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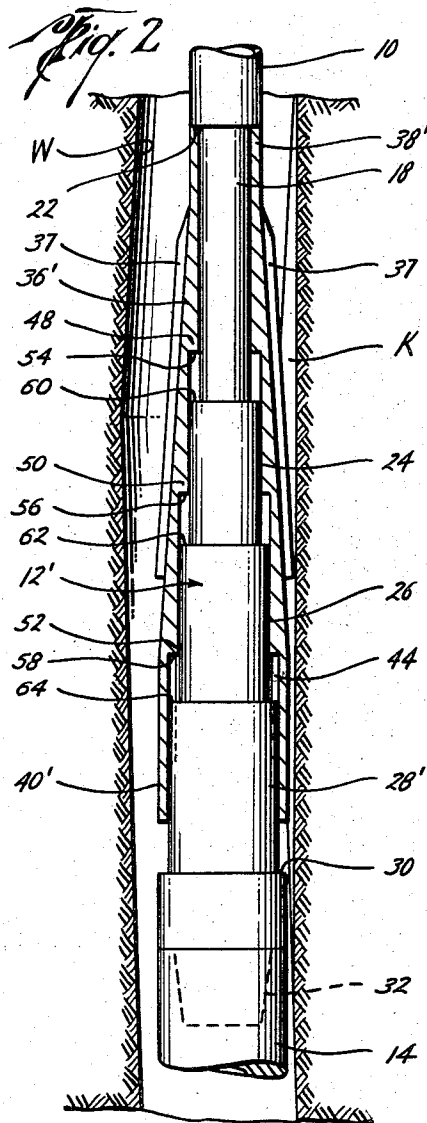
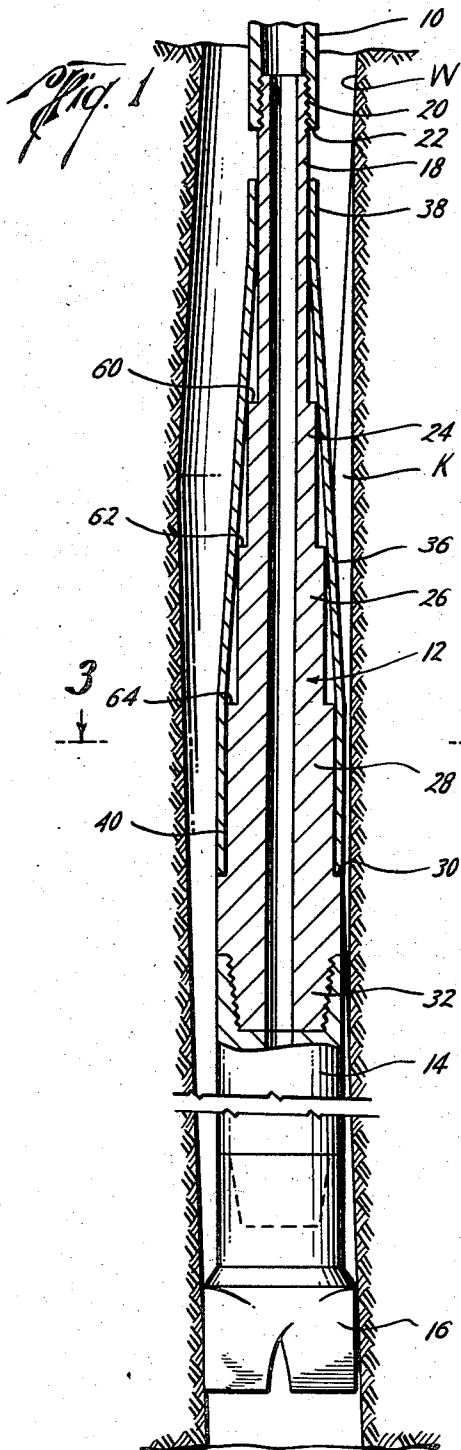
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GUIDE FOR DRILL COLLAR SUBS

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2 Sheets-Sheet 1



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Fig. 4

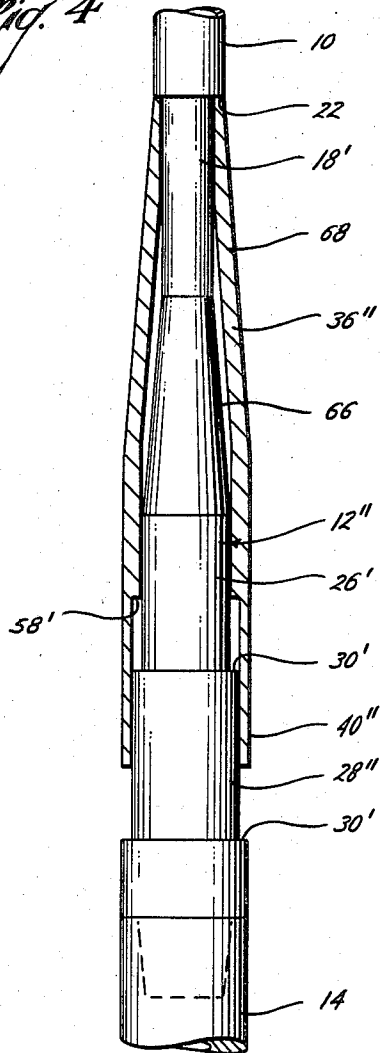


Fig. 5

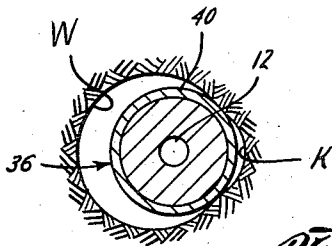
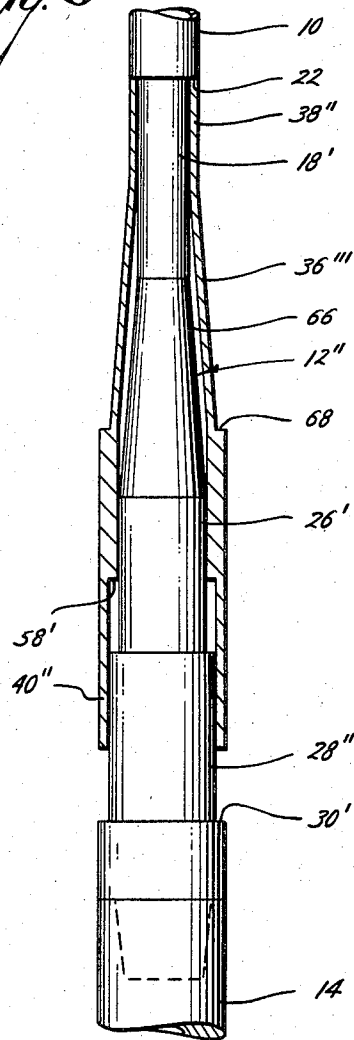


Fig. 3

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GUIDE FOR DRILL COLLAR SUBS

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3 Claims. (Cl. 255—28)

This invention relates to a guide for drill collar subs and more particularly to a device which is adapted to be applied to a drilling string used in the drilling of wells for the purpose of guiding a drill collar sub in said string past a formation in a well bore, such as a key seat or other obstruction therein.

In the carrying out of well drilling operations and especially in the drilling of oil wells it is customary to employ a drilling string to whose lower end a bit is attached by means of a drill collar and drill collar sub. The drill collar or collars in such a string is customarily of smaller external diameter than the bit and the string above the drill collar sub is of substantially smaller external diameter than the drill collar. Due to the fact that the bore of the well is usually not straight, the drill string often is in contact with the wall of the bore at some locations therein, which results in the formation of longitudinal grooves, commonly called key seats which are of substantially smaller diameter than that of the bore. The presence of such key seats in a well bore presents a serious difficulty in the removal of the drill string in that the string has a tendency to straighten out under its own weight and that of the drill collars and bit upon the exertion of an upward pull on the string, so that the drill collar sub or drill collar may enter the key seat and become stuck therein.

Heretofore, a drill collar sub has been frequently employed whose upper end is substantially of the same external diameter as that of the drill string and which is formed with a gradual taper to an external diameter substantially equal to that of the drill collar. A drill collar sub of this type has no abrupt changes in diameter and possesses the advantages of increased strength and resistance to breakage or twisting off under the stress encountered in the drilling operation. Because of its tapering shape, however, drill collar subs of this type have the disadvantage that they may easily enter and become wedged in a key seat causing the drill string to become stuck in the well bore. This disadvantage of the tapering drill collar sub has resulted in the abandonment of its use in many instances despite its obvious advantages of strength and durability.

The present invention has for an important object the provision of a guide for drill collar subs whereby the above disadvantage of a tapered drill collar sub may be overcome, and whereby a jarring action may be performed, if necessary to release the drill string in the event of sticking in a key seat.

Another object of the invention is to provide a guide for tapered drill collar subs whereby the advantages of a tapered sub may be secured without the attendant hazard of the same becoming stuck in the well bore.

A further object of the invention is the provision of a guide for drill collar subs, which permits the use of a tapered drill collar sub, said guide embodying a sleeve adapted to be mounted on the sub to permit relative longitudinal movement of the sub and sleeve and said sleeve having an external tapering surface positioned to operate

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as a guide to prevent the sticking of the sub in a key seat or other formation forming an obstruction in the well bore.

Another object of the invention is to provide a combined drill collar sub and guide therefor wherein the sub has a number of portions of different external diameters forming one or more external, annular, upwardly facing shoulders spaced apart longitudinally of the sub and the guide is of sleeve-like formation having one or more internal faces positioned for engagement with one or more of said shoulders to limit the relative longitudinal movement in one direction between the guide and sub.

A further object of the invention is the provision of a guide for drill collar subs which is of sleeve-like formation and relatively light construction and which has an external tapering surface positioned to serve as a guide to engage the wall of a well bore to guide the sub past a key-seat in the bore whereby sticking of the sub in the key-seat is prevented.

The above and other important objects and advantages of the invention may best be understood from the following detailed description constituting a specification of the same, when considered in conjunction with the annexed drawings, wherein—

Figure 1 is a vertical, cross-sectional view of a portion of a well bore showing a preferred embodiment of the invention in position therein and illustrating the manner in which the invention operates to guide a drill collar sub past a key seat in the bore;

Figure 2 is a view similar to that of Figure 1 illustrating a somewhat modified form of the invention;

Figure 3 is a cross-sectional view, taken along the line 3—3 of Figure 1, looking in the direction indicated by the arrows;

Figure 4 is a fragmentary, side elevational view, partly in cross-section of a somewhat different embodiment of the invention; and,

Figure 5 is a view similar to that of Figure 4 illustrating a further modification of the invention.

Referring now to the drawings in greater detail, the invention is illustrated in connection with its use with a tubular drilling string of the usual type, the numeral 10 designating a tool joint on the lower section of such a string, to the lower end of which a drill collar sub 12 is connected and which is in turn connected to one or more drill collars, such as that shown at 14 attached to a drilling bit 16 of conventional design.

The drilling string, made up in the manner described above is employed in the drilling of wells in the customary manner, the bore of such a well being illustrated at W in Figures 1, 2 and 3, with the string in position therein.

In the drilling of a well by the use of equipment of this kind key seats such as that shown at K are often produced, due to curvature of the well bore, which causes the drilling string to be rotated in contact with the wall of the bore thereby forming an elongated slot whose diameter is smaller than that of the well bore. When an upward pull is exerted on the drilling string, as when the same is being withdrawn from the well, the drilling string tends to straighten out under its own weight and that of the drill collars and bit, so that there is a tendency for the drill collar sub to enter such a key seat, which often results in the drill collar becoming wedged in the key seat.

In the present invention the drill collar sub 12 has an upper end portion 18 whose external diameter is somewhat smaller than the external diameter of the tool joint 10 and which may be externally threaded, as indicated at 20 for connection to the lower end of the drill pipe, whereby an external downwardly facing shoulder 22 is formed providing an upper impact face.

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Beneath the portion 18 the sub is formed with one or more portions, such as those indicated at 24, 26 and 28, which are of progressively larger external diameters, the lowermost portion 28 providing an upwardly facing shoulder 30 forming a lower impact face and being formed at its lower end with an externally threaded pin portion 32 for connection to the upper end of the drill collar 14. The sub, thus constructed and connected constitutes a mandrel whose upper end is smaller in external diameter than the tool joint 10 and whose lower end portion is of substantially the same external diameter as the drill collar to provide upper and lower longitudinally spaced, oppositely facing impact faces.

An external, sleeve-like, guide element 36 surrounds the sub 12 and is shaped to provide an external, longitudinally tapered surface, which terminates at its upper end in an end portion 38 whose external diameter is substantially equal to that of the tool joint 10 and at its lower end in an end portion 40 whose external diameter is substantially equal to the external diameter of the portion 28 of the sub below the shoulder 30 thereof. The guide element 36 is of substantially shorter length than the length of the sub between the upper and lower impact faces 22 and 30 and is free to rotate on the sub.

In making use of the invention, constructed and arranged as described above, the drilling string is lowered into the well bore in the condition shown in Figure 1. In the event that it becomes necessary to remove the drilling string from the well, the guide element forms a guide to prevent the sub from entering a key seat such as the key seat K, and becoming stuck or wedged therein, and since the guide is substantially as large as the drill collar 14 the drill collar is guided past the key seat without sticking therein. Should the guide element happen to become stuck or wedged in the key seat or some other obstruction in the bore, then the string may be lowered to cause the impact face 22 to engage the upper end of the sleeve to jar the sleeve downwardly out of the key seat.

It will also be apparent that by making the guide element of a length such that the lower end portion 40 does not move to a position above the portion 28 of the sub, sand, mud, or the like is prevented from becoming lodged or packed between the sleeve and sub because of the close fit between the portions 18 and 28 of the guide and the portions 38 and 40 of the sub, so that the guide element will rest upon the shoulder 30 during the operation of the equipment, in position to be engaged at its upper end by the upper impact face 22 in the event that the guide element should become stuck in a key seat.

A somewhat modified form of the invention is illustrated in Figure 2, wherein the guide element 36' has internal splines or teeth 44 within the lower end portion 40' thereof, which are in intermeshing engagement with external splines or teeth on the portion 28' of the sub 12', the splines of the guide and sub being of a length greater than the difference in length between the guide element and the distance between the impact faces 22 and 30 whereby the splines will be in engagement in all positions of the guide element on the sub, so that the guide element will always rotate with the sub. In this form of the invention the guide element may be provided with external lugs or teeth 37, whereby the guide element may be rotated to perform a reaming action in a key seat if desired. In Figure 2 the guide element 36' is shown in its uppermost position on the sub with the impact face 22 in contact with the upper end of the guide element, as when performing a downward jarring action on the guide element. The length of the guide element is such that the lower end of the same cannot move above the portion 28' of the sub 12' whereby mud or the like is prevented from lodging between the splines of the sub and guide element. If desired the guide element may be internally thickened, as at the locations 48, 50 and 52 to form internal downwardly facing shoulders 54, 56 and 58, which may

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be positioned to engage external upwardly facing shoulders such as those indicated at 60, 62 and 64, to limit downward movement of the guide element on the sub. The guide element may also be of a length such that the lower end of the guide element is in contact with or somewhat separated from the lower impact face 30 when the element reaches its lowermost position on the sub.

A further embodiment of the invention is illustrated in Figure 4, wherein the sub 12'' has a tapered portion 66. The guide element 36'' in this form of the invention has a thickened wall portion 68 which tapers at its upper end portion. By this arrangement the guide element may be made stronger and conforms at its inner surface to the external shape of the sub. This form of the invention is used in the same manner as described in connection with the form of the invention illustrated in Figure 1.

In Fig. 5, there is shown a still further modification of the invention, in which the sub is of the same configuration as that shown in Figure 4. The guide element 36''' of this form of the invention is provided with an external upwardly facing shoulder 68, which may serve as a wiping or cutting element upon upward movement of the guide element in a key seat.

In all forms of the invention the guide element serves as a guide to engage the wall of a well bore to guide the sub past a key seat therein, whereby the sub is effectively prevented from entering and becoming stuck or wedged in a key seat, and provides a means whereby the sub may be moved vertically in the event that the guide element should become stuck in such a formation to enable the guide element to be released.

The invention has been disclosed herein in connection with certain specific embodiments of the same, but it will be understood that these are intended by way of example only, and that various changes can be made in the construction of the parts without departing from the spirit of the invention or the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. Well drilling equipment comprising a tubular drill string, a drill collar sub connected to said string and a drill collar connected to said sub, said sub having an upper end portion whose external diameter is substantially smaller than the external diameter of the tool joints of the string to provide an external downwardly facing impact face on the lower end of the string and a cylindrically shaped lower end portion whose external diameter is substantially equal to the external diameter of the drill collar and whose upper end forms an external, annular, upwardly facing shoulder above the lower end of the sub, a tubular guide surrounding and movable longitudinally on the sub and having an upper end portion whose external diameter is substantially equal to the external diameter of said tool joints and whose internal surface is shaped to slidably fit the external surface of the upper end portion of the sub in all positions of the guide on the sub, and a lower end portion formed with an internal surface shaped to slidably fit the external surface of said cylindrically shaped portion and whose external diameter is substantially equal to the external diameter of said drill collar, said guide being formed with an internal annular shoulder positioned for engagement with said external shoulder to limit downward movement of the guide on the sub and being of a length substantially greater than the distance between said impact face and said external shoulder and such that the lower end of said guide is below said external shoulder in all positions of the guide on said sub.

2. Well drilling equipment comprising a tubular drill string, a drill collar sub connected to said string and a drill collar connected to said sub, said sub having an upper end portion whose external diameter is substantial-

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ly smaller than the external diameter of the tool joints of the string to provide an external downwardly facing impact face on the lower end of the string and a cylindrically shaped lower end portion whose external diameter is substantially equal to the external diameter of the drill collar and whose upper end forms an external, annular, upwardly facing shoulder above the lower end of the sub, a tubular guide surrounding and movable longitudinally on the sub and having an upper end portion whose external diameter is substantially equal to the external diameter of said tool joints and whose internal surface is shaped to slidably fit the external surface of the upper end portion of the sub in all positions of the guide on the sub, and a lower end portion formed with an internal surface shaped to slidably fit the external surface of said cylindrically shaped portion and whose external diameter is substantially equal to the external diameter of said drill collar, the external surface of said guide tapering upwardly between said upper and lower end portions of the guide and said guide being formed with an internal annular shoulder positioned for engagement with said external shoulder to limit downward movement of the guide on the sub and being of a length substantially greater than the distance between said impact face and said external shoulder and such that the lower end of said guide is below said external shoulder in all positions of the guide on said sub.

3. Well drilling equipment comprising a tubular drill string, a drill collar sub connected to said string and a drill collar connected to said sub, said sub having an upper end portion whose external diameter is substantially smaller than the external diameter of the tool joints of the string to provide an external downwardly facing impact face on the lower end of the string and a cylindrical-

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ly shaped lower end portion whose external diameter is substantially equal to the external diameter of the drill collar and whose upper end forms an external, annular, upwardly facing shoulder above the lower end of the sub, a tubular guide surrounding and movable longitudinally on the sub and having an upper end portion whose external diameter is substantially equal to the external diameter of said tool joints and whose internal surface is shaped to slidably fit the external surface of the upper end portion of the sub in all positions of the guide on the sub, and a lower end portion formed with an internal surface shaped to slidably fit the external surface of said cylindrically shaped portion and whose external diameter is substantially equal to the external diameter of said drill collar, the external surface of said guide tapering upwardly between said upper and lower end portions of the guide and said guide being formed with an internal annular shoulder positioned for engagement with said external shoulder to limit downward movement of the guide on the sub and being of a length substantially greater than the distance between said impact face and said external shoulder and such that the lower end of said guide is below said external shoulder in all positions of the guide on said sub, and external cutting means on said upwardly tapering surface of said guide.

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