United States Patent

Collett

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[54] SELF-LOCKING SNAP-ON COLLAR FOR OIL WELL OPERATIONS

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[21] Appl. No.: **31,279**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 872,229, Oct. 29, 1969, abandoned.

[52] **U.S. Cl.** .....**308/4 A**

[51] **Int. Cl.** **F16c 17/00**

[58] **Field of Search** .....308/4 A, 4; 285/45, 235, 236, 285/373, 419; 175/323, 325

[56] **References Cited**

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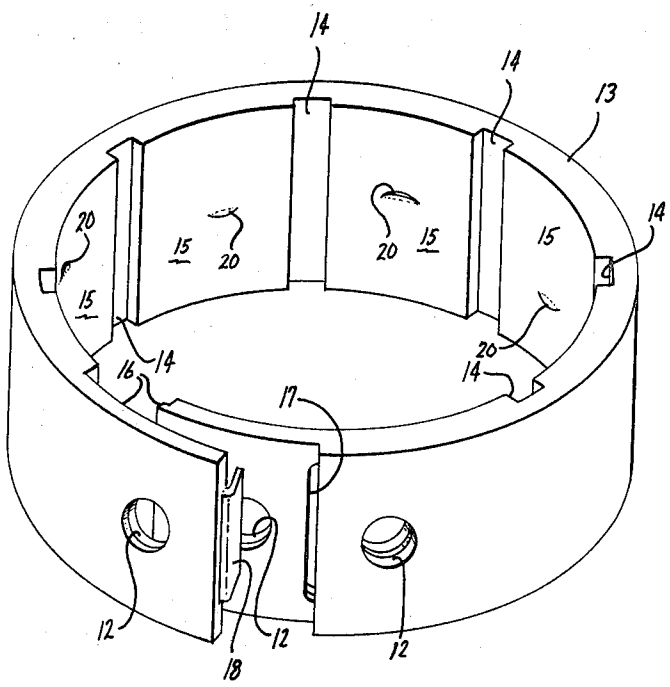
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[57] **ABSTRACT**

A thrust or stop-collar principally adapted for use on oil well drill pipes, sucker rods, guides, and similar equipment, combines a base of elastomeric or similar material with a novel spring insert. Configuration of the collar plus the effect of the specially constructed insert combine to give a very great bond between the shaft and the collar while permitting ready and economical installation and removal. An alternate embodiment provides a removable gripping ring inserted concentrically around the inner surface of the collar and disposed by geometry and construction to exert additional bond between the shaft and collar as further insurance against slipping while retaining the ease of installation and removal.

7 Claims, 10 Drawing Figures



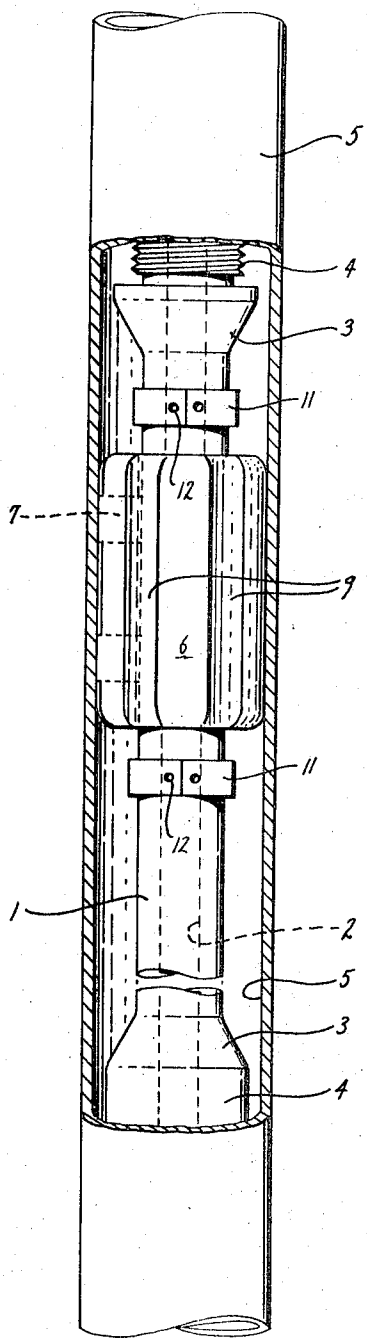
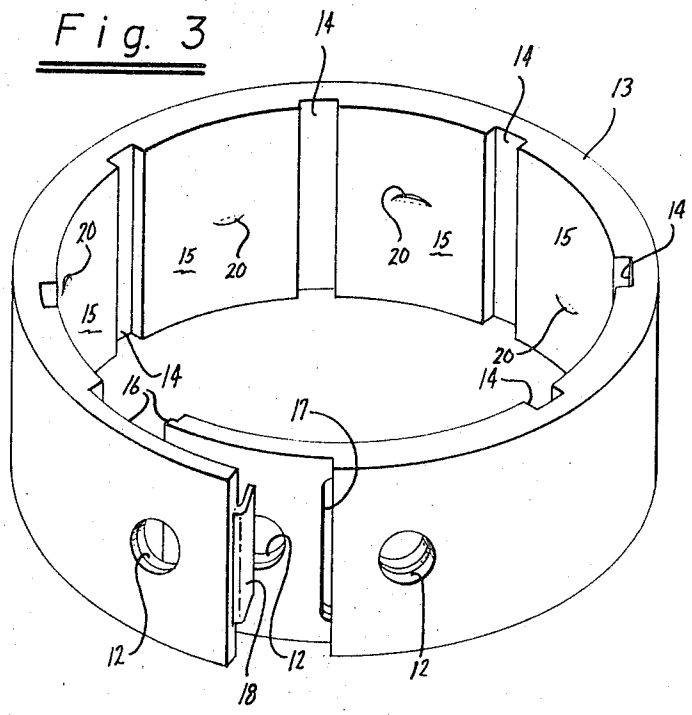


Fig. 1

Fig. 3



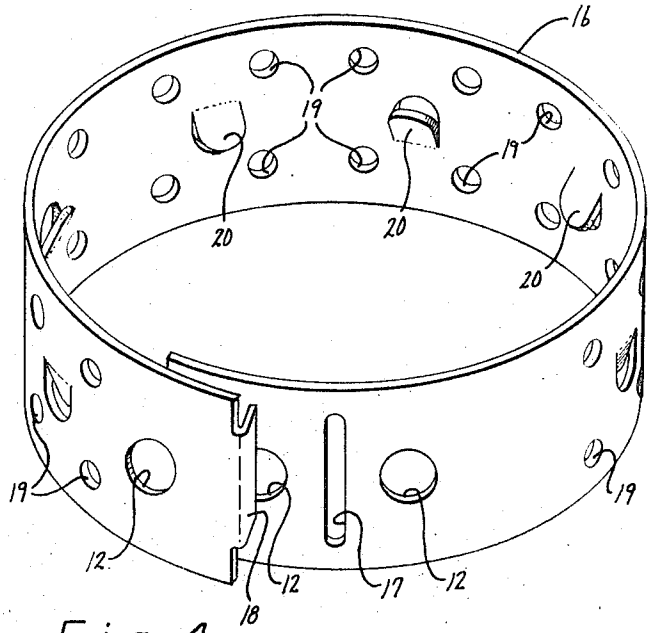


Fig. 4

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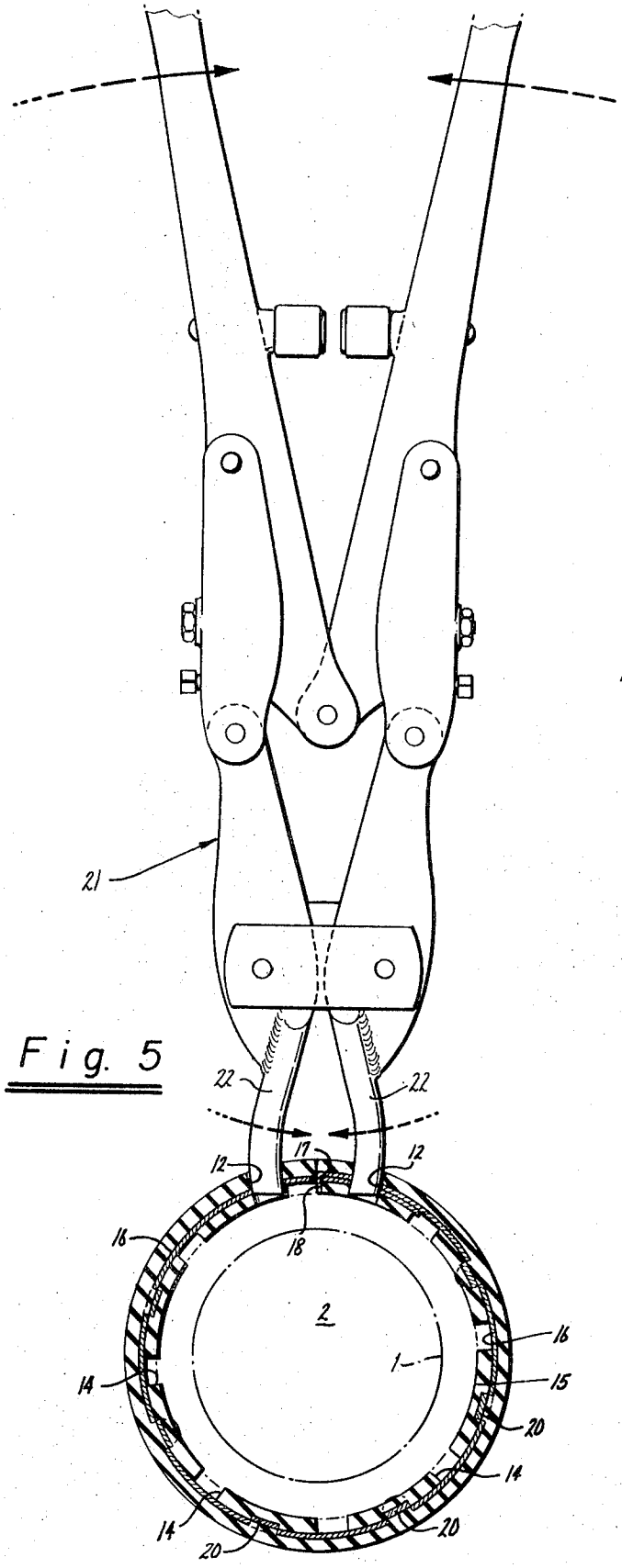


Fig. 5

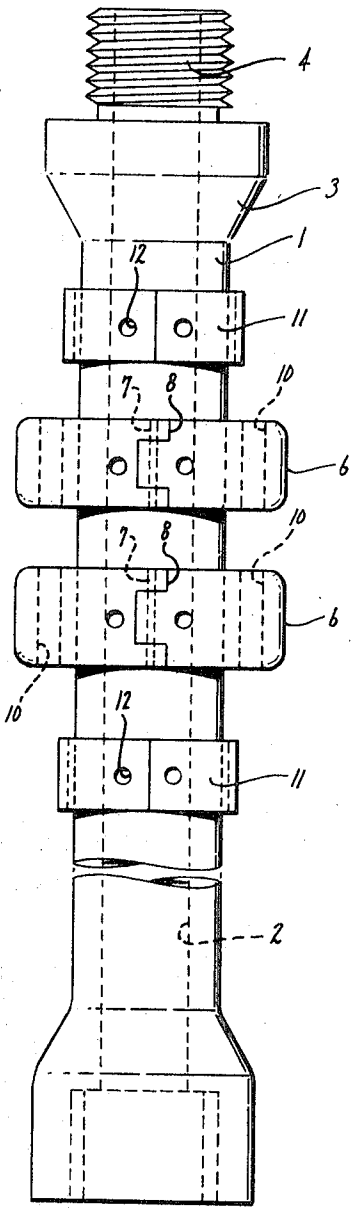


Fig. 2

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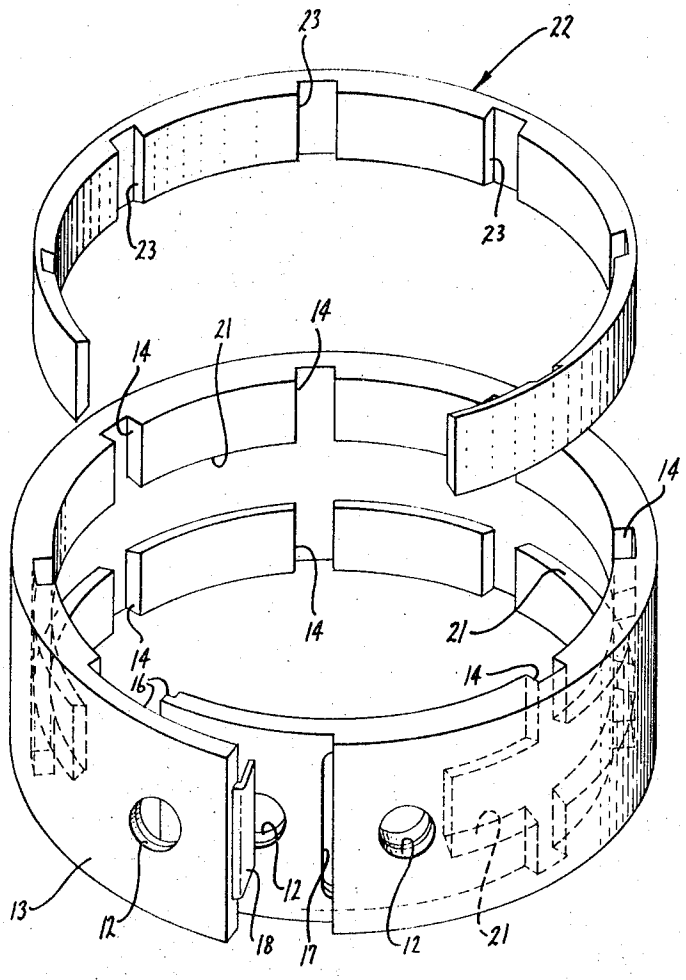


Fig. 6

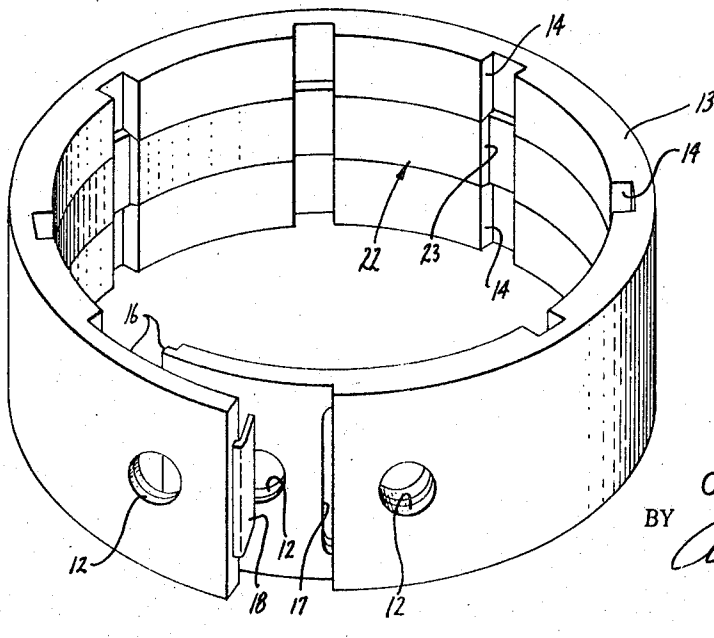


Fig. 7

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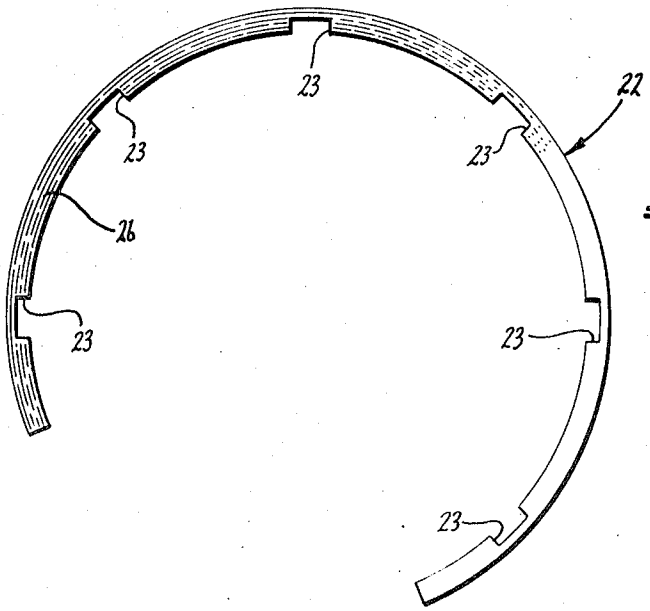


Fig. 8

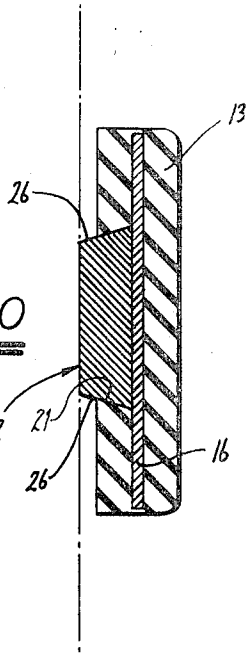


Fig. 10

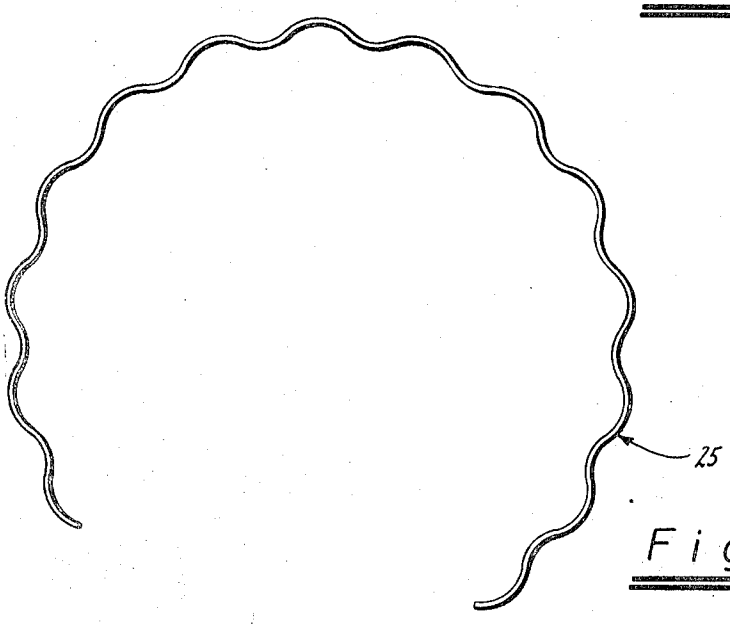


Fig. 9

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SELF-LOCKING SNAP-ON COLLAR FOR OIL WELL OPERATIONS

This application is a continuation-in-part of my co-pending application Ser. No. 872,229 filed Oct. 29, 1969, now abandoned.

BACKGROUND OF THE INVENTION

The drilling and pumping of oil wells has presented a great many long standing problems insofar as proper operation of the drill pipe or sucker rod in the well bore tube or casing are concerned. Some of these are set forth in my co-pending applications Ser. No. 701,641 filed Jan. 30, 1968, now U.S. Pat. No. 3,490,526 and Ser. No. 810,136 filed Mar. 25, 1969, now Pat. No. 3,528,499. These problems are, in general, brought about by the extremely high temperatures and pressures encountered and by the very high loads and stresses resulting from operating at great depths.

In the case of sucker rods, various types of guides have been devised to attempt to obtain proper operation of the rod in the tube. These have been developed so as to facilitate the up and down motion of the rod in the tube, prevent binding and jamming, undue friction, wear, breakage, especially where the well bore itself is quite crooked, as is often the case.

In the case of drill pipes, similar problems are encountered. Protectors of various types of construction have been devised of facilitate the rotation of the pipe and its descent into the well. These in general act as bushings and may be fixedly positioned on the pipe and rotate with it or be loosely positioned thereon and permit of limited motion in an axial direction, as well as floating or not rotating with the pipe while the latter is rotating and descending into the well.

Illustrations of the former type of protector are seen in my U.S. Pat. Nos. 3,019,063 and 3,094,360. Illustrations of the latter type are seen in U.S. Pat. No. 3,397,017 to Grant and in my co-pending application Ser. No. 810,136, mentioned above.

The problems have been attacked also by the use of different materials for the protectors and guides, such as special elastomeric materials and various plastic materials with or without the combination of metallic elements of various configurations.

In every instance, whether the protector or guide is stationary, or whether it is movable or floating, there is the problem of confining it to its fixed position or confining its travel within fixed and predetermined limits. This is very important in that the guide or protector must not travel along the rod or tube to points where it is not needed and especially over enlarged portions of the rod or pipe where it would expand and cause jamming.

To protect against the latter condition, various types of stop-collars have been used. These have comprised essentially, thrust collars similar to those used on rotating shafts of machinery, fixedly positioned on the rod or pipe by means of set screws or clamps and located at the desired positions. Illustrations of these are seen on my U.S. Pat. No. 3,094,360 and Grant's U.S. Pat. No. 3,397,017.

The problem of maintaining these stop-collars at the predetermined locations under the extreme conditions existing in oil well operations has been a tremendous one for many years.

The loads existing on a drill pipe may be as high as 40 tons or more. The tensile stress on the pipe wall, of course, causes it to elongate and consequently causes the outside circumference to decrease or shrink. Both of these effects combine to cause the stop-collars to loosen on the pipe or rod and shift position, thereby nullifying their value and, in fact, increasing the hazard to the well.

Another problem which aggravates the condition and is well known to those skilled in the art of oil field operations, is that any device of this class, especially pipe protectors and thrust or stop-collars, must be so constructed that they could be quickly and economically applied to the pipe and easily removed from the pipe in the field with a minimum expenditure of time and labor.

SUMMARY OF THE INVENTION

I have discovered that by utilizing a stop-collar of a novel construction comprising an elastomeric or similar material in combination with a metallic component, in itself having a number of novel features, I am able to solve the operating problems outlined above. I have discovered further that I am able to construct my novel collar so as to make it readily and easily applied to an oil well drill pipe, sucker rod, or other component, and quickly removed therefrom. I have discovered still further that my novel construction produces unusual and unexpected results insofar as adherence by my collar to a drill pipe or other well components are concerned, as well as resistance to undesirable movement while preserving the integrity of the well.

More specifically, I utilize a stop-collar which is basically of an elastomeric or similar material. Imbedded in the base I employ a metallic insert of spring steel, or similar material. My insert is specially constructed to effect a tight and positive bond with the base material of the collar and at the same time provide a positive contact with the drill pipe or rod.

I further employ a special configuration of the internal surface of my collar which multiplies the effectiveness of the bond between my collar and the pipe, or other element, while at the same time providing for proper circulation of the drilling mud or oil. Actually, the latter feature was at first introduced to provide for adequate circulation, but I have discovered that it produced an unusual and unexpected result insofar as strong contact between the collar and pipe as described more fully below.

I have discovered that by using the basic construction of my invention I am able, with the aid of comparatively simple tools, to effect the rapid and economical application of my collar to an oil well component and its removal therefrom. Part of this is due to the basic simplicity of my invention as compared with previous devices.

Finally, I have discovered further that by adding a concentric removable gripping ring on the interior surface of my collar and in contact with the pipe, I am able to obtain still greater adherence between the collar and the pipe and still be able to rapidly and simply remove the collar from the pipe and also to replace the removable gripping ring.

All of the foregoing will be evident to those skilled in the art from the detailed description which follows.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section through a typical well showing drill pipe, protector, and stop-collars.

FIG. 2 is a partial elevation of the upper end of one joint of a drill pipe showing location of protectors and stop-collars in position.

FIG. 3 is an isometric view of the stop-collar of my invention is unlatched position.

FIG. 4 is a metallic spring insert of my stop-collar, showing bonding holes, dogs, latch slot, and tongue.

FIG. 5 is a cross-section through a drill pipe showing the method of application of my collar.

FIG. 6 is an exploded isometric view of an alternate embodiment of my invention employing a removable gripping ring insert.

FIG. 7 is an isometric view of my collar showing the provisions for utilizing the gripping ring.

FIG. 8 is an end view of the removable gripping ring.

FIG. 9 is an end view of a corrugated backing spring which I may use instead of my removable gripping ring.

FIG. 10 is a cross-section through my collar showing the relationship between my collar and gripping ring.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings and particularly first to FIG. 1, there is seen the shaft of a drill pipe or sucker rod 1. Actually, what is shown in FIG. 1 is a drill pipe, but it will be evident to those skilled in the art that this description could be

readily applied to a sucker rod as well, with certain obvious modifications. In the case of a drill pipe, there is a hollow central channel 2 which is concentric with the outside diameter of the pipe and provides a conduit for the circulation of drilling mud. To facilitate the junction of successive lengths of drill pipe, the latter are equipped with tapered sections 3 to enlarge the diameter and provide for a threaded section 4 at each end, one being a male type and the other a female type connecting element. The bore tube or well casing 5 is of suitable metallic construction well known to those skilled in the art.

A protector 6 is disposed to ride on the outside diameter of the drill pipe 1 and bear against the inside diameter of the bore tube 5. The protector may be of any particular construction known to the art, such as that described in my application Ser. No. 801,136. It may be of plastic, elastomeric, or even metallic construction and is equipped with a locking pin 7 and liquid circulating grooves 9 in the embodiment shown on FIG. 1. My stop-collars 11 equipped with latching holes 12 are positioned on drill pipe 1 in a predetermined spaced relation with the protector in a manner described more fully below.

The actual relative position of the protector, and the stop-collars on the drill pipe will vary with the condition of the well. In a typical situation the first or upper stop-collar may be located approximately 3 feet from one end of the drill tube section with a space of approximately 2 inches between the stop-collars and the protector, permitting the corresponding amount of travel up and down by the protector. The actual overall length of drill pipe sections may be 30 feet or more.

In the case of particularly crooked or difficult wells, I may use two protectors which may be spaced approximately 3 inches apart, between one set of stop-collars. This embodiment is shown in FIG. 2. Here my two protectors 6 are equipped with locking pins 7 and interlocking joint 8, which facilitates snapping of the protector, usually of elastomeric or plastic material, around the outside of drill pipe 1. In this embodiment inner circulating grooves are seen at 10. The other elements and components are as described for FIG. 1.

Referring now more particularly to FIG. 3, there is seen my stop-collar 11 with its latching holes 12. The body of the stop-collar is comprised principally of an elastomeric material in which are provided axial grooves 14, the latter performing combined function of providing for circulation of liquid and the formation of contact pads on the inner surface of the collar 15, which are disposed to bear against the outside surface of the drill tube. Imbedded concentrically in the elastomeric material 13 is a metallic insert 16 which may be of spring steel or similar material. Near one end of the open collar 11 there is located a slot 17 which is in alignment with a tongue 18 positioned on the opposite end of the collar. Positioned on the metallic insert and protruding through he interior surface of the elastomeric material 13 are are punched out bonding tabs or dogs 20. The latter are best seen on FIG. 4 to which reference should now be had.

The metallic insert, which may be of any springy material, but I prefer to use a good grade of spring steel, is equipped with at least two rows of bonding holes 19 suitably spaced around the circumference of the inert 16. These serve to strengthen the physical bond between the metallic insert 16 and the elastomeric material 13, which may be accomplished by any suitable method known to the art.

The bonding tabs or dogs 20 are preferably punched out of the body of the metallic insert 16 in the form of protruding lips of roughly semi-circular configuration and disposed to point alternately toward opposite ends of the collar insert 16. They are likewise disposed to protrude beyond the inside surface of elastomeric material 13 as mentioned above and bite into the drill tube as described below. These tabs or dogs serve the additional purpose of strengthening the bond between the metallic insert 16 and the elastomeric material 13.

Seen also on FIG. 4 is slot 17 and tongue 18 which form an integral part of the metallic insert 16 and combine to form a latching mechanism for the collar. The function of all of the foregoing elements and their inter-relationship may be understood from a study of FIG. 5 to which reference should now be had.

In addition to illustrating the method of application or installation of my stop-collar on a drill pipe, FIG. 5 shows another view of the various elements of my invention described above. To install my collar I first open it manually a sufficient distance to permit spring it over the outside circumference of drill pipe 1 in a radial direction somewhere near the desired final location on the drill pipe with reference to the pipe itself, as described above. I then may slide it axially to its final position on the pipe, manually. I then employ my special installation tool 21. This comprises essentially a pair of tongs having a high mechanical advantage or leverage ratio and equipped with latching pins 22. The latching tool 21 is open sufficiently so that latching pins 22 may line up with outer latching holes 12. The pins 22 are then inserted in the corresponding holes 12 and the handles of tool 21 brought together which acts to compress the entire collar 11. This is continued until tongue 18 is opposite slot 17 into which it then springs due to the inherent springiness of my collar. At this point the latch pin 22, which is closest to tongue 18 will be opposite center latching hole 12, on my collar, thereby providing clearance for the part of latching pin 22 which protrudes through the interior of metallic insert 12 and facilitates the completion of the joining of the collar around the pipe.

Referring again to FIG. 4 there is seen a section of metallic insert 16 extending from its inner end as far as slot 17 and designated as 16*a*. This may be referred to as my 'land.' The inherent springy nature of my insert 16 as hereinabove set forth causes my tongue 18 to ride on the surface of land 16a as the insert is being compressed by the action of tool 21. When tongue 18 riding on the land comes opposite to slot 17 it automatically springs into slot 17. Because of its acute angle configuration described above, tongue 18 provides a positive engagement of my collar. I may round off the engaging edge of slot 17 to facilitate this engagement. In my event, it is evident that I may rapidly effect this engagement by movement of my tongue 18 only along its own cylindrical surface in a circumferential direction and need not employ any special tool or other means to effect axial movement of my tongue 18 in order to effect its engagement with slot 17.

In other words, engagement between the tongue and slot of my invention may be effected by movement in a single circular plane only, which is of tremendous advantage in view of the high pressures and stresses encountered which make latching and unlatching devices of this type exceedingly difficult.

The use of this construction and method of installation produces a combination of effects, the result of which are to provide an unusually strong bond or adherence between my collar and the drill tube.

In addition to the holding effect resulting from the positive action of the digs 20, I obtain an unusual and highly effective bonding action between the inner surface of my collar and the outer surface of the pipe. This is brought about by the effect of the pads 15 which are formed as a result of the circulation grooves 14 as described above. These pads act individually because of the resilient nature of the material under the action of the spring tension of the metal insert 12. Thus any irregularity, deformation, or entry of foreign matter between the tube and inner surface of the collar is automatically compensated for, which would not be the case if this inner surface were continuous. In this manner, a very unusual and unexpected increase in bond between collar and tube results.

To provide for still more positive contact between my collar and the rotating pipe I may install my collar on the pipe so that the direction of rotation of the pipe tends to increase the strength of engagement between my slot 17 and tongue 18. Thus as shown in FIG. 3 my drill pipe would be rotating in a clockwise direction when viewed from the top of the figure. To insure this I may mark the direction of rotation at an appropriate place on my collar and place the word "" on the upper edge of the collar thus assuring installation of my collar on the pipe to obtain the greatest advantage from my construction.

Of course, I proportion the inside diameter of my collar in relation to the outside diameter of the drill pipe in a predetermined relationship depending on the nature of the material which I use for my elastomeric cover and in proportion to its known resilience. This will vary with he particular material used, but will not affect the basic nature of the strong bond which results from my construction and method and installation.

It should now be evident to those skilled in he art that in addition to the high bond which I obtain, my collar may be very readily and quickly installed in the field and very easily removed. In fact, the removal may be effected by merely placing a screw driver between the overlapping portions of the collar at a point close to the slot **17** and tongue **18** and giving it a slight twist, thereby causing the collar to spring off. My construction and installation, it is evident, eliminates the use of set screws, pins, or other additional components to effect the desired result.

As stated above, I have described an installation applying particularly to a drill pipe. It should now be evident also that similar installation of my collar may be made on a sucker rod. When located on a sucker rod close to its upset portion or close to the coupling, my collar may act as a protector in itself. This is particularly advantageous in protecting the well tubing as the rod moves or heaves during operation and especially so in a particularly crooked well. I have also found that my construction and method of installation may be used to position a centralizer on a well casing as a protector itself or as a sub-stabilizer, as for example, on a Kelly bar. In all these applications, the construction of my collar and its method of installation are essentially like those described above for a drill pipe.

Attention should now be had to figs. **6** through **10** which illustrate an alternate and improved embodiment over those disclosed above. In this embodiment I provide a concentric circular groove **21** in the body of my collar **13**. I then provide a new ring insert **22** best seen on FIG. **8** which is disposed to fit inside groove **21** and is equipped with vertical circulation grooves **23** which are disposed to coincide with the old grooves **14** in the basic collar.

Instead of my ring insert **22** I may use a spring or corrugated member **25**, best seen on FIG. **9**, inserted in groove **21**. This ring, like my ring **22**, is disposed to bear against and apply pressure to the outer surface of the drill pipe. When using my ring **22** I may provide it with chamfered edges **26** to comprise a dovetail construction between basic ring **13** and insert **22** which may be best seen on FIG. **10**.

For the material for my removable insert **22** I may use any suitable elastomeric or plastic material depending upon the particular special application. My corrugated member **25** may be of any metal or other resilient material and may be coated with a plastic or elastomeric material. I have discovered, for example, that differently fabricated materials have different gripping power as distinguished from generally molded materials which have good wearing properties.

As thus constructed, my gripping ring provides a very greatly increased resistance to motion of the collar in an axial direction and greatly improves its gripping action. As thus constructed also, my gripping ring may be readily removable and replaced with rings having a smaller inside diameter to compensate for pipe wear.

The grooves in an axial direction **23**, of course, preserve the circulating features of my basic disclosure described above.

I claim:

1. In a split collar of generally cylindrical configuration for oil well drilling equipment and having a body of elastomeric material, the improvement comprising:

a spring member of generally cylindrical configuration embedded concentrically in said body;

a slot through said body and said spring member positioned near the first end of said collar;

that portion of said body external to said spring member terminating at a point adjacent to said slot thereby forming an exposed outer surface of said spring member from said slot to said first end of said collar;

a tongue positioned on the second end of said spring member in alignment with said slot, forming an acute angle with the tangent to said spring member, protruding inwardly through said body and disposed to bear against said exposed outer surface of said spring member;

means associated with said spring member for tightening said collar around a cylindrical shaft and simultaneously causing said tongue to ride against said exposed outer surface until said tongue springs into said slot;

whereby said collar is held in a tightly fixed position around and against said shaft;

said means for tightening being further characterized by effecting the engagement between said tongue and said slot through movement of said tongue in a single circular plane.

2. A split collar of generally cylindrical configuration for use with oil well drilling equipment and employing a spring member imbedded in a body of elastomeric material, said collar being characterized by:

means for tightening said collar around a cylindrical shaft;

positive tongue and slot means for engaging said collar around said shaft in a tightened position;

engaging means positioned on the inner surface of said collar,

said engaging means being disposed for contact against said shaft to prevent axial movement of said collar relative to said shaft;

said spring member in said collar having an area positioned on its outer cylindrical surface adjacent to and in cooperative relation with said slot and said tongue;

whereby the engagement of said collar around said shaft may be effected by movement of said tightening means in a circular direction only;

said spring member in said collar having an exposed area on its outer cylindrical surface encompassing said slot;

said tongue means being disposed for riding against said exposed area while under the action of said tightening means;

whereby the engagement between said tongue and said slot means and said collar around said shaft is effected by movement of said tongue means relative to said slot means in a circular direction only.

3. A split collar of generally cylindrical configuration for oil well drilling equipment comprising:

a body of elastomeric material;

a spring member in cooperative relation with said body;

axial grooves on the inside surface of said collar defining a plurality of parallel contact surfaces;

a plurality of holes through said spring member and around the circumferences thereof;

a slot positioned near the first end of said split collar;

a tongue positioned near the opposite end of said split collar and in alignment with said slot;

means associated with said spring member for tightening said collar around said shaft and causing said tongue to be inserted in said slot;

a circular groove around the inner surfaces of said collar;

a removable ring adapted for insertion in said grooves.

4. The collar of claim **3** in which said removable ring comprises the combination of a springy material and an elastomeric outer covering.

5. The device of claim **1** in which cooperating opposed ends of said spring member adjacent to said slot and to said tongue comprise overlapping cylindrical surfaces;

said ends of said surfaces being exposed on their axial edges;

whereby the disengagement between said slot and said tongue may be readily effected by insertion of disengaging means between said overlapping cylindrical surfaces in an axial direction only.

6. The device of claim **1** in which said acute angle formed between said tongue and spring member comprises in addition a circular arc between said tongue and said spring member.

7. The device of claim 1 in which said means for tightening said collar comprises a pair of oppositely spaced holes one of said holes being positioned adjacent said slot and the other positioned adjacent said tongue said holes being suitably reinforced to prevent rupture of said spring member while being subject to the action of said tightening means.

* * * * *