

Jan. 14, 1941.

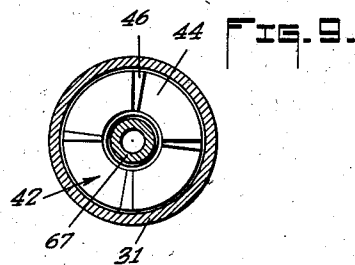
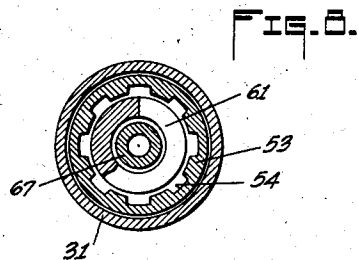
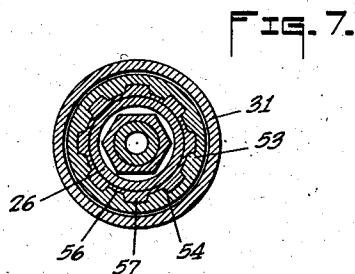
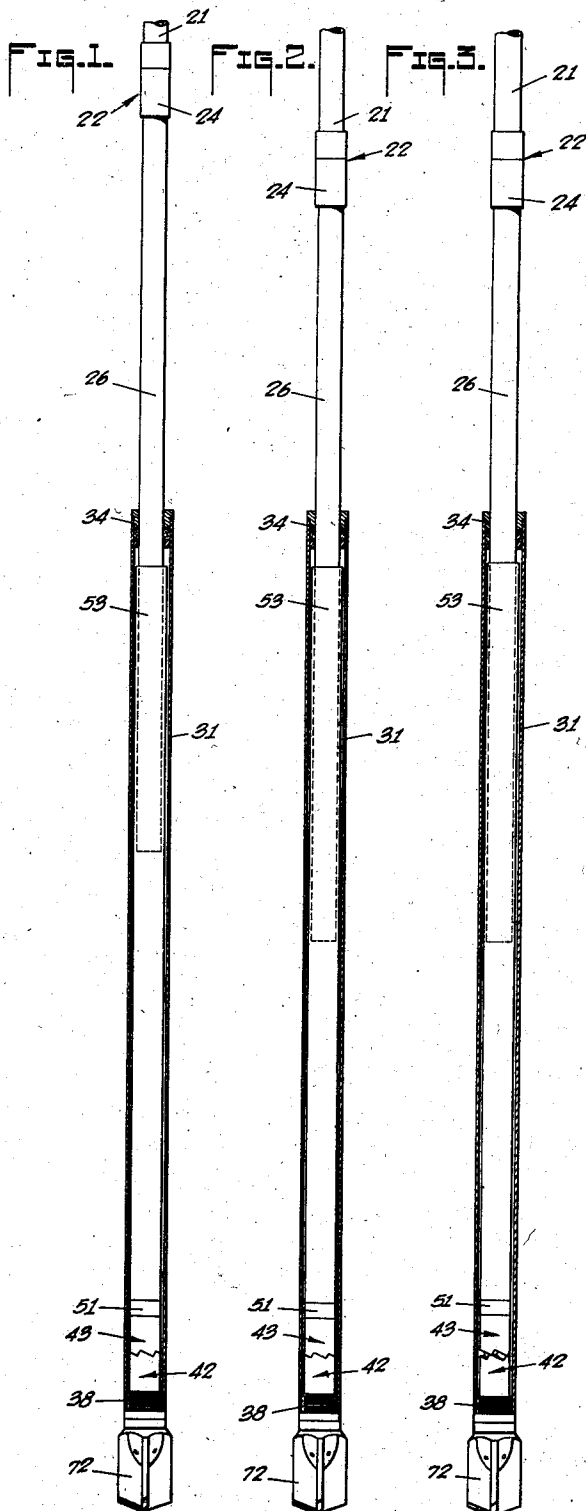
G. E. PREBENSEN

2,228,482

DRILL BIT

Original Filed June 18, 1937

3 Sheets-Sheet 1



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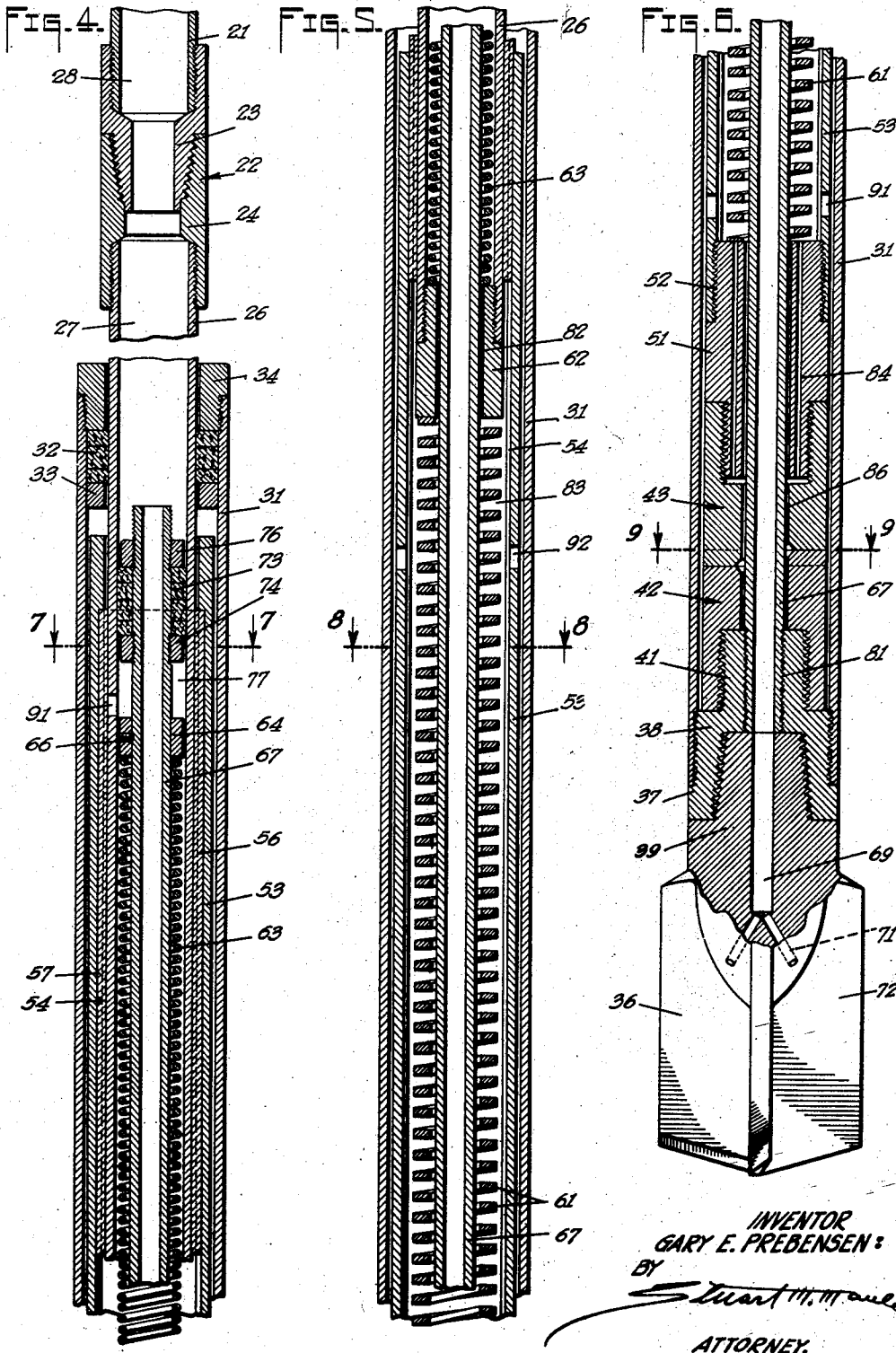
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DRILL BIT

Original Filed June 18, 1937 3 Sheets-Sheet 2



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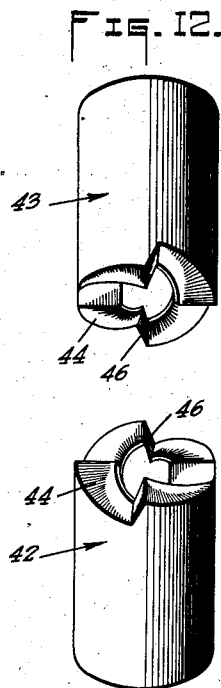
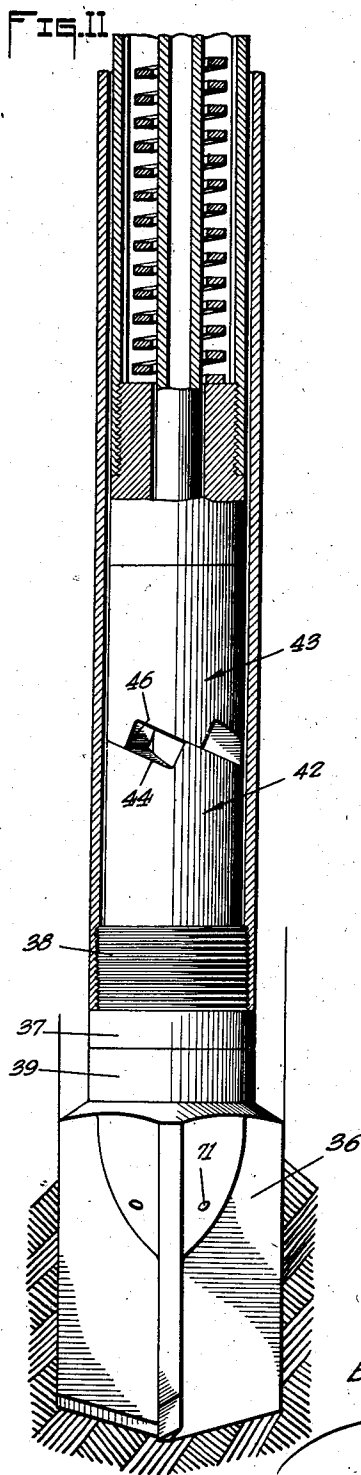
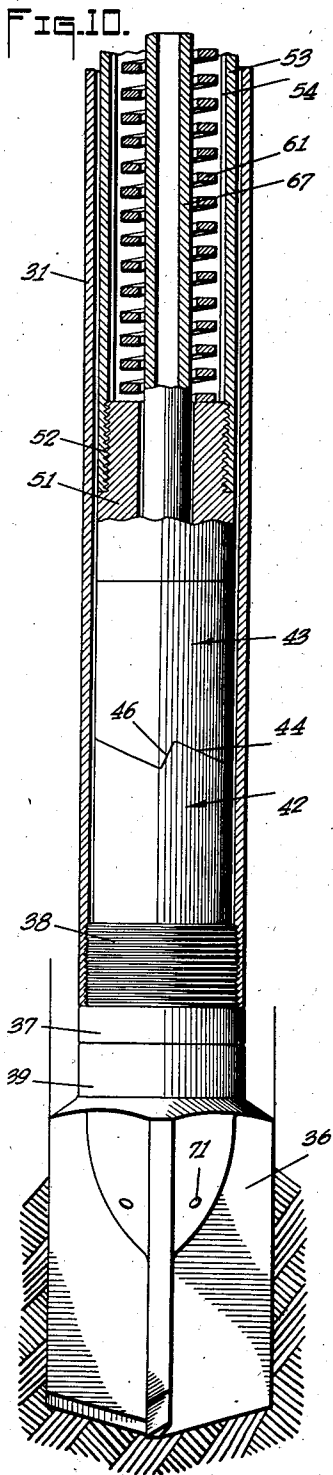
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G. E. PREBENSEN

2,228,482

DRILL BIT

Original Filed June 18, 1937 3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,228,482

DRILL BIT

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Application June 18, 1937, Serial No. 148,942
Renewed June 3, 1940

16 Claims. (Cl. 255—61)

This invention relates to drilling bits of the type commonly employed for drilling oil wells, and has for an object the provision of a drill of improved design through the use of which the drilling of an oil well or similar deep hole through different types of formations and under various conditions of operation is greatly facilitated and expedited, and made materially less expensive and generally more advantageous than has been possible when using any of the various types of drilling bits which heretofore have been available.

A more detailed object of the present invention is the provision of a well-drilling bit which is capable of operating according to the well-known "rotary" principle or, when occasion demands, is converted to operate in accordance with the principle of percussion, i. e., according to the principle of drilling wherein a formation is shattered and chipped away as the result of the imposition of a heavy and abrupt blow or percussive force upon the drill.

Another object is to provide a drilling apparatus of the character described which is self-regulating to the extent that as long as the bit is operating in that type of formation which is most easily eroded by rotary action, the bit will rotate; but as the bit encounters harder material, a part of the rotative energy imparted to the bit by the drill stem is translated into percussive energy to be exerted by the bit against the formation.

It is another object in this same connection, therefore, to provide a bit, the action of which is made manifest to the drilling operator, so that he is kept constantly informed of the character of the formation being drilled.

A further object of the present invention is to provide a drilling tool of the character described, which, while being capable of imposing a very heavy shock, or percussive force, upon the bit, is also provided with means for adequately cushioning the drill stem and rotary of the drilling apparatus from the reaction forces which necessarily are set up in that portion of the tool which strikes the bit in order to develop the desired percussive forces.

A still further object is to provide, in a drill tool of the character described, means whereby the bit is frequently lifted from the bottom of the hole or, if not actually so lifted, the pressure of the bit on bottom so greatly relieved that circulation fluid is given increased opportunity to wash under and past the cutting edges of the bit, for the manifold purpose of cooling those cutting edges and washing away the detritus and

thus avoiding the tendency of the bit to "ball up."

Yet another object is to provide a rotary drilling bit wherein is provided means for precluding all possibility of "twisting off" the drill stem or otherwise damaging the drilling apparatus should the bit become so firmly stuck in the formation that its continued rotation is impossible.

A still further object is to provide a drilling tool by the use of which the tendency to drill away from vertical is reduced to a minimum.

Simplicity of construction, economy of manufacture and maintenance, and sufficient durability to insure prolonged and heavy use are other desiderata which have been taken into consideration in the design of the drilling tool of the present invention.

The invention possesses other objects and features of advantage, some of which, with those enumerated, will be set forth in the following description of the particular embodiment of my invention which is illustrated in the drawings accompanying and forming a portion of the specification. It is to be understood that I do not limit myself to the showing made by the said drawings and description, as I may adopt variations of the preferred form within the scope of my invention as set forth in the claims.

Referring to the drawings:

Fig. 1 is a view, partially in side elevation and partially in vertical section, of a drilling bit embodying the principles of the present invention. The parts are in the respective positions assumed thereby while the weight of the bit is suspended upon the drill stem.

Fig. 2 is a view similar to Fig. 1, but showing the bit with the parts in the respective positions assumed thereby after a portion of the weight of the bit has been imposed upon the bottom of the hole being drilled.

Fig. 3 is another view similar to Fig. 1 but showing the cam element separated.

Figs. 4, 5 and 6 are enlarged vertical medial sectional views showing the upper, middle and lower portions, respectively, of a bit embodying the principles of the present invention. These views are in reality a single view broken into three sections.

Fig. 7 is a transverse sectional view, taken upon the line 7—7 of Fig. 4, with the direction of view as indicated.

Fig. 8 is a transverse sectional view taken upon the line 8—8 of Fig. 5, with the direction of view as indicated.

Fig. 9 is a transverse sectional view taken upon

the line 9—9 of Fig. 6, with the direction of view as indicated.

Fig. 10 is a view similar to Fig. 6 but showing the cam elements in side elevation and in their most closely interconnected position.

Fig. 11 is a view similar to Fig. 10 but showing the cam elements in a greater degree of separation.

Fig. 12 is a perspective view of the cam elements alone.

The drawings illustrate one embodiment of the present invention operatively connected to the lower end of a drill stem 21 by any suitable means, such as a tool joint 22 comprising threadedly interconnected pin and box members 23 and 24 respectively. Secured to the lower end of the box member 24 is a relatively long tube 26, the bore 27 of which is at all times in communication with the bore 28 of the drill stem 21, inasmuch as both the pin 23 and the box 24 of the tool joint 22 are hollow. The major portion of the tube 26 is telescopically disposed within a cover tube 31 and suitable packing 32 establishes a fluid-tight seal between the cover tube 31 and the tube 26 which, for the sake of convenience, will hereinafter be termed the "telescoping tube." Packing 32 is confined between a retaining ring 33 rigid with the cover tube 31 and a gland nut 34 threaded into the upper end of the cover tube.

The cover tube 31 extends substantially throughout the entire length of the drill, its lower end being rigidly connected to the drilling bit 36, preferably by being threadedly engaged upon the box member 37 of the coupling 38, the pin member 39 of which is preferably an integral portion of the bit 36.

The box member 37 is provided with an upwardly extending threaded pin 41, by means of which the lower cam member 42 is rigidly screwed to the coupling 38 and hence to the pin 36. Cooperatively associated with the lower, or anvil, cam 42 is an upper or hammer cam 43. These cams 42 and 43 are best shown upon Figs. 10 to 12, inclusive. Each is preferably provided with a plurality of sloping surfaces 44 terminating in an abrupt shoulder 46 on each cam member 42, 43. The sloping surfaces 44 all slope in the same direction around the axis of that cam member. The teeth 44, 46 of the other member are complementarily formed so that when the cam members 42, 43 are in their position of most intimate engagement (Fig. 10), the two cam elements fit nicely together. Rotary drilling normally being accomplished by a rotary motion of the drill in a clock-wise direction, the parts are so arranged that when the upper, hammer cam member 43 turns in a clock-wise direction with respect to the lower, anvil cam, the sloping surfaces of the upper cam member 43 will slide upon the sloping surfaces of the lower cam member, raising the upper cam member 43 away from the lower cam member 42 (Fig. 11). This will continue until the crests of the teeth of the upper cam member pass the crests of the teeth of the lower cam member, whereupon the upper, hammer cam 43 will drop forcibly upon the lower cam 42, imparting (by means of its weight and spring elements to be described hereinafter) a severe blow or percussive force to the lower anvil cam 42, which percussive force is transmitted directly to the bit 36.

Secured to the upper end of the upper cam member 43 is a coupling 51 to which is rigidly secured as by threads 52 a tube 53, the bore of which is provided with splines 54. These splines 54 provide means for connecting the tube 53 with

the telescoping tube 26 in such a manner that the two tubes are locked together for rotation but for free telescoping movement with respect to each other, preferably the tube 26 being disposed inside the tube 53. Whereas any suitable means for establishing the splined interconnection between these two tubes 26 and 53 may be employed, the embodiment shown utilizes a suitable length of tubing 56 which is rigidly secured to the outside of the telescoping tube 26 as by being shrunk thereon. Splines 57 complementary to and slidably engaged with the splines 54 of the tube 53 are formed upon the outer surface of the tube 26. Hence it becomes apparent that whereas a limited degree of vertical movement of the drill stem 21 is permitted without corresponding vertical movement of the upper cam 43 although the cam 43 is caused to rotate at all times with the drill stem 21.

However, any lowering movement of the drill stem 21 with respect to the upper cam 43 is resisted by a relatively heavy coil spring 61 which is under compression between the coupling 51 and any suitable means, such as a threaded pin 62, providing an abutment rigid with the lower end of the telescoping tube 26. This same threaded pin 62 also provides a convenient abutment for the lower end of another compression spring 63, the upper end of which is continually pressing upwards against the adjustable collar 64. This collar 64 is adjustably secured, as by a suitable set screw 66 adjacent the upper end of the tube 67, which is suitably disposed inside the telescoping tube 26. Moreover, the tube 67 is open at its upper end to the bore of the telescoping tube 26, so that the circulation fluid which is provided at relatively high pressures within the bore 28 and the drill stem is at all times available within the bore of the tube 67 also. Consequently this tube will hereinafter be termed the "circulation tube." It communicates at its lower end (see Fig. 6) with the bore of the coupling 38, and thence with a suitable axial hole 69 in the bit 36. From the hole 69 preferably a plurality of orifices 71 conduct the circulation fluid to the exterior of the bit 36, delivering the fluid preferably between the flukes 72 in the conventional manner. Inasmuch as vertical movement of the circulation tube 67 with respect to the telescoping tube 26 occurs when the upper cam 43 rides over the lower cam 42, suitable packing means 73 are interposed between the telescoping tube 26 and the circulation tube 67, this packing 73 being compressed between suitable compression rings 74 and 76 threadedly engaged upon the circulation tube 67 adjacent its upper end. This prevents the leakage of circulation fluid into the chamber 77 between the circulation tube 67 and the telescoping tube 26. It is within this chamber 77 that the compression spring 63 is disposed. Inasmuch as this compression spring 63 is at all times pressing upwards against the collar 64 which is rigid with the circulation tube 67, this tube is at all times urged upwards with respect to the same member (the threaded pin 62 which is secured to the lower end of the telescoping tube 26) as that against which the upper end of the larger spring 61 presses. The lower end of the circulation tube 67 being rigidly connected as by threads 81 to the coupling 38, the effect of the spring 63 is to pull the lower cam member 42 upwards against the upper cam member 43, whereas the effect of the lower spring 61 is to press the upper cam 43 downward against the lower cam 42.

As stated, the upper side of the chamber 77 is closed by the packing 73. The pin 62 against which the spring 63 presses has a bore 82 loose enough to present a material degree of clearance between the pin 62 and the outer circumference of the circulation tube 67, hence communication is established at all times between the chamber 77 and the chamber 83 immediately therebelow, within which the larger spring 61 is disposed. Both these chambers are kept filled with a suitable lubricant which is permitted to penetrate to the cam surfaces through the expedient of suitable oil holes 84 extending longitudinally through the coupling 51 and through the bore 86 of the cam members 42 and 43, which is sufficiently larger than the outer circumference of the circulation tube 67 to permit such oil penetration. This same body of lubricant also is permitted to penetrate to the splines 54, 56, through the expedient of an oil hole 91 in the wall of the telescoping tube 26 adjacent the upper end of the chamber 77; and lubricant is also permitted to penetrate to the space between the cover tube 31 and the tube 53 by means of an oil hole 92 in the tube 53, preferably adjacent the upper end of the chamber 83.

It becomes apparent, therefore, that the drilling tool of the present invention comprises a body made up of upper and lower body portions, i. e., of upper and lower cams 43 and 42, respectively, which are continually urged into engagement with each other by the springs 61 and 63. The parts are so disposed that, although the engaging surfaces of these cams are inclined, the springs force them together with sufficient pressure to cause the bit 36 to be turned by the upper part of the body, which of course is rotated in the conventional manner by the drill stem 21 being connected thereto by the splines 54 and 56 and the telescopic tube 26 as explained hereinabove. Accordingly, when the drill is being operated, in fairly loose material, such as oil sand, gravel or the like, offering comparatively little resistance to the rotation of the bit 36, the bit will rotate in the same manner as a conventional fishtail or similar drilling bit. However, when harder material or other type of formations offering greater resistance to rotation of the bit is encountered, the tendency will be developed for the bit and the lower or anvil cam 42 to remain stationary and for the upper part of the body of the bit to rotate with respect thereto. Obviously, this tendency is resisted by the spring 61, but when the force-resisting rotation of the bit 36 becomes sufficient to reduce the speed at which the bit 36 rotates to less than that at which the drill stem is rotating, the cams of the upper portion 43 of the body of the drill will ride upwards along the inclined surfaces of the cam of the lower part of the body 42 (see Fig. 11) until the crests of the upper cams pass the crests of the lower cams, at which time the spring 61 will force the upper part 43 of the body downward with great force and considerable speed, causing the upper part of the body to strike the lower part and thus developing a large percussive force, tending to drive the cutting edges of the bit 36 into the formation. This action causes the bit to develop a shattering and chipping action which is most effective in eroding hard material such as rock. The bit has proven to be highly effective when sloping strata of hard materials are encountered. The result of encountering such sloping strata with an ordinary rotary bit is to cause the bit to be deflected from the

vertical, to follow the slope of the hard stratum. However, when the bit of the present invention encounters such a hard stratum, the cutting edges at just one side of the bit will first encounter that hard material, causing the bit immediately to be slowed in its rotative movement, bringing the hammering or percussive action of the cam into play which, as explained, produces the chipping and gouging action of the cutting edges of the bit against the sloping stratum. This occurs before the bit has been given opportunity to deflect from the true vertical, i. e., when the body of the bit is still guided in a vertical hole, and inasmuch as the operator is advised of the type of stratum which his bit has encountered, he is given the opportunity to slow down the rate at which the draw works pays out cable to lower the drill stem, thus permitting the now chipping bit to penetrate the sloping surface of the hard stratum before time is allowed for it to be deflected by that stratum from the vertical.

Another advantage of the bit of the present invention is that when the crests of the cams pass each other, both the springs 61 and 63 are permitted to expand for an instant, i. e., until the upper cam again reaches its lowermost seat against the lower cam. Of course, the pin 62 against which both springs push is not permitted to move upwards, because of the fact that it is held at its then elevation by being rigidly connected to the lower end of the drill stem; hence the only effect of the spring 61 is to push the upper portion 43 of the body rapidly downward toward the lower portion 42. The spring 63, however, being at all times under compression between the pin 62 and the collar 66, is given an instantaneous opportunity to push the collar 66 upward, carrying with it the circulation tube 67 and the lower portion 42 of the body, to which the tube 67 is connected. This either raises the bit 36 slightly from the bottom of the hole or, if not actually so raising it, relieves the pressure with which the bit bears against the bottom of the hole sufficiently to permit an increased amount of circulation fluid to wash around the cutting edges; hence the cutting edges of the bit of the present invention are more adequately cooled than in the case of the conventional fishtail bit and the detritus which otherwise tends to accumulate at and adjacent the cutting edges is more adequately washed away by the relatively rapidly moving fluid. Accordingly, the bit of the present invention has much less tendency to become overheated and to "ball up" than bits of more conventional design.

Being connected to drill stem to be rotated thereby only when the resistance to such rotation is less than that which can be overcome by the action of the springs 61 and 63, the bit 36, even if it should become firmly lodged in the formation being drilled so as to remain stationary, will not cause the "twisting off" of the drill stem. Instead, in all probability it will work itself loose, because of the then exceedingly rapid rate at which percussive blows would be imparted to the bit. Moreover, the operator, being informed of the fact that the bit is no longer rotating because the shock of each percussion is made manifest to him, both by sound and by feel, will permit no further pay-out of drill stem until the bit has chipped its way clear again.

Although as stated the shock of each percussion is transmitted to a certain degree through the entire length of the drill stem, thus keeping

the operator informed of the character of the formation being drilled, this shock is not so great as to endanger the crystalline structure of the material of which the drill pipe and rotary are constructed. Such shock is transmitted from the body of the drill to the drill stem, through the springs 61 and 63, which therefore act in the capacity of shock absorbers, diminishing this reactive force to a very great degree.

The respective strengths of the two springs 61 and 63 are such that the drill is self regulating, at least to a certain measure. Regardless of the manner in which the drilling operator controls the rate at which the drill stem is lowered, the drill will compensate for variation in the character of the formation being drilled. As stated, when drilling through soft material, the bit will freely rotate, and when harder material is encountered, the bit will itself, and without any effort on the part of the operator, develop the percussive "chipping" action of the bit so that the drilling in that type of material progresses with the type of motion of the bit which is most advantageous in eroding that particular type.

I claim:

1. In a drilling tool, a body, coupling means for attaching one end of said body to a drill stem, a bit carried at the other end of said body, said body comprising a driving portion connected to said coupling means to be rotated thereby as said drill stem rotates and a driven portion connected to said driving portion but revoluble with respect thereto, inter-engaging upper and lower cams interposed between said two portions whereby said driven portion is rotated with said driving portion so long as longitudinal movement of either portion with respect to the other is prevented, yielding means pressing said upper cam downwards against said lower cam, and yielding means pressing said lower cam and bit upwards toward said upper cam and tending to lift said bit just after the passage of the crests of the cams past each other.

2. In a drilling tool, a body comprising a lower, driven portion, means for securing a bit to the lower end thereof, and cam-means on the upper end of said lower body portion, and an upper, driving portion, cam-means on the lower end thereof interengaged with said first-mentioned cam-means whereby said driven portion is rotated by said driving portion so long as they are not permitted to separate, a tube rigid with said upper body portion, another tube telescopically engaged therewith, spline means interconnecting said tubes for rotation together and longitudinal movement with respect to each other, means for connecting said second mentioned tube to a drill stem, and resilient means under compression between said second mentioned tube and said upper body portion.

3. In a drilling tool, a body comprising a lower, driven portion, means for securing a bit to the lower end thereof, and cam-means on the upper end of said lower body portion, and an upper, driving portion, cam-means on the lower end thereof interengaged with said first-mentioned cam-means whereby said driven portion is rotated by said driving portion so long as they are not permitted to separate, a tube rigid with said upper body portion, another tube telescopically engaged therewith, spline means interconnecting said tubes for rotation together and longitudinal movement with respect to each other, means for connecting said second mentioned tube to a drill stem, means providing an abutment rigid with the

lower end of said second mentioned tube, and a spring under compression between said upper body portion and said abutment.

4. In a drilling tool, a body comprising a lower, driven portion, means for securing a bit to the lower end thereof, and cam-means on the upper end of said lower body portion, and an upper driving portion, cam-means on the lower end thereof interengaged with said first-mentioned cam-means whereby said driven portion is rotated by said driving portion so long as they are not permitted to separate, a tube rigid with said upper body portion, another tube telescopically engaged therewith, spline means interconnecting said tubes for rotation together and longitudinal movement with respect to each other, means for connecting said second mentioned tube to a drill stem, means providing an abutment rigid with the lower end of said second mentioned tube, a spring under compression between said upper body portion and said abutment, a tension tube secured at its lower end to said lower body portion, and extending upwards through said upper body portion and through said abutment, means providing an abutment rigid with said tension tube, and a spring under compression between said two abutments.

5. In a drilling apparatus, a drill column adapted to be extended into a well and rotated therein, a bit carried thereby, resilient means interposed between said column and said bit and transmitting weight of said column to said bit, means actuated by said column in rotating for imparting percussion to said bit, tension means connected to said bit and extending upwards therefrom, and a spring interposed between said drill column and said tension means and pulling said bit upwards toward said column.

6. In a drilling tool, a body portion adapted to be extended into a well and rotated therein, a bit carried by said body portion in position to be rotated thereby against the bottom of said well, means within said body portion and actuated by rotation thereof for imparting percussion to said bit, and means within said body portion providing a reservoir for lubricating oil, said reservoir being in communication with said percussion-imparting means whereby said percussion-imparting means are flooded in a bath of oil at all times during operation of said drilling tool.

7. In a drilling tool, a body portion adapted to be extended into a well and rotated therein, a bit carried by said body portion in position to be rotated thereby against the bottom of said well, means within said body portion and actuated by rotation thereof for imparting percussion to said bit, means within said body portion providing a reservoir for lubricating oil, said reservoir being in communication with said percussion-imparting means whereby said percussion-imparting means are flooded in a bath of oil at all times during operation of said drilling tool, and means providing a by-pass for conducting circulation fluid past said reservoir and percussion-imparting means to said bit without contaminating said lubricating oil.

8. In a drilling apparatus, a drill column adapted to be extended into a well and rotated therein, a tubular housing suspended on the lower end thereof, a drilling bit, means for mounting said bit upon the lower end of said housing, said bit being movable both axially and revolubly with respect to said drill column, cooperating upper and lower cam members disposed within said housing, said upper cam member being carried

by said drill column and said lower cam member being rigid with said bit, and resilient means urging said cam members yieldably against each other whereby the lower cam member and bit are urged to rotate by said upper cam member but said cam members are permitted to move away from each other and override when said upper cam member rotates with respect to the lower, lubricant within said housing and flooding said cam members, and packing means sealing said housing against flow of liquid into or out of said housing.

9. In a drilling apparatus, a drill column adapted to be extended into a well and rotated therein, a tubular housing suspended on the lower end thereof, a drilling bit, means for mounting said bit upon the lower end of said housing, said bit being movable both axially and revolubly with respect to said drill column, cooperating upper and lower cam members disposed within said housing, said upper cam member being carried by said drill column and said lower cam member being rigid with said bit, and resilient means urging said cam members yieldably against each other whereby the lower cam member and bit are urged to rotate by said upper cam member but said cam members are permitted to move away from each other and override when said upper cam member rotates with respect to the lower, lubricant within said housing and flooding said cam members, packing means sealing said housing against flow of liquid into or out of said housing, and means providing a by-pass for conducting circulation fluid from said drilling column past said cam members to said bit without contaminating said lubricant.

10. In a drilling apparatus, a drill column adapted to be extended into a well and rotated therein, a tubular housing suspended on the lower end thereof, a drilling bit, means for mounting said bit upon the lower end of said housing, said bit being movable both axially and revolubly with respect to said drill column, cooperating upper and lower cam members disposed within said housing, said upper cam member being carried by said drill column and said lower cam member being rigid with said bit, and resilient means urging said cam members yieldably against each other whereby the lower cam member and bit are urged to rotate by said upper cam member but said cam members are permitted to move away from each other and override when said upper cam member rotates with respect to the lower, and a spring interposed between said drill column and said bit and urging said bit upwards away from the bottom of said well.

11. In a drilling tool, a drill column, means providing an abutment rigid with the lower end thereof, a coupling, means connecting said coupling to said abutment to be rotated thereby but permitting relative axial movement therebetween, an upper cam rigid with said coupling, a lower cam cooperatively engaged therewith, and revoluble with respect thereto whereby said cams are enabled to override, a bit carried by said lower cam, a spring under compression between said abutment and said coupling whereby downward pressure of said column is imposed upon said bit except at the instant following overriding of the high points of said cams past each other, means rigid with said bit and extending therefrom past said abutment, and a spring under compression between said abut-

ment and said extending means to pull said bit upwards.

12. In a drilling tool, a drill column, means providing an abutment rigid with the lower end thereof, a coupling, means connecting said coupling to said abutment to be rotated thereby but permitting relative axial movement therebetween, an upper cam rigid with said coupling, a lower cam cooperatively engaged therewith and revoluble with respect thereto whereby said cams are enabled to override, a bit carried by said lower cam, a spring under compression between said abutment and said coupling whereby downward pressure of said column is imposed upon said bit except at the instant following overriding of the high points of said cams past each other, a tube rigid with said bit and extending upwards therefrom past said cams and abutment, said bit having a passage therein communicating with said tube and leading through said bit to deliver fluid to the working parts thereof and the upper end of said tube communicating with the bore of said column to conduct fluid to said bit therefrom, means providing an abutment adjacent the upper end of said tube, and a spring under compression between said abutments and urging said bit toward said drill column.

13. In a drilling tool, a drill column, means providing an abutment rigid with the lower end thereof, a tube having a splined connection with said abutment and extending downward therepast, a coupling rigid with the lower end of said tube, an upper cam rigid with said coupling, a lower cam cooperatively engaged therewith and revoluble with respect thereto whereby said cams are enabled to override, a bit carried by said lower cam, a spring under compression between said abutment and said coupling whereby downward pressure of said column is imparted to said bit except at the instant following overriding of the high points of said cams past each other, a circulation tube rigid with said bit and extending upwards therefrom through said cams and abutment, means on said circulation tube providing an abutment above said first mentioned abutment, and a spring under compression between said abutments.

14. In a drilling tool, a drill column, means providing an abutment rigid with the lower end thereof, a tube having a splined connection with said abutment and extending downward therepast, a coupling rigid with the lower end of said tube, an upper cam rigid with said coupling, a lower cam cooperatively engaged therewith and revoluble with respect thereto whereby said cams are enabled to override, a bit carried by said lower cam, a spring under compression between said abutment and said coupling whereby downward pressure of said column is imparted to said bit except at the instant following overriding of the high points of said cams past each other, a circulation tube rigid with said bit and extending upwards therefrom through said cams and abutment, means on said circulation tube providing an abutment above said first mentioned abutment, a spring under compression between said abutments, means closing the upper end of said splined tube and enclosing said second mentioned spring, said splined tube and said closing means therefor cooperating to define a reservoir, and lubricant within said reservoir.

15. In a drilling tool, a drill column, means providing an abutment rigid with the lower end thereof, a tube having a splined connection with said abutment and extending downward there-

past, a coupling rigid with the lower end of said tube, an upper cam rigid with said coupling, a lower cam cooperatively engaged therewith and revoluble with respect thereto whereby said cams are enabled to override, a bit carried by said lower cam, a spring under compression between said abutment and said coupling whereby downward pressure of said column is imparted to said bit except at the instant following overriding of the high points of said cams past each other, a circulation tube rigid with said bit and extending upwards therefrom through said cams and abutment, means on said circulation tube providing an abutment above said first mentioned abutment, a spring under compression between said abutments, means closing the upper end of said splined tube and enclosing said second mentioned spring, said splined tube and said closing means therefor co-operating to define a reservoir, and lubricant within said reservoir, said coupling having a passage therethrough whereby said lubricant is conducted to said cams.

16. In a drilling tool, a drill column, means providing an abutment rigid with the lower end thereof, a tube having a splined connection with said abutment and extending downward therepast, a coupling rigid with the lower end of said tube, an upper cam rigid with said coupling, a lower cam cooperatively engaged therewith and

revoluble with respect thereto whereby said cams are enabled to override, a bit carried by said lower cam, a spring under compression between said abutment and said coupling whereby downward pressure of said column is imparted to said bit except at the instant following overriding of the high points of said cams past each other, a circulation tube rigid with said bit and extending upwards therefrom through said cams and abutment, means on said circulation tube providing an abutment above said first mentioned abutment, a spring under compression between said abutments, means closing the upper end of said splined tube and enclosing said second mentioned spring, said splined tube and said closing means therefor cooperating to define a reservoir, lubricant within said reservoir, said coupling having a passage therethrough whereby said lubricant is conducted to said cams, a cover tube rigid with said bit and extending upwards therefrom past and enclosing said cams, coupling, splined tube and its closing means, and packing means sealing the upper end of said cover tube but permitting relative motions between it and said drill column, said splined tube and its closing means having openings therein for the flow of lubricant to the space between them and said cover tube.

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