(57) Abrégé/Abstract:
The present invention provides a slip system for fractionally engaging a temporarily set body, such as a packer or a whipstock, within a wellbore. The slip system comprises (1) a plurality of slips; (2) a tubular slip ring for holding the individual slips at an end; and (3) a tubular cone body having beveled surfaces for receiving the individual slips when the slip system is actuated. Each slip has a first end that defines a tail, and a second opposite end that defines a slip body. The tail and the slip body are integral, meaning that the intermediate shank portion of prior art slips is essentially removed. In its place, a dovetail geometry is provided within the tail, creating an increased tail width at the end of the tail opposite the slip body. The slip ring has a plurality of pockets, with each pocket being dimensioned to receive the dovetailed configuration of the tail on the respective slips.
ABSTRACT OF THE DISCLOSURE

The present invention provides a slip system for frictionally engaging a temporarily set body, such as a packer or a whipstock, within a wellbore. The slip system comprises (1) a plurality of slips; (2) a tubular slip ring for holding the individual slips at an end; and (3) a tubular cone body having beveled surfaces for receiving the individual slips when the slip system is actuated. Each slip has a first end that defines a tail, and a second opposite end that defines a slip body. The tail and the slip body are integral, meaning that the intermediate shank portion of prior art slips is essentially removed. In its place, a dovetail geometry is provided within the tail, creating an increased tail width at the end of the tail opposite the slip body. The slip ring has a plurality of pockets, with each pocket being dimensioned to receive the dovetailed configuration of the tail on the respective slips.
SLIP SYSTEM FOR RETRIEVABLE PACKER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to downhole tools for use in a hydrocarbon wellbore. More particularly, the present invention pertains to packers used for sealing fluid flow within a wellbore. More particularly still, the present invention relates to a slip system for use in a downhole tool, such as a retrievable packer.

Description of the Related Art

In the process of completing a wellbore, it is oftentimes desirable to seal a portion of the wellbore from fluid flow. An example is the sealing of the annular region between a string of production tubing and a surrounding string of casing. In such an instance, the packer is run into the wellbore near the lower end of the production tubing. The packer is then set through the application of hydraulic pressure through the tubing string. The packer includes a sealing element that is compressed and extruded into engagement with the surrounding casing string. In this way, the annular region between the production string and the casing is sealed to fluid flow. This, in turn, serves to direct the flow of production fluids up the production tubing and to the surface.

An annular packer may also be used in connection with a formation treatment operation. For example, hydraulically actuated packers are oftentimes employed in order to isolate certain formations during a fracturing operation. In addition, hydraulically actuated annular packers are typically used in connection with acid treatments for cleaning downhole tools, such as pipe and sand screens. In these instances, the packer is run into the wellbore on a working string rather than production tubing.

It is common to incorporate slip systems into packers. Slip systems assist in mechanically holding the packer in place along the surrounding casing, thereby protecting the integrity of the fluid seal provided by the sealing element. Slip systems include a slip, and a cone having a beveled surface for receiving the slip.
Typically, a plurality of slips are disposed radially around the outer diameter of a tubular mandrel. The slips have a tail that is connected to a slip ring. The slip ring, in turn, is slideably placed around the outer diameter of a central mandrel in the packer. Movement of the slip ring through hydraulic or hydro-mechanical actuation drives the slip ring axially towards the cones. Movement of the slip ring causes the respective slips to be driven along the beveled surfaces of the cones, and thereby moved radially outward into engagement with the surrounding tubular.

Figure 1 presents a known arrangement for a portion of slip system 50 as commonly employed with a wellbore packer. A slip ring 30 is first seen in the drawing. The slip ring 30 defines a relatively short tubular member having a plurality of pockets 32. The pockets 32 are equidistantly spaced around the slip ring 30 in radial array. Each pocket 32 is configured to receive an end portion 14 of a slip 10. In the slip ring 30 shown in Figure 1, five pockets 32 are shown, meaning that five slips 10 will be employed in the slip system 50. Of course, various numbers of pockets 32 and corresponding slips 10 are known.

An exemplary slip 10 is also seen in Figure 1. The slip 10 has a first end that defines a tail 14. The slip 10 has a second opposite end that defines a slip body 12. The slip body 12 has an outer surface for engaging a surrounding tubular string, such as a string of casing, or liner (not shown). A plurality of teeth 18, or “wickers,” is placed along the slip body 12 to assist in creating a frictional engagement with the surrounding tubular string.

The tail 14 and the slip body 12 of the slip 10 are connected by an intermediate shank 16. The shank 16 in known slips 10 has a width that is narrower than the width of the tail portion 14. In addition, the shank 16 and tail portion 14 are configured in a perpendicular geometry in order to form a “T.” The shank 16 and the tail portion 14 of the slip 10 are configured to be received in a pocket of the slip ring 30, such as pockets 32 of Figure 1.

It can be seen from Figure 1 that the geometry of the pockets 32 is configured to mate with that of the shank 16 and the tail portion 14 of the slip 10. In this respect, each pocket 32 has a base opening 34 for receiving the tail portion 14
of the slip 10. Similarly, each pocket 32 has a neck opening 36 extending up from
the base portion 34 for receiving the shank 16 of the slip 10.

In some instances, the slip 10 will include a guide rail 20. Typically, a pair
of guide rails 20 is disposed on either side of the slip body 12. The guide rails 20 are
slideable along slots (not shown) in a cage body (also not shown) associated with
the cones. The guide rails 20 assist in directing the slips 10 into engagement with
the surrounding tubular body when the slip system is set.

In certain applications, it is desirable to be able to retrieve a packer from
the wellbore. In order to retrieve the packer, the slip system for the packer must be
released from the surrounding casing. This, in turn, means that the slip ring 30 must
be moved away from the cones, and the slips 10 moved downward off of the
respective beveled surfaces of the cones. In some instances, release of the slip
system requires extreme mechanical force, such as the application of many
thousands of pounds of tensile force imparted by pulling up on the packer mandrel
(not shown in Figure 1). In order to release the slip system, this mechanical tensile
force is directed through the shank portion 16 of the slips 10 and associated neck
portion 36 of the pockets 32.

It can be seen from the view of Figure 1 that the shank 16 has a limited
width. Where extreme and sudden tensile force is generated during release of the
packer, a great deal of tensile force must be borne by the trim amount of material in
the shank 16. Further, because of the perpendicular geometry of the tail portion 14
of the slip 10, a great deal of shear stress must be borne by the tail 14 at the points
of contact with the base portion 34 of the pockets 32. If the shank 16 or tail 14 of the
slip 10 are unable to withstand the generated tensile and shear forces, the slip 10
will break, leaving the packer frictionally set within the wellbore. This, in turn,
requires expensive milling and circulation operations to remove the packer.

In order to overcome the problem described above created by the
geometry of the slips 10, the manufacturer might choose to increase the thickness of
the slip system. It can be seen from the exemplary arrangement in Figure 1 that
both the slip 10 and the slip ring 30 have a defined thickness “t.” However, it is
desirable by the operator of the well to have a thin slip system, so as to retain a
larger bore within the packer. A larger bore means more area through which production fluids may flow in a production tubing, and a greater diameter for running tools down the wellbore.

The manufacturer might also consider increasing the width of the shank \textbf{16}. However, increasing the width of the shank \textbf{16} produces a reciprocal reduction of material in the slip ring, i.e., \textbf{30}, at the neck opening \textbf{36}. In addition, significant shear load is still borne at the perpendicular point where the slip shank \textbf{16} meets the tail \textbf{14}. Thus, an overall increase in tensile strength within the slip system is not necessarily gained.

There is a need, therefore, for a slip system in a retrievably set tool, such as a retrievable packer, that is able to withstand extreme tensile forces applied during packer release. Further, there is a need for such a slip system that retains a thin geometry. Still further, there is a need for such a slip system that is capable of setting a packer within casing strings having a wide range of weight grades such that a multitude of packer/slip system sizes is not needed in product inventory.

\textbf{SUMMARY OF THE INVENTION}

The present invention provides an improved slip system that is able to withstand greater tensile forces during packer release without an increase in thickness of material. The slip system comprises (1) a plurality of slips; (2) a tubular slip ring for holding the individual slips at an end; and (3) a tubular cone body having beveled surfaces for receiving the individual slips when the slip system is actuated.

Of significance is the geometry of the individual slips. Each slip has a first end that defines a tail. The slip has a second opposite end that defines a slip body. The slip body has an outer surface for engaging a surrounding tubular string, such as a string of casing, or liner. Pluralities of teeth are placed along the slip body to assist in creating a frictional engagement with the surrounding tubular string. The tail and the slip body are integral, meaning that the intermediate shank portion of prior art slips is essentially removed. Instead, a dovetail geometry is provided within the tail, creating an increased tail width at the end of the tail opposite the slip body.
To aid in the positioning of the slips within their respective cone body pockets, the bodies of the slips and the pockets have mating beveled side edges. The sides of the bodies of the slips are beveled to face upwardly, while the sides of the pockets are beveled to face downwardly. With this arrangement, the guide rails 20 and slots of slip systems of the prior art are no longer needed.

The slip ring comprises a tubular body having a plurality of pockets. Each pocket is substantially equidistantly spaced in radial array around the slip ring. Further, each pocket is dimensioned to receive the dovetailed configuration of the tail on the respective slips.

To further aid in the positioning of the slips within their respective slip ring pockets, the tails of the slips and the pockets have mating beveled side edges. The sides of the tails of the slips are beveled to face upwardly, while the sides of the pockets are beveled to face downwardly. At the lower end, the lower edge of the tails of the slips are beveled to face downwardly, while the lower edge of the pockets are beveled to face upwardly. With this arrangement, an additional downward radial force is placed into the tail of slips during retrieval in addition to that created by the cone pocket geometry. Additionally, the pocket geometry limits the outward radial travel of the slips preventing them from becoming disengaged from the slip ring.

**BRIEF DESCRIPTION OF THE DRAWINGS**

So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the appended drawings (Figures 2-7). It is to be noted, however, that the appended drawings (Figures 2-7) illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope.

Figure 1 provides a perspective view of a slip system of the prior art. A slip ring and an exemplary slip are provided. (The tubular body providing the cones is not shown.) An exemplary slip is shown exploded away from the slip ring for clarification.
Figure 2 presents a perspective view of a slip system of the present invention, in one embodiment. A tubular slip ring is seen for holding individual slips. A single exemplary slip is shown within one of the pockets of the slip ring. Finally, a tubular cone body having beveled surfaces for receiving the respective slips is shown.

Figure 3A presents a cross-sectional view of the slip system of Figure 2. The system has been cut longitudinally along line 3A-3A.

Figure 3B presents a second cross-sectional view of the slip system of Figure 2. Here, the slip system is shown through line 3B-3B.

Figure 4 is a perspective view of an individual slip of the slip system in the present invention, in one embodiment. The outer surface of the slip is seen.

Figure 5 shows another perspective view of the individual slip of Figure 3. In this view, the inner surface of the slip is seen.

Figure 6 provides a cross-sectional view of a packer as might employ the slip system of Figure 2. This is a hydraulically actuated packer. The packer is seen in its run-in position.

Figure 7 provides another cross-sectional view of the packer of Figure 6. In this view, the packer is being actuated. Fluid injected under pressure causes a setting piston to act against upper and lower slip systems, and an intermediate sealing element. The packer is seen set against a surrounding string of casing.

Figure 8 presents yet another cross-sectional view of the packer of Figure 6. Here, the packer is being released from frictional and sealed engagement with a surrounding tubular body.

Figure 9 presents an alternate embodiment of a slip system. The alternate slip system employs a modified slip design. The alternate slip system is shown in perspective view.

Figure 10 presents the modified slip of Figure 9, in perspective view.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides a slip system 100 for frictionally engaging a temporarily set body, such as a packer or a whipstock, within a wellbore. An improved slip system 100 of the present invention, in one embodiment, is shown in Figure 2. The slip system 100 comprises (1) a plurality of slips 110; (2) a tubular slip ring 130 for holding the individual slips 110 at an end; and (3) a tubular cone body 140 having beveled surfaces 142 for receiving the individual slips 110 when the slip system 100 is actuated.

Figures 3A and 3B present cross-sectional views of the slip system 100 of Figure 2. In Figure 3A, the slip system 100 has been cut longitudinally along line 3A-3A. In Figure 3B, the slip system 100 is shown through line 3B-3B. From these cross-sectional views, the tubular nature of the slip ring 130 and the cone body 140 are seen.

Of significance in the slip system 100 of the present invention is the geometry of the individual slips 110. Figure 4 provides a perspective view of an individual slip 110 of the slip system 100 in the present invention, in one embodiment. The outer surface of the slip 110 is seen. Figure 5 shows another perspective view of the individual slip 110 of Figure 3. In this view, the inner surface of the slip 110 is shown. From Figures 4 and 5 it is seen that each slip 110 has a first end that defines a tail 114. The slip 110 has a second opposite end that defines a slip body 112. The slip body 112 has an outer surface for engaging a surrounding tubular string, such as a string of casing, or liner (not shown). Pluralities of teeth, such as wickers 118, are preferably placed along the slip body 112 to assist in creating a frictional engagement with a surrounding tubular string (not shown).

The tail 114 and the slip body 112 are integral, meaning that the intermediate shank portion of prior art slips is essentially removed. Instead, a dovetail geometry is provided within the tail 114, creating an increasing tail width at the end of the tail 114 opposite the slip body 112. In this manner, the overall width of the slip 110 is increased, thereby increasing its ability to withstand tensile forces without a reciprocal increase in thickness. Further, tensile forces in the tail portion 114 are borne along an angle, thereby increasing the tensile strength of the slip 110.
Referring again to Figure 2, the slip system 100 of the present invention also includes a slip ring 130. The slip ring 130 comprises a tubular body having a plurality of pockets 132. Each pocket 132 is substantially equidistantly spaced in radial array around the slip ring 130. Further, each pocket 132 is dimensioned to receive the dovetailed configuration of the tail 114 on the respective slips 110. Thus, the pockets 132 each employ a mating dovetail configuration.

To further aid in the positioning of the slips 110 within their respective slip ring pockets 132, the tails 114 of the slips 110 and the pockets 132 preferably have mating beveled sides. The sides 111 of the tails 114 of the slips 110 are beveled to face outwardly (shown in FIGS. 4 and 5), while the sides 131 of the pockets 132 are beveled to face inwardly. The end 117 of each tail 114 of the slips 110 is beveled to face inwardly (shown in FIGS. 4 and 5), while each edge 137 of the pockets 132 that receives the ends 117 is beveled to face outwardly. Enough play is afforded in the mating configuration of the pockets 132 to allow the slips 110 to slide and move radially outward to engage a surrounding casing.

In order to demonstrate the operation of the slip system 100 of the present invention, it is helpful to refer to a retrievable downhole tool in which the system 100 might be deployed. Examples of such a tool are retrievable packers and whipstocks. The slip system 100 may be set either hydraulically or mechanically using any known actuation means. For purposes of clarity, an exemplary retrievable packer 200 is shown in Figure 6. Figure 6 presents a cross-sectional view of a packer 200 as might receive the slip system 100 of Figure 2. The exemplary packer 200 is a hydraulically actuated packer 200. The packer 200 is seen in Figure 6 in its run-in position.

The packer 200 generally defines an elongated tubular tool have an upper end 200U and a lower end 200L. The packer 200 includes a sealing element 230 disposed intermediate the upper 200U and lower 200L ends. The sealing element 230 is seen in cross section in Figure 6. The sealing element 230, of course, is fabricated from a pliable and compressible material that is capable of being extruded into sealing engagement with surrounding casing (shown at 250 in Figure 6) when the packer 200 is actuated.
The packer 200 also comprises an elongated packer mandrel 210. The packer mandrel 210 extends from the upper end 200U to the lower end 200L of the packer 200. The packer mandrel 210 defines an elongated tubular body. The packer mandrel 210 has an inner diameter defining a bore 205, and an outer diameter. In the arrangement for the packer 200 of Figure 6, all operational parts, including the sealing element 230, are disposed along the outer diameter of the packer mandrel 210.

The upper end of the packer mandrel 210 includes a threaded connection 212U. The threads connect to a lower joint of production tubing, an injection tubing, or some other working string (not shown). The lower end of the packer mandrel 210 also preferably includes a threaded connection 212L. The lower connection 212L may be left open, or may be attached to a tailpipe, a bottom sub, or even another packer for isolating an area of interest.

As noted, a sealing element 230 is circumferentially disposed around the packer mandrel 210. A pair of gauge rings 232U, 232L is placed above and below the sealing element 230, respectively. The upper gauge ring 232U provides a shoulder above the sealing element 230, while the lower gauge ring 232L provides a shoulder below the sealing element 230. Thus, compression of the sealing element 230 is accomplished by moving the upper 232U and lower 232L gauge rings relatively towards one another.

An elongated housing 240 is disposed below the lower gauge ring 232L. The housing 240 defines an elongated tubular body concentrically placed around the packer mandrel 210. The upper end of the housing 240 is threadedly connected to the lower end of the lower gauge ring 232L. An annular region 242 is retained between the concentrically arranged packer mandrel 210 and the surrounding housing 240.

One or more ports 215U, 215L are placed within the packer mandrel 210. The ports 215 serve as setting ports, and provide fluid communication between the bore 205 of the packer mandrel 210 and the annular region 242 within the housing body 240. As will be described further below, the channel of fluid communication created by the setting ports 215U, 215L allows hydraulic pressure to be applied to
the sealing element 230 and slip systems 220U, 220L around the packer mandrel 210. More specifically, upper setting ports 215U serve to actuate the sealing element 230 and upper slip system 220U, while lower setting ports 215L serve in actuating the lower slip system 220L.

A pair of subs 214U, 214L is also provided around the packer mandrel 210. First, a top sub 214U is provided proximate to the upper end 212U of the packer mandrel 210. Second, a bottom sub 214L is provided above the lower end 212L of the packer 210. The top sub 214U is threadedly connected to the packer mandrel 210, such that it has no relative movement with the packer mandrel 210. Likewise, the bottom sub 214L is connected to the packer mandrel 210. However, the connection between the bottom sub 214L and the packer mandrel 212L is temporary. To this end, a shear ring 213 is provided between the bottom sub 214L and the packer mandrel 212L. As will be described more fully below, the shear ring 213 retains the connection between the bottom sub 214L and the packer mandrel 210 until it is desired to release the packer 200 from the surrounding wellbore.

As noted earlier, a pair of slips 220U, 220L is provided with the packer 200 of Figure 6. First, an upper slip system 220U is provided above the sealing element 230. More specifically, the upper sealing element 220U is disposed between the top sub 214U and the upper gauge ring 232U. The lower slip system 232L is placed below the sealing element 230. More specifically, the lower slip system 220U is disposed between the elongated outer housing 240 and the bottom sub 214L.

The lower slip system 220L may be a known slip system, such as slip system 50 shown in Figure 1. It can be seen that the slip system 220L includes slips 224L disposed within a slip ring 222L. The slips include teeth 226L on an outer surface thereof. The slips 224L also have an inner surface configured to ride along a beveled surface 228L of a lower cone body 229L.

Because of the extraordinary tensile forces running through the packer 200 during release, the upper slip system 220U must be a slip system such as slip system 100 shown in Figure 2. Visible in Figure 6, in cross section, are components of a slip system 220U in accordance with the slip system 100 of Figure 2. Thus, there is a slip 224U (analogous to slip 110 of Figure 2); there is a slip ring
222U (analogous to slip ring 130 in Figure 2); there is an upper cone 228U (analogous to tubular cone body 140 in Figure 2); and there are beveled surfaces 229U (analogous to the outwardly beveled surfaces 142 seen in Figure 2).

Figure 6 presents the packer 200 in its run-in position. In this view, the sealing element 230 and the slips 220U, 220L have not been set. However, in Figure 7, it can be seen that the packer 200 has been actuated. Figure 7 provides a cross-sectional view of the packer of Figure 6, but with the packer 200 having been actuated. To this end, the sealing element 230 has now been compressed between the upper 232U and lower 232L gauge rings. The sealing element 230 is seen extruded into sealed engagement with a surrounding casing 250.

Actuation of the sealing element 230 has been accomplished by injection of hydraulic fluid, under pressure, through upper setting ports 215U. Details concerning actuation of the packer 200 in order to effectuate sealing are not important for purposes of the present invention. It is noted, however, that a setting piston 260 is provided around the packer mandrel 210. More specifically, the setting piston 260 is nested concentrically between the packer mandrel 210 and the surrounding housing 240. The setting piston 260 acts in response to hydraulic pressure provided through the lower setting ports 215L. The setting piston 260 moves downwardly against the lower cone system 220L. At the same time, hydrostatic and formation pressures act together against the housing 240. Relative movement between the housing 240 and the setting piston 260 is permitted. Relative upward movement of the housing 240 relative to the packer mandrel 210 and setting piston 260 serves to compress the sealing element 230 and to also set the upper slip system 220U.

As noted, the packer 200 is designed to be retrievable from within the casing 250. The packer 200 is released by a straight pull of the production tubing (or other working string) above the packer 200 and from the surface. Because the packer 200 withstands extremely high forces during operation, extraordinary tensile force is required to release the packer 200. For this reason, the improved slip system 100 of the present invention is necessary to serve as the upper slip system 220U in the packer 200.
Figure 8 presents yet another cross-sectional view of the packer 200 of Figure 6. Here, the packer 200 is being released from frictional and sealed engagement with the surrounding tubular body 250. It can be seen that the lower shear ring 213 has broken, releasing the packer mandrel 210 from the bottom sub 214L. This allows the packer mandrel 210 to move upward relative to the sealing element 230 and the upper 220U and lower 220L slip systems. Again, the details as to how the various components of the packer 200 are released are not important; it is sufficient to note that split rings 217 engage shoulders along the components of the packer 200, allowing the packer 200 and its radially disposed components to be removed from the wellbore.

Figure 9 presents an alternate embodiment of a slip system 100’. The slip system 100’ employs a modified slip design, shown at 110’ in Figure 10. The modified slip design utilizes slips 110’ which have teeth 118’ with a finer pitch, and which cover the majority of the slip surface. This more evenly distributes the loads placed into the slip system 100’ during operation of the retrievably set tool, such as packer 200 of Figures 6A-6B. Additionally, a small section 119’ at the front of each slip 110’ does not contain teeth. In one arrangement, the surface of this flat section 119’ is 0.010” below that of the teeth 118’. This serves to limit the depth that the teeth bite into the casing.

The tail of the slip 110’ has a similar dovetail geometry as the previous embodiment shown in Figures 4 and 5; however, the sides 111’ of the slip tail 114’ are not beveled, nor are the sides 131’ of the mating pockets 132’ on the slip ring 130’. During retrieval, this serves to eliminate any radial force in the slip ring 130’ which can cause deflection or deformation of the slip ring 130’. These changes allow the slip system 100’ to withstand significantly higher working loads while maintaining retrievability.

While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.
Claims:

1. A slip system for use in a retrievable downhole tool, the slip system comprising:
   a plurality of slips, each slip having a first end defining a slip body, and a second end defining a tail, each of the respective tails having a generally dovetail configuration;
   a tubular slip ring, the slip ring having a plurality of pockets configured to receive a respective tail of an individual slip; and
   a tubular cone body, the cone body having a plurality of beveled surfaces configured to receive a respective slip body of an individual slip when the slip system is actuated.

2. The slip system of claim 1, wherein the pockets and the respective tails of the slips have mating beveled side edges.

3. The slip system of claim 2, wherein the side edges of the tails of the slips are beveled to face upwardly, while the side edges of the pockets are beveled to face downwardly.

4. The slip system of claim 3, wherein the lower edges of the tails of the slips are beveled to face downwardly, while the lower edges of the pockets are beveled to face upwardly.

5. The slip system of claim 1, wherein the retrievable downhole tool is a packer.

6. The slip system of claim 1, wherein the retrievable downhole tool is a whipstock.

7. A slip system for use in a retrievable downhole tool, the slip system comprising:
   a plurality of slips, each slip having a first end defining a slip body, and a second end defining a tail, each of the respective tails having a progressively greater width opposite the slip body; and
a cone body, the cone body having a plurality of beveled surfaces configured to slidably receive a respective slip body of an individual slip when the slip system is actuated.

5 8. The slip system of claim 7, further comprising:
a slip ring, the slip ring having a plurality of pockets configured to receive a respective tail of an individual slip.

9. The slip system of claim 8, wherein the tail of each slip defines an essentially dovetail configuration.

10. The slip system of claim 9, wherein the slip body of each respective slip has an outer surface defining a plurality of teeth for releasably engaging a surrounding tubular body.

11. The slip system of claim 10, wherein the slip body of each respective slip further comprises opposing sides having upwardly beveled surfaces received within the plurality of beveled surfaces of the cone body.

12. The slip system of claim 11, wherein the outer surface of the slip body further comprises a flat portion approximately 0.010" below that of the teeth.
Fig. 1
(Prior Art)