the upper end of this plunger member there is threaded a head 46 provided with a socket adapted to be engaged by a go-devil, which head 46 locks a packing cup member 48 against an annular ring 50, the lower end of which is engaged by a compression spring 52 reacting between it and a shoulder within the sleeve 34. The lower end of the plunger 44 carries a pair of projections 54 adapted to engage and hold latch extensions 56 provided on the upper ends of the engaging members 22. These elements are rounded and beveled as indicated for the purpose hereafter described. A packing cup 58 is clamped at the lower end of the member 44 by a nut 60 and bears upon the inner surface of the sleeve 30.

Communication between the channels 18 and the region immediately above the packing cup 48 is provided by means of openings 61.

The outward movement of the engaging members 22 is limited by contact of faces 62 on the extensions thereof with shoulders 54 formed internally in the sub body.

In the use of this arrangement, the collar of the whipstock extends above the position of the upper ends of the engaging members 22, which occupy the outward positions indicated in chain lines, being received in longitudinal slots in the whipstock collar, desirably with close clearance so that upon rotation of the whipstock by means of the sub, stresses are transferred through the engaging members 22 rather than through a shear pin which, below the level of the sub, secures the whipstock to a drill collar or bit. Thus assembled, the whipstock bit and sub and other elements, including for example an orientation sub located above sub 2, are lowered on a sectional drill stem to approximately the depth at which the whipstock will be ultimately fixed. The drill stem and the parts carried thereby may now be rotated while a well surveying instrument is lowered through the same to a position to make a record of orientation, for example, in accordance with the Hyer patent mentioned above. During such rotation, stresses are taken by the hardened engaging members 22 rather than by the relatively weak shear pin, which must ultimately be sheared off. When the surveying instrument reaches its proper level, the drill stem may be moved up and down, i. e., spudded, so that torsional strains are taken out of the assembly and then the entire assembly is held at rest for sufficient time for the surveying instrument to make a record. At this time, the position of the rotary table may be noted at the surface.

As soon as sufficient time has elapsed for the making of the record, the surveying instrument may be withdrawn by its supporting wire line, or retrieved by means of an overshot if it was originally dropped in go-devil fashion, and during such withdrawal the drill stem may be again rotated, at which time the stresses of rotation will again be assumed by the engaging members 22. After the record is analyzed and the proper position of the drill stem ascertained, the rotary table may be turned to a position, as determined by the marks thereon and the record of the surveying instrument, to bring the whipstock to the desired position, whereupon spudding is again effected to insure that stresses in the system are removed and the whipstock properly lined up.

Following this, the weight of the drill stem is caused to rest on the shear pin, first driving the whipstock into the earth at the bottom of the bore hole to anchor it, and thereafter shearing off the pin so that drilling may be accomplished.

The whipstock under these circumstances, and as indicated in said application Serial No. 336,113, desirably has a tapered or conical region at the lower portion of its collar, so that as the sub moves downwardly, the rivets 28 will engage this surface, with the result that the engaging members 22 are cammed inwardly against the pressure of the spring 26. As this inward movement occurs, the rounded ends of the latch extension 56 will ride over the beveled portions of extensions 54, camming the member 44 downwardly until they move inwardly to a sufficient extent to clear these members, whereupon the member 44 will be moved upwardly by the action of spring 52 to latch the engaging members 22 in their inner position. As the sub moves further downwardly, if the most restricted portion of the whipstock collar is too small for the passage of the rivets 28, they will be sheared off. Even if they are not sheared off at this time, however, they will in general be worn or broken away during the subsequent drilling.

Except for the possible continued projection of the rivets 28, the sub now presents a cylindrical aspect, and consequently drilling may occur down the face of the whipstock in usual fashion without engagement of any projecting parts with the whipstock or earth.

If it is desired to withdraw the drill stem, for example to change the bit, while leaving the whipstock in position in the hole, withdrawal may be effected without disturbing the whipstock position if the engaging members 22 remain latched inwardly. If, however, at the time of initial withdrawal or at the time of some subsequent withdrawal it is desired to remove the whipstock, it is only necessary to drop a go-devil through the drill stem to engage the head 46 of the plunger 44 so that by its weight it may compress the spring 52 and so release the engaging members 22 for outward movement under pressure of the spring 26. When they move outwardly in this fashion, they will be in position to engage the collar of the whipstock so that subsequent raising of the drill stem will raise the whipstock with it.

The above operations are essentially similar to those involved in the operation of the device of said application Serial No. 366,113, and no claim is made thereto in the present application.

The present improvements relate to matters of auxiliary consideration in carrying out the above. During the periods of rotation, both involved in the setting of the whipstock and the subsequent drilling, circulation of mud occurs and the retrieving sub is subjected to this circulation throughout quite extended periods. Quite large hydrostatic pressure differences may occur in the apparatus between, for example, the passage 8 and the exterior of the drill stem due to restricted passages through the bit and the throttling of flow, particularly at the bit during drilling when a relatively large quantity of mud is being recirculated. Such a pressure difference if permitted to produce a flow past the various operating parts of the retrieving sub, will very rapidly wear these parts, since the solid materials carried by the mud are generally highly abrasive. Without adequate protection, for

example, such flow of mud would wear away the engaging members 22 by passing between them and their clearances with the walls of the slots in which they are located, and additionally mounting parts of a movable member such as 44 would be badly worn. Furthermore, it is possible under such circumstances for sediment to pack in the spring chambers or the like to such extent as possible to prevent the springs from performing their intended functions.

In the present construction, the packing 42, located where the sleeve 34 seats within the bore 8 and the cups 48 and 58 completely protect the moving portions of the device against the hydrostatic pressure differences between the inside and outside of the sub. A relatively small pressure gradient will exist between the upper and lower ends of the channels 18, but neglecting this as a first approximation, it will be seen that the major pressure existing in the bore 8 and these channels will be applied to the insides of the cups 48 and 58, which, properly fitting the bores of the sleeves 34 and 36, respectively, will resist any infiltration of mud to the region about the latches 56 from which it might pass to the exterior of the sub about the engaging members 22. These packing cups 48 operate in usual fashion, with the result that increase in pressure tends merely to force them more tightly into engagement with the bores in which they slide.

In view of the existence of some pressure gradient in the channels 18, it is desirable to insure that this pressure gradient cannot act to tend to trip the device and permit engaging members 22 to move outwardly. To avoid this, not only is the pressure within the channels applied to the opposite ends of the plunger 44 in balanced fashion, but the inside diameter of the sleeve 30 is made slightly greater than the inside diameter of the sleeve 34, so that, even though the pressure within the sleeve 30 may be somewhat less than that existing above the packing 48, there is a net pressure upwards aiding the spring 52 to hold the latching means in engagement. These differences in diameter will take care of any increased gradients due to increased rates of flow. The channels 18 are, of course, made as large as possible so that the gradient between the two ends of the plunger in pounds per square inch will be a minimum.

The modification of Figure 4 resembles to a considerable extent that of Figures 1, 2 and 3. The sub body in this case, indicated at 70, is provided with upper and lower sockets 72 and 74, respectively, adapted for the same attachments as the sockets 4 and 6 of the previously described modification. The bore 76 extending from the socket 72 communicates with the bore 78 extending from the socket 74 through side channels connected to the bores by passages 80 and 82, respectively. These channels communicate also with an intermediate region of the bore 76 through smaller passages 83 to effect a pressure balance. Pivoted loosely at 84, as in the previous modification, are engaging members 86 carrying copper or other soft metal rivets 88 and being urged outwardly by a spring or a plurality of springs, as indicated at 90. A mounting member 92 is secured in the bore 76 by means of threaded pins 94, and is surmounted by a packing cup 96, which is clamped by means of a nut 98 forming the lower abutment for a pressure spring 100 which at its upper end engages and forces upwardly the head of a plunger 102, which passes through a stuffing box 104 formed in the

lower end of the member 192. The plunger 102 carries a head 106 fitting loosely within the bore 76, which is provided with an extension having transverse beveled members 108 engageable by the latching extensions 110 of the engaging members 86.

It will be evident from the described construction of this modification that its operative functions are essentially identical with those of the other modification. In the present case, the passage of any mud by the member 92 is prevented by the cup 96. It will be evident that in this case the pressure gradient across the member 92 will be essentially the entire difference in pressure existing between the bore 76 and the portion of the bore hole outside the sub. The stuffing box 104 and the cup 96 resist this pressure, though, as will be evident, it exerts on the plunger 102 a net downward pressure equal to the pressure in pounds per square inch multiplied by the cross-sectional area of the portion of 102 where it passes through the stuffing box 104. Openings 105 insure equalization of pressure between the upper and lower faces of the member 106. The plunger 102, however, may be of relatively small diameter where it passes through the stuffing box, and in this modification the spring 100 is made sufficiently strong to prevent any tripping of the latches by reason of the existing pressure gradient.

Besides the features above described, it will be noted that both modifications have in common a construction involving a removable assembly of the plunger parts, i. e., in the modification of Figure 1 upon withdrawal of the pin 36, the sleeve 34, the spring and all the movable parts may be removed as a unit. Likewise, in the modification of Figure 4 by removal of the pins 94, the spring member 92 and all the removable parts may be removed together.

What I claim and desire to protect by Letters Patent is:

1. Means for effecting removal of a whipstock or the like from a bore hole comprising a body arranged to be included in a drill string above a bit, means carried by said body and expandible outwardly to engage and lift a whipstock or the like with the drill string, spring means urging said expandible means outwardly, and means for latching said expandible means inwardly against said spring action, the last mentioned means comprising a sleeve member mounted in a bore in said body exposed to entrance of mud under pressure during drilling, a plunger slidable axially in said sleeve, packing between said plunger and sleeve, packing between said sleeve and the walls of the bore in which it is located, and spring means reacting between said plunger and sleeve member, said plunger being engageable with said expandible means to effect said latching action, and said sleeve, plunger, and last named spring means being removable from the body as a unit.

2. Means for effecting removal of a whipstock or the like from a bore hole comprising a body arranged to be included in a drill string above a bit, means carried by said body and expandible outwardly to engage and lift a whipstock or the like with the drill string, and means for controlling said expandible means, the last mentioned means comprising a sleeve member mounted in a bore in said body exposed to entrance of mud under pressure during drilling, a plunger slidable axially in said sleeve, packing between said plunger and sleeve, packing between said sleeve and the walls of the bore in which it is located,

and spring means reacting between said plunger and sleeve member, said plunger serving by its movement to control said expandible means, and said sleeve, plunger, and last named spring means being removable from the body as a unit.

3. Means for effecting removal of a whipstock or the like from a bore hole comprising a body arranged to be included in a drill string above a bit, means carried by said body and expandible outwardly to engage and lift a whipstock or the like with the drill string, and means for controlling said expandible means, the last mentioned means comprising a plunger, means for guiding said plunger for axial movements within said bore, means for packing the plunger within its guiding means, and spring means for urging said plunger in one direction, said plunger being exposed to mud pressure during drilling at both of its ends and presenting thereat areas subject to the pressure such that said pressure results in a net application of force to the plunger tending to move it in the same direction as said spring means.

4. Means for effecting removal of a whipstock or the like from a bore hole comprising a body arranged to be included in a drill string above a bit, means carried by said body and expandible outwardly to engage and lift a whipstock or the like with the drill string, and means for controlling said expandible means, the last mentioned means comprising a plunger, means for guiding said plunger for axial movements within said bore, means for packing the plunger within its

guiding means, and spring means for urging said plunger upwardly, said plunger being exposed to mud pressure during drilling at both of its ends and presenting to the pressure a larger area at its lower end than at its upper end so that said pressure results in a net application of force to the plunger tending to move it upwardly, said plunger being adapted to be moved downwardly by the action of a go-devil thereon.

5. Means for effecting removal of a whipstock or the like from a bore hole comprising a body arranged to be included in a drill string above a bit, means carried by said body and expandible outwardly to engage and lift a whipstock or the like with the drill string, spring means urging said expandible means outwardly, and means for latching said expandible means inwardly against said spring action, the last mentioned means comprising a plunger, means for guiding said plunger for axial movements within said bore, means for packing the plunger within its guiding means, and spring means for urging said plunger in one direction, said plunger being engageable with said expandible means to effect said latching action and said plunger and expandible means having cooperating relatively slidable surfaces so that forced inward movement of said expandible means serves to cam said plunger against the action of the last named spring means to effect said latching action after predetermined inward movement of the expandible means.

GOTTDANK L. KOTHNY.