Oct. 31, 1967 J. R. DOHERTY 3,349,455

DRILL COLLAR SAFETY SLIP

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Fig. 1

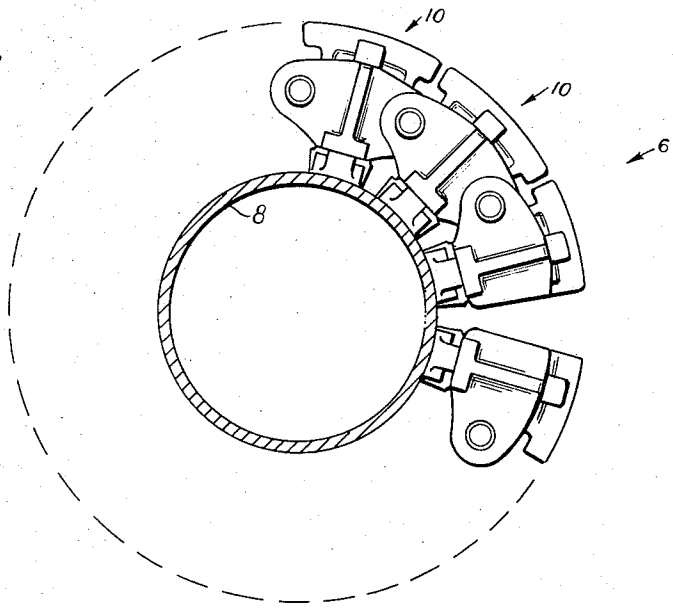


Fig. 2

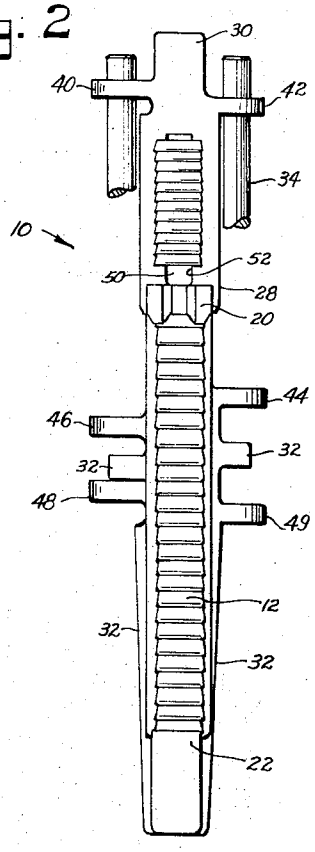
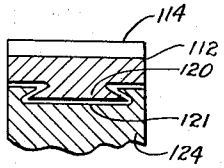


Fig. 7



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Fig. 3

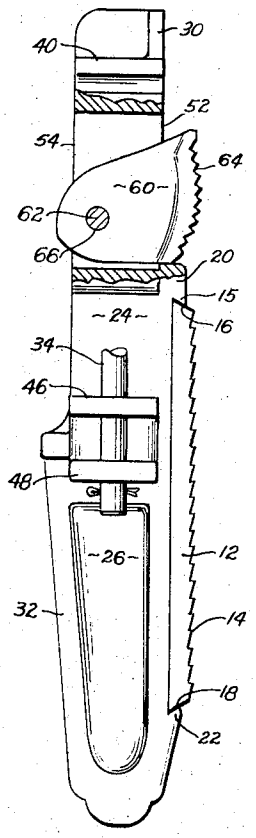


Fig. 4

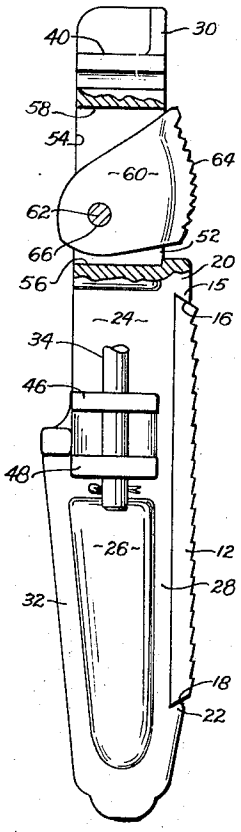


Fig. 5

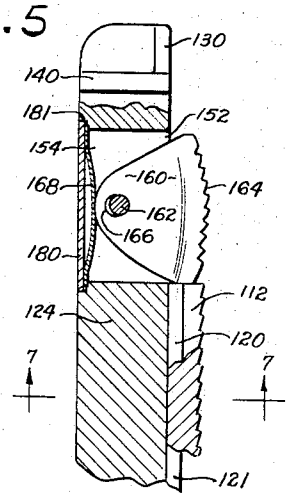
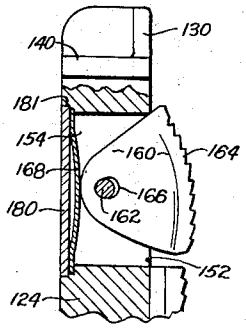


Fig. 6



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DRILL COLLAR SAFETY SLIP

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8 Claims. (Cl. 24—263)

This invention relates to the art of bore hole operations including well drilling, and more particularly for use with that type of apparatus which is provided with a tapered means, such as found in a rotary table or may be placed on top a casing, and through which extends a drill string, consisting of the drill and drill stem with sections of the tubing interposed between them. The tapered means, or bowl, is conventional and is adapted to receive a set of pipe slips therein to hold the drill stem fixed in place relative to the casing or table.

In the progress of drilling a well, as the depth increases, it is necessary to remove the drill pipe so as to replace the drill bit at the lower extremity thereof by breaking up the drill string into successive pipe section. The last several hundred feet of the drill stem is comprised of drill collars which are constant in diameter and provide no projections by which a positive acting clamp or the like may be used to secure the drill stem while making up or breaking down the drill string. During this operation it has become customary to employ a set of slips to hold the drill and string of collars at some particular point of elevation while the additional sections are being connected. When a sub or an additional drill collar is being placed on the string, the string may be inadvertently jarred, whereupon the string will slip through the liner of the slips and accordingly be lost in the well. This is especially so when the liners have become unduly worn so as to provide an insufficient amount of friction between the liner face and the drill collars. In the case where the drill collars are being made up, only a few feet of travel is required before the drill stem is lost in the bore hole. Where the sub has been added on to the drill string and the entire string slips, the string may travel several feet before the slips again take hold or set, thereby attempting to stop the movement of the traveling pipe. By this time the momentum of the heavy string of pipe has become so great that the slips cannot stop the movement, or if the slips do set, they will fail and the pipe accordingly is dropped to the bottom of the well. If the slips do hold, and stop the movement of the pipe, the drill stem will usually part below the turn table and the remaining string accordingly fall into the bore hole.

Hereinafter, such apparatus as well casing, tubing, rods, drill pipe and the like will be referred to as "pipe" with the understanding that such term is sufficiently comprehensive to include any form of object with which the invention may be associated.

Accordingly, the primary purpose of my invention is to provide a gripping device which may react more rapidly and set the slips around the moving pipe before it has had a chance to gain sufficient momentum to do any serious damage.

Another object of this invention is to provide a gripping device having an auxiliary cam means thereon that automatically sets the slips into greater gripping relationship to the string of pipe upon initial movement of the pipe string.

A further object of this invention is to provide a set of slips comprised of a novel gripping device which has dual engaging members, with the engaging surfaces of the

members being arranged so that one of the engaging members acts in a fashion so as to multiply the force exerted by the second engaging member upon movement of the pipe.

A still further object of this invention is to provide a gripping device which will hold a string of pipe so that additional sections of pipe may be added or removed as well as to prevent the string of pipe from slipping and falling into a bore hole.

A still further important object of this invention is to provide a pipe holder of such special construction that when it is seated in the taper of a rotary table, or other type supporting means, it will securely grip and hold the pipe string suspended so as to allow additional joints of pipe to be added or removed therefrom, and additionally including an auxiliary cam device that will cause the main pipe holder to increase the force of its grip upon the string of pipes should the pipe begin to slip.

Another additional object of this invention is to provide a novel segmented set of slips having arranged on a face thereof a dove-tailed configuration which mates with a longitudinal groove located in the body of the segment and which is retained in place by the upper auxiliary cam device, thereby enabling one to readily change the liners in the field when the slips have become worn out.

Other objects and advantages will appear from the following specification taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a top plan view of the invention and shows the relationship of the segments with respect to each other.

FIGURE 2 shows a plan view of a single segment of the invention, viewed from the pipe gripping side thereof.

FIGURE 3 is a side view, partially in section, and with some parts broken away, showing the cam in the extended and engaging position.

FIGURE 4 is similar to FIGURE 3 and shows the upper cam assembly in the unengaged position.

FIGURE 5 is a modification of the device illustrated in FIGURES 2, 3, and 4, with some parts shown in section.

FIGURE 6 is similar to FIGURE 5 and shows the modified upper cam assembly in opposite position to that of FIGURE 5.

FIGURE 7 is a partial sectional view of FIGURE 5.

Referring more particularly now to the drawings, wherein like numerals of reference designate similar parts in each of the figures, there is seen illustrated in FIGURE 1 a set of slips **6** made up of a multiplicity of segments each generally indicated by the numeral **10** and hinged together so as to encompass a pipe **8** therewithin. As seen in FIGURE 1, the set of slips **6** is one hinge short of forming a completely enclosed circle, and accordingly the pipe holder may be forced open at this unhinged portion so as to increase the gap at the missing hinge joint to thereby enable the pipe holder to be easily spread apart and placed adjacent the pipe whereupon it is then pulled about the outer periphery of the pipe and dropped into position in a conventional bowl located at the top of the casing or into the conventional tapered housing at the top of a rotary table.

Looking now to the details of FIGURE 2, taken in conjunction with FIGURES 3 and 4 wherein there is illustrated one of the twelve segments **10** of the slips that is adapted to be pinned together in a hinged manner to form the complete pipe holder or set of slips illustrated in FIGURE 1. As seen in FIGURES 2, 3, and 4, the

main body 24 of the segment 10 is comprised of a single or integrally cast framework having an inner web 28 at at the pipe side of the segment with a removable liner 12 forcibly pressed into the lips 15, 22 of the elongated slot formed between upper stop 20 and lower extension of lip 22. The upper and lower lips are milled at a converging relationship with each other and at a pitch equal to that formed at each extremity 16 and 18 of the removable liner 12. The liner 12 is removably affixed to the main body 24 by providing a safety pin (not shown) which pin is held in position by cam 60. Teeth 14 are formed on the inner face of the liner to form a vertical friction face that is engageable with the pipe in such a manner that as the firmness of engagement of the slip against a downwardly traveling pipe increases, the teeth tend to bite deeper into the pipe wall.

The upper portion of the main body 24 is provided with a rectangular slot 50 having vertical walls therein connected by upper wall 58 and lower wall 56. Numeral 52 indicates the pipe side of the slot and numeral 54 the outer side of the slot. The slot is apertured by drilling a hole diametrically therethrough to receive a cam pin 62 therein so as to provide for pivotal rotation of the cam 60 about the pin 62. The cam 60 is diametrically apertured at the pivotal end as indicated by numeral 66 and aligned with the frame formed about slot 50 so as to receive the cam pin 62. The cam 60 is provided with an elliptical body and a vertical reinforced or flanged face 64. The face 64 is widened to substantially the same width of the liner and provided with a friction face by milling teeth or serrations thereon in a manner similar to the teeth 14 of the liner 12. The cam 60 is rotatably received in the slot 50 and is free to pivot between the limits formed by the upper face of the slot and the upper face or stop member 20 of the body.

The friction face of the cam 60 is contoured as indicated so that during its rotational movement the cam face in conjunction with the pivot pin 62 will convert the rotary motion of the cam into irregular directional motion perpendicular to the drill pipe to thereby exert a tremendous pressure against the drill pipe and thereby effectively cause the teeth of the cam to dig into the drill pipe. When the cam 60 is in the engaged position of FIGURE 3, the teeth 64 of the cam overhang the teeth 14 of the slip 12 a distance equivalent to the tooth depth of the cam. When the cam 60 is in the retracted position, as illustrated in FIGURE 4, the teeth of the cam are vertically aligned with the teeth 14 of the liner 12.

Looking now to FIGURE 2, in conjunction with the remaining figures, it will be noted that either side of the segment 10 is provided with three aligned ears 40, 46, and 48 having apertures therethrough to receive a common hinge pin 34. The adjacent like ears 42, 44, and 49 are misaligned an amount equal to the width of each oppositely arranged ear so as to permit a multiplicity of like segments to be hinged together by the hinge pin. For example, ear 40 is adapted to mate with ear 42 of an adjacent like segment, and the two ears 46, 48 are adapted to be received within two similar ears 44, 49 of an adjacent segment.

The main body 24 is provided with lightening holes 26 and is suitably reinforced with an upper inner web extension 30, and a lower outer tapered web 32. The inner web 28 carries a longitudinal slot that receives the liner and pin and maintains the liner 12 rigidly attached thereto. The lower outer web 32 is built up as illustrated so as to present a large bearing surface to the tapered bowl of a spider located about a casing or the bowl of a rotary table. The load imposed upon the liner 12 is transmitted to the lower outer tapered web 32 and into the structure surrounding the bore hole by the main body portion that connects the inner and outer reinforcing webs 28 and 32.

Looking now to FIGURES 5 and 6 in conjunction with FIGURE 7 there is depicted therein an alternate embodiment of the present invention which comprehends an easily removable liner 112 that is held in operative position by the dove-tailed configuration 120 that in turn mates with an elongated groove 121 of like pitch that is milled into the inner web portion of the main body 124. The liner 112 is maintained substantially in place by the abutting relationship of the cam 160 at the upper extremity thereof.

The cam 160 carries an elongated aperture 166 so as to enable spring 168 to maintain the cam 160 in abutting relationship with the pipe against which the segment is to be placed.

It will now be apparent to those skilled in the art that FIGURE 5 illustrates the cam 160 to be in the maximum engaging position, that is, the cam has been rotated to its extreme point of engagement with an adjacent pipe, to thereby set the slips 112 more firmly against the pipe.

FIGURE 6 shows the cam 160 in an unengaged position, with spring 168 forcing the cam 160 up and away from the pipe side of the slips. This position would be assumed by the cam when the slips are not engaged between the pipe and bowl.

The sliding movement of the pipe along the friction face of the slip wears the teeth thereby eventually demanding replacement of the liner 112. When this state of wear is reached, the liner 112 is replaced easily by removing the cam pin 162 whereupon the cam 160 is removed from the slot and the liner 112 is removed vertically upwards and replaced with a new liner whereupon the cam and pin arrangement is then reassembled.

In making up a string of pipe or tubing, the pipe holder is engaged around the upper end of the string suspended in the bore, and when an additional joint of pipe is screwed onto the upper end of the string, the thus completed string is elevated, thereby freeing the teeth of the liner from the pipe and clearing the slips from its wedging action. A workman may then grip a handle provided on the slips and pull the assembly upwardly and outwardly clear of the pipe and bowl and rest the slips in a vertically standing position on the rotary of the drilling rig. The entire string is then lowered until its upper end is again opposite the bowl or the taper in the turntable, whereupon the set of slips is again lifted into place between the pipe and the bowl where it will of its own accord seat into place and rigidly grip the pipe as the elevator is lowered.

In breaking up a string of pipe the upper joint to be unscrewed extends above the rotary table with the pipe holder maintaining the next lower adjacent joint rigidly affixed to the bowl or the taper in the rotary table. When the joint is unscrewed and removed, the string is then elevated, thus releasing the slips, whereupon the slips can again be set on its base on the top of the rotary.

As will now be evident to those skilled in the art, the instant novel set of slips is wedged between the pipe and the bowl of the drilling rig with the pipe riding against the teeth of the friction face 14 of each segment and carrying the outside lower outer web 32 against the bowl with a force that is proportional to the weight of the string of pipe. The friction face 64 of the cam 60 rests against the pipe while the friction face 14 of the liner 12 rigidly grip the pipe. Gravity maintains the friction face 64 against the pipe. Should the pipe slip due to a greasy or perhaps extremely smooth exterior, or because the teeth 14 have become unduly worn, the teeth of friction face 64 of cam 60 will follow the pipe thereby rotating the cam about pin 62 and accordingly exerting a pressure on the pipe in proportion to the weight of the string of pipe. As cam 60 rotates about pivot pin 62 the slips will be forced downwardly and into tighter engagement against the string of pipe until the necessary force required to stop the slippage of the pipe is exerted by the pipe holder. Since the friction face 64 always rides against the exterior of the pipe, an extremely small slippage will set the cam action into motion to thereby immediately arrest the pipe

movement. Under ordinary circumstances the cam **60** will carry no load.

It should be noted that the cam, upon engagement with the string of pipe, not only provides an additional downwardly directed force, thus causing the sloped portion of the segment at web **32** to be driven further along the bowl taper and hence into tighter engagement with the pipe, but additionally the cam **60** exerts an outward force against pin **62** that has a tendency to pivot the segment about an area at the upper extremity of the web **32** whereby the lower portion of the slip will be driven into tighter engagement with the pipe.

In the case where a tool string has slipped, due to the inability of the friction face **14** to maintain the string of pipe held in its relative position, the tool is removed in the before mentioned conventional fashion, merely by lifting the pipe a small amount so as to remove the weight from the slips. Normally, when a string of pipe slips and sets cam **60** it will be evident that the liners are dull and need replacement.

When the slips are dropped into place between the drill stem and the bowl, the liners become aligned with the drill stem and at the same time the cams ride down and against the drill collar, where gravity forces them to remain in a dormant or standby position until they are needed. At any time, after the slips are operatively in place, that the drill stem should for some reason start to move with respect to the cams, the cams will cause the slips to arrest such movement. Hence the cam merely lays against the drill collar and, in the event the drill collar starts moving due to slippage through the slips, the cams will roll with the pipe, thereby forcing the slips into tighter engagement with the drill collar, thereby arresting any movement of the drill stem.

It should be noted that this invention is particularly useful and may be built into any slip that is used in conjunction with drill pipe, drill collars, tubing, flush joints, and the like. Furthermore, the main body of the slip preferably is cast as an integral part from 4130 steel, and the cams, including the serrated surface, are preferably cast from 8620 steel, although the main body may alternatively be cast from various light weight alloys, including the magnesium alloys.

While I have described the preferred embodiments of this invention, and illustrated the novel pipe holder in the accompanying drawings, certain changes or alterations may appear to those skilled in the art to which this invention relates, and I, therefore, reserve the right to make all such changes or alterations as shall fairly fall within the scope of the appended claims.

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

1. A pipe holder or set of slips made up of a series of segments hinged together and adapted to be placed between a pipe and a bowl at the top of a well casing or the like;

each segment having a main body and a liner removably fastened to the pipe engaging side of said main body;

said liner having a friction face thereon that engages the pipe when placed in operative relationship thereto;

a cam including means pivotally mounting said cam to said main body of said segment and having a friction face thereon adapted to be pivoted into a pipe engaging position, whereby;

when said pipe holder is operatively engaging the pipe, slippage of the pipe relative to said liner will cause said cam to rotate thereby increasing the friction exerted by said liner against the pipe.

2. The apparatus of claim **1** wherein said main body includes an elongated member having an upper frame portion, an outer-side including an enlarged tapered bottom portion, a pipe side opposite said tapered bottom portion, and hinge sides;

offset ears extending from each hinge side that cooperate with the ears of an adjacent segment to form a hinge between adjacent segments;

said upper frame portion forming a slot extending from said pipe side to said outer side;

a first web adjacent the pipe side;

a second web on the opposite body portion including said tapered body portion, and;

said second web being tapered downwardly toward said first web and forming a load bearing surface at a pitch substantially equal to the bowl in which the pipe holder is adapted to be placed.

3. The apparatus of claim **1** wherein the friction face of said cam is provided with a serrated surface that forms teeth adapted to present a high friction surface when the pipe travels downwardly with respect thereto;

said cam friction face normally clearing said pipe in the retracted position;

said cam friction face vertically overhanging the friction face of said liner an amount equal to the depth of said serrated surface when said cam is in the fully engaging position.

4. The apparatus of claim **3** wherein said main body includes an upper framework adapted to house said cam;

means forming an aperture diametrically of said framework;

said cam having an upstanding flange to accommodate said serrated surface and an elliptical reduced body portion extending toward a pivotal end;

there being an aperture at said pivotal end aligned with the aperture of said framework;

a cam pin removably received in said frame and cam apertures about which the cam may pivot from the recited pipe engaging position to the retracted position.

5. The apparatus of claim **4** wherein the serrated surface of the upstanding flange is eccentric with respect to the pivotal end thereof;

said serrated surface clearing the pipe when in the disengaging position with respect to the pipe, and when pivoted from the disengaging to the engaging position, said serrated surface progressively extends toward and engages the pipe up to a maximum depth of the serrations thereon, whereby;

the eccentric cam thereby converts rotary motion into irregular directional motion perpendicular to the pipe.

6. The apparatus of claim **5** wherein said cam aperture is elongated in a longitudinal direction perpendicular with respect to said cam flange;

resilient means urging said cam in a direction toward the pipe side of the segment, whereby;

when said pipe holder is placed about a pipe, said serrated surface always engages the pipe to thereby instantly start rotational movement of said cam upon failure of the slips to properly hold the pipe.

7. The device of claim **6** wherein said resilient means includes a flat compressed leaf spring;

an upper and lower shoulder in the upper and lower frame assembly on the side opposite said pipe engaging side;

a cover plate received in said shoulders;

said spring cooperating with said shoulders and said pivotal end of said cam to thereby urge said cam toward said pipe engaging side.

8. The apparatus of claim **1** wherein said slip is formed in a dove-tailed configuration projecting outwardly and longitudinally of the slip on the side opposite the pipe engaging side;

there being a milled slot of opposite configuration to said dove-tailed slip located longitudinally in the pipe engaging side of said main body;

said cam overhanging said slip to thereby maintain said slip removably placed in said milled slot.

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