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- (71) Applicant: **BAKERHUGHES INCORPORATED**
[US/US]; P.O. Box 4740, Houston, TX 77210 (US).
- (72) Inventor: **LEMM, William, C.**; 2203 Country Club Blvd.,
Sugar Land, TX 77478 (US).
- (74) Agent: **PORTER, Andre, J.**; Intellectual Property Coun-
sel, Baker Hughes Incorporated, P.O. box 4740, Houston,
TX 77210-4740 (US).
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(54) Title: RELATIVELY MOVABLE SLIP BODY AND WICKER FOR ENHANCED RELEASE CAPABILITY

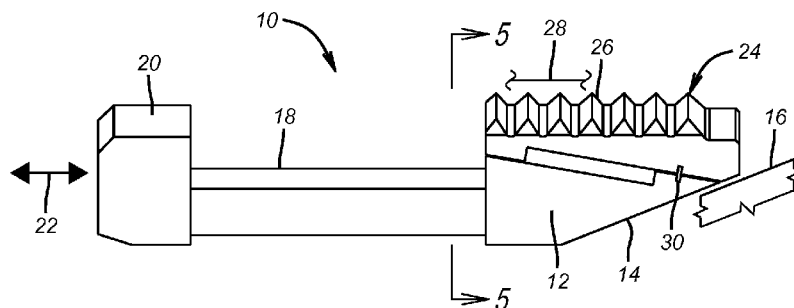


FIG. 1

(57) Abstract: A slip assembly is in two pieces that move relatively to each other to facilitate release. The wicker portion is dove-tailed to the base near a center underside location and at the edges. A positive travel stop converts the initial relative movement into tandem movement of the base and the wicker segment after a predetermined relative movement that has resulted in release. Adjacent components prevent relative movement during the radially outward movement for setting the assembly during which there is tandem movement of the base portion and the wicker portion. The two portions can be initially attached with a breakable member that fails during the release movement.



RELATIVELY MOVABLE SLIP BODY AND WICKER FOR ENHANCED RELEASE CAPABILITY

FIELD OF THE INVENTION

[0001] The field of the invention is slips for anchoring subterranean tools and more particularly a multi-component design that allows relative movement between a slip body and a wicker segment to facilitate release.

BACKGROUND OF THE INVENTION

[0002] Slips are typically extended by relative movement with respect to an adjacent cone. As the slip element rides up the cone it is moved radially toward a surrounding tubular. The leading face of each slip has a surface treatment commonly referred to as wickers which can be made of a hard material such as tungsten carbide or polycrystalline diamonds to enhance the bite of the slips into the surrounding tubular. Traditionally, slip wickers are made of carburized (heat-treated) steel. Wickers can also be made of high-yield materials coated with tungsten carbide or carbide inserts can be used in place of wickers by affixing them to a base material. Typically the wickers penetrate the inner wall of the pipe to facilitate the grip. Slips commonly anchor isolation devices such as packers and bridge plugs.

[0003] The common issue with slips is to get them to release especially after being set a very long time or after being exposed to extreme loading or operating conditions. Typically, force is applied to the slip to try to force the slip to ride down on the cone for a release of the wickers. Sometimes, especially after a long period of being in a set position and in a debris laden environment it becomes difficult to get the slips to release. Sometimes the slips refuse to fully release and a milling operation that is very expensive is needed to enable removal of the associated device.

[0004] Prior designs guide the slips at their edges to make sure they don't cock when being extended and to allow them to tangentially transfer radial loading when part of a continuous slip ring. Typical of some of the one piece slip arrangements are: US 4311196; GB 2323869; US 6213204; US 5487427; US 5174397; US 3279544; and US 6241017. Existing designs also pose an issue with manufacturing complexity and associated cost, both with the slips

and supports, as well as the isolation device itself. These designs still present an issue of difficult release and the present invention presents a design to deal with this issue. The design features a two piece construction with a relatively movable base structure allows pulling the base of the assembly out from under the set wicker portion. The two elements move in tandem for a set. The base portion guides the wicker portion above both in the center and the edge of the wicker portion. These and other features of the present invention will be more readily apparent to those skilled in the art from a review of description of the preferred embodiment and the associated drawings while recognizing that the full scope of the invention is to be determined from the appended claims.

SUMMARY OF THE INVENTION

[0005] A slip assembly is in two pieces that move relatively to each other to facilitate release. The wicker portion is dovetailed to the base near a center underside location, at the edges or both. A positive travel stop converts the initial relative movement into tandem movement of the base and the wicker segment after a predetermined relative movement that has resulted in release. Adjacent components prevent relative movement during the radially outward movement for setting the assembly during which there is tandem movement of the base portion and the wicker portion. The two portions can be initially attached with a breakable member that fails during the release movement.

[0006] It may also be possible to invert the geometry, such that the wicker and slip body segments are dovetailed at the edge with motion constrained by a tab at the center of the wicker segment and a slot of predetermined length in the center surface of the slip body segment.

This alternative geometry would be more complicated, but it is feasible and it may allow additional shoulders between the parts at release.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a side view of the assembly in the run in position;

[0008] FIG. 2 is a perspective view of the assembly looking at the top of the assembly in the run in position;

[0009] FIG. 3 is a side view of the assembly in the released position;

[0010] FIG. 4 is a perspective view of the assembly in the released position;

[0011] FIG. 5 is the view along lines 5-5 of FIG. 1; and

[0012] FIG. 6 is a perspective view of the bottom of the assembly in the run in position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] FIG. 1 illustrates a base assembly **10** that has a wicker support segment **12** that has a ramp **14** to ride along a slip cone schematically illustrated as **16**. The mandrel of the tool is not shown but such a mandrel supports the cone **16** and has a device to create relative movement for setting and releasing a slip. Segment **12** has a shank **18** that leads to end **20** which is retained by an actuating mechanism that is not shown but is well known in the art. Arrow **22** represents the bidirectional forces that can be applied during the setting and release sequences. For setting a force is applied toward the cone **16**. The wicker segment **24** moves in tandem with the base assembly **10** up the cone **16** until the wickers **26** engage and penetrate into the surrounding tubular schematically illustrated as **28**. A breakable member **30** can be optionally used to hold the base segment **12** to the wicker segment **24**. This device can be a shear pin or other comparable device that releases on a predetermined shear force. During the tandem movement for the setting of the assembly the breakable member **30** will stay intact. At the onset of a pulling force away from cone **16** being applied to end **20** the breakable member **30** will fail. The base segment **10** will then be retracted and its movement will be guided by a dovetail **32** near the center bottom of the wicker segment **24**. There is also edge guiding using opposed inwardly facing edge guides **34** that extend from the underside **36** of the wicker segment **24** onto an adjacent guide surface **38**. Although this detail is shown in the drawings on one side, it is actually disposed on opposing sides so that the relative movement of segment **12** with respect to the wicker segment **24** that is against the tubular **28** is guided laterally on opposed parallel surfaces **40**, only one of which is shown in the drawings. Surface **42** on guides **34** eventually engages surface **44** on opposed sides of segment **12** and after that engagement there is tandem movement of the base segment **10** with the wicker segment **24**.

[0014] Those skilled in the art will appreciate that the slip assembly has two relatively movable parts allowing a base segment to be pulled out from under a wicker segment. The use of the segment design allows the use of dissimilar materials for the base and wicker segments. It also allows

maintaining full area contact for the wicker segment on the surrounding tubular when set. The fixation for tandem movement when setting has support in the center of the underside of the wicker segment and edge support so that during the release sequence the base segment comes back straight using the dovetail and edge guiding. After a predetermined amount of movement of the base relative to the wicker segment there is a travel stop that ends such relative movement so that the wicker segment is forcibly brought down the cone ramp after much of the loading has already been released due to the initial movement of the base segment. As a result much lower release forces are needed than in the known designs and the risk of pulling so hard that the slip shears in two as has happened in the past is removed.

[0015] The above description is illustrative of the preferred embodiment and many modifications may be made by those skilled in the art without departing from the invention whose scope is to be determined from the literal and equivalent scope of the claims below:

I claim:

1. A slip assembly for securing a subterranean tool to a surrounding tubular, comprising:
 - a mandrel supporting a ramp;
 - a slip assembly for selective movement along said ramp for selective contact and release from engagement with the surrounding tubular, said slip assembly further comprising:
 - selectively relatively movable and stacked base and wicker segments for movement on said ramp to bring said wicker segment into contact with the surrounding tubular and to release from the surrounding tubular.
2. The assembly of claim 1, wherein:
 - said base and wicker segments move in tandem when moving toward the surrounding tubular.
3. The assembly of claim 1, wherein:
 - said base segment is moved relatively to said wicker segment when said wicker segment is against the surrounding tubular for release of said wicker segment from the surrounding tubular.
4. The assembly of claim 1, wherein:
 - said relative movement brings stop surfaces on said segments into contact for subsequent tandem movement.
5. The assembly of claim 1, wherein:
 - said segments are axially relatively movable.
6. The assembly of claim 1, wherein:
 - said wicker segment is dovetailed to said base segment.
7. The assembly of claim 1, wherein:
 - said wicker segment further comprises edge projections to maintain alignment between said segments during relative movement between them.
8. The assembly of claim 1, wherein:
 - said segments allow the use of different materials.
9. The assembly of claim 1, wherein:
 - said segments are dovetailed together about their respective center axes.

10. The assembly of claim 1, wherein:
said base segment comprises opposed edge recesses in which ride opposed projections on said wicker segment for guidance of relative movement therebetween.
11. The assembly of claim 1, wherein:
said segments can be initially secured to each other with a breakable member.
12. The assembly of claim 11, wherein:
said breakable member remains intact during initial tandem movement toward the surrounding tubular.
13. The assembly of claim 1, wherein:
said base segment is pulled out from under said wicker segment to remove a compressive reaction force on said wicker segment from the surrounding tubular for release of said wicker segment from the surrounding tubular.
14. The assembly of claim 1, wherein:
said base segment has opposed guiding surface disposed at an angle to an axis of said mandrel.
15. The assembly of claim 2, wherein:
said base segment is moved relatively to said wicker segment when said wicker segment is against the surrounding tubular for release of said wicker segment from the surrounding tubular.
16. The assembly of claim 15, wherein:
said relative movement brings stop surfaces on said segments into contact for subsequent tandem movement.
17. The assembly of claim 16, wherein:
said segments are axially relatively movable.
18. The assembly of claim 17, wherein:
said wicker segment is dovetailed to said base segment.
19. The assembly of claim 18, wherein:
said wicker segment further comprises edge projections to maintain alignment between said segments during relative movement between them.

20. The assembly of claim **19**, wherein:

said base segment is pulled out from under said wicker segment to remove a compressive reaction force on said wicker segment from the surrounding tubular for release of said wicker segment from the surrounding tubular.

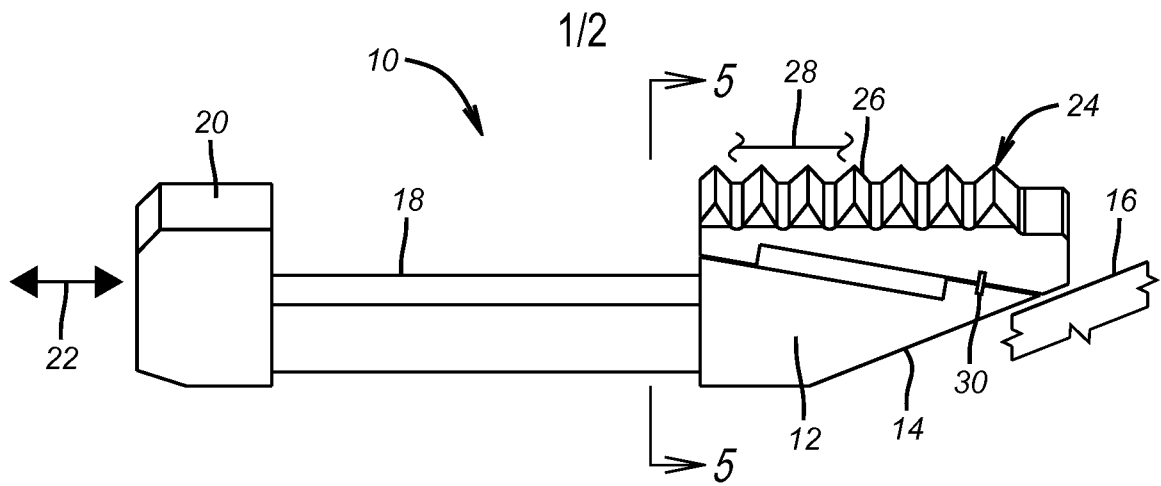


FIG. 1

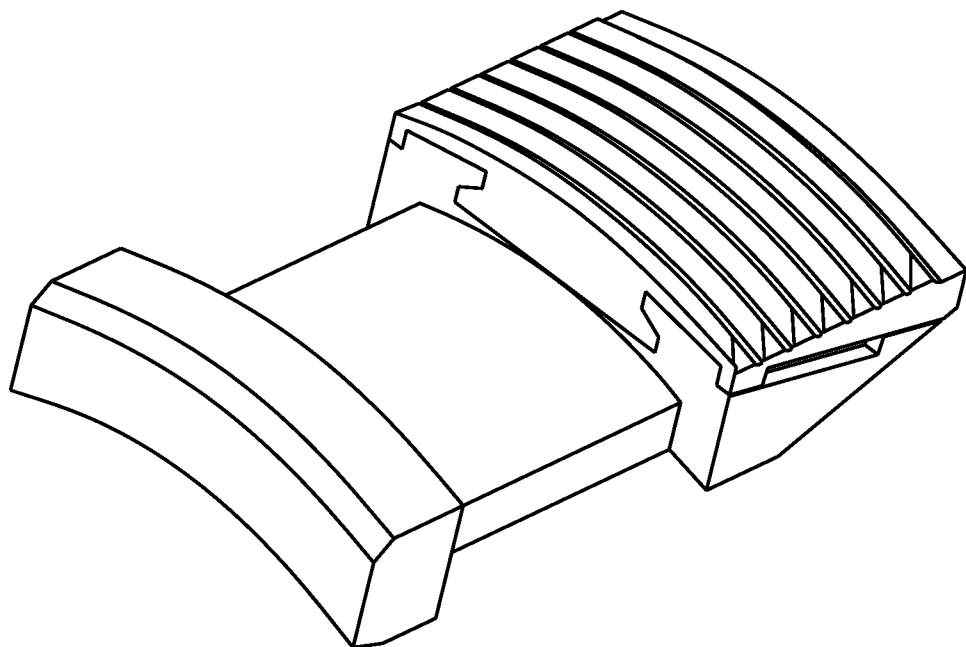


FIG. 2

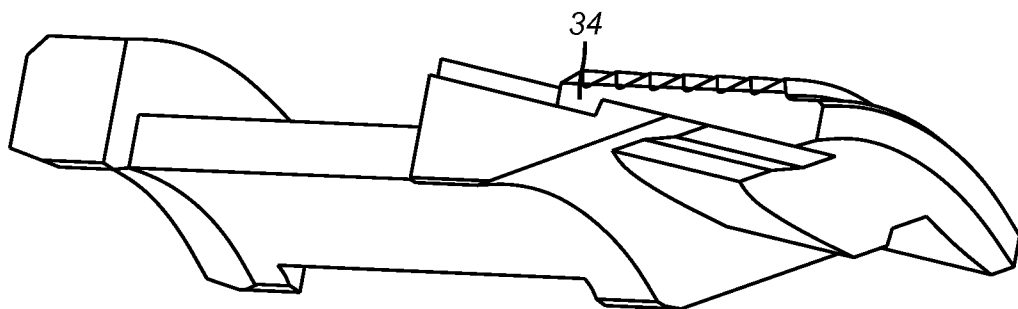


FIG. 3

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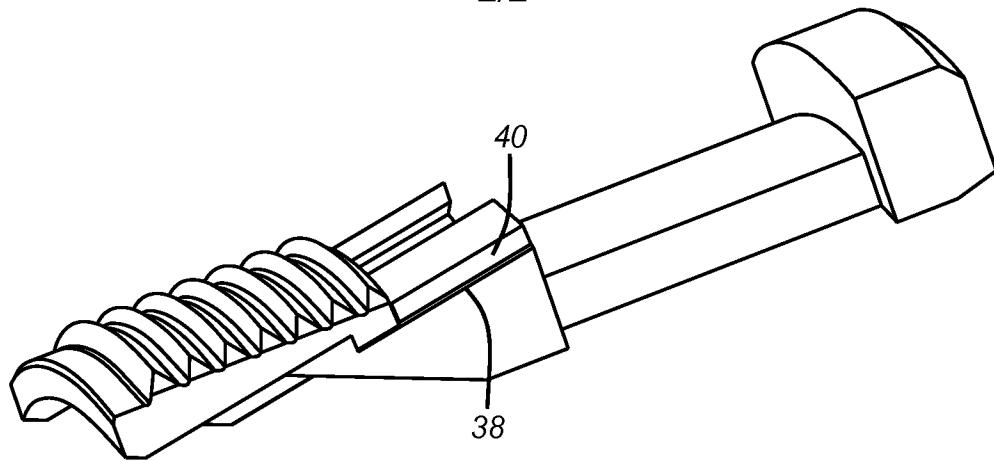


FIG. 4

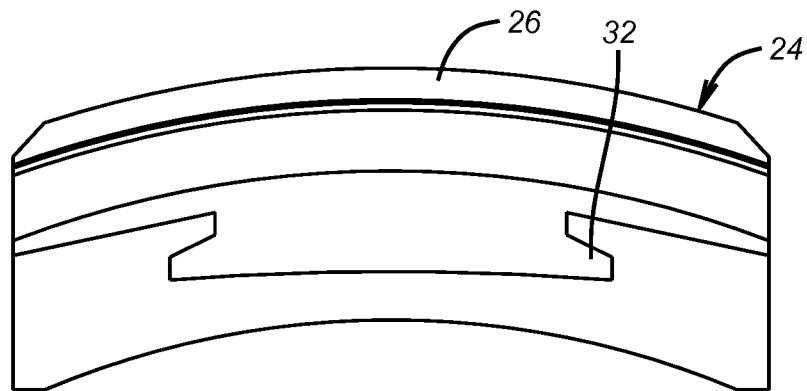


FIG. 5

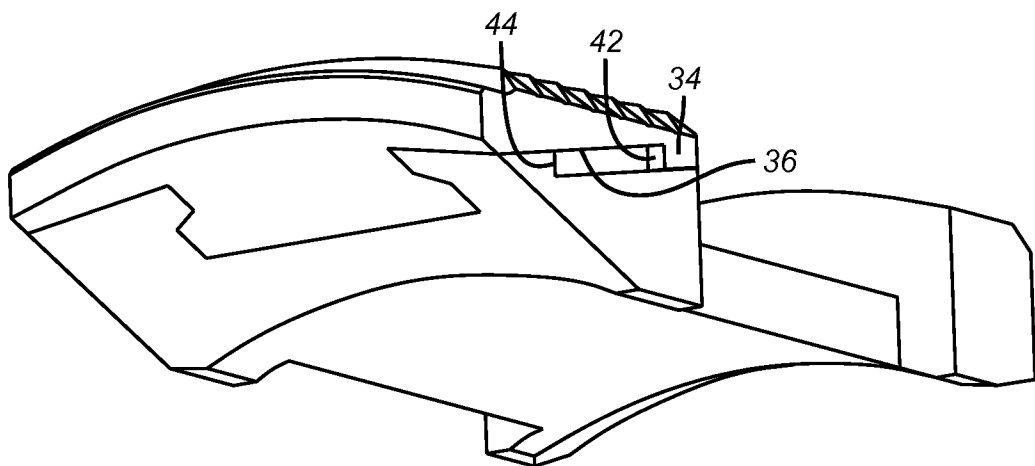


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/024392**A. CLASSIFICATION OF SUBJECT MATTER****E21B 23/01(2006.01)i, E21B 33/129(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
E21B 23/01; E21B 33/12; E21B 19/16; E21B 7/08; E21B 23/00; E21B 43/10; E21B 33/129Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: slip assembly, ramp, wicker, breakable member, and relatively movable**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012-0292053 A1 (XU et al.) 22 November 2012 See paragraphs [0019], [0022], [0029] and figures 1-2, 7.	1-20
A	US 2012-0111556 A1 (PALMER et al.) 10 May 2012 See paragraphs [0057]-[0058] and figures 9A-9C, 10.	1-20
A	US 5174397 A (CURRINGTON, A. RONALD) 29 December 1992 See column 3, line 55 - column 5, line 65 and figures 1, 5a-5c.	1-20
A	US 4762177 A (SMITH, JR., SIDNEY K.) 09 August 1988 See column 4, line 17 - column 5, line 2 and figures 2, 4-6.	1-20
A	US 8505651 B2 (BRANDT et al.) 13 August 2013 See column 2, lines 13-37 and figure 2.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

LEE, Dal Kyong

Telephone No. +82-42-481-8440



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/024392

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US 5174397 A	29/12/1992	None	
US 4762177 A	09/08/1988	None	
US 8505651 B2	13/08/2013	US 2011-0253386 A1 WO 2011-130123 A2 WO 2011-130123 A3	20/10/2011 20/10/2011 05/01/2012