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(54) PIPE JOINT CATCHING TOOL WITH REPLACEABLE BLADES

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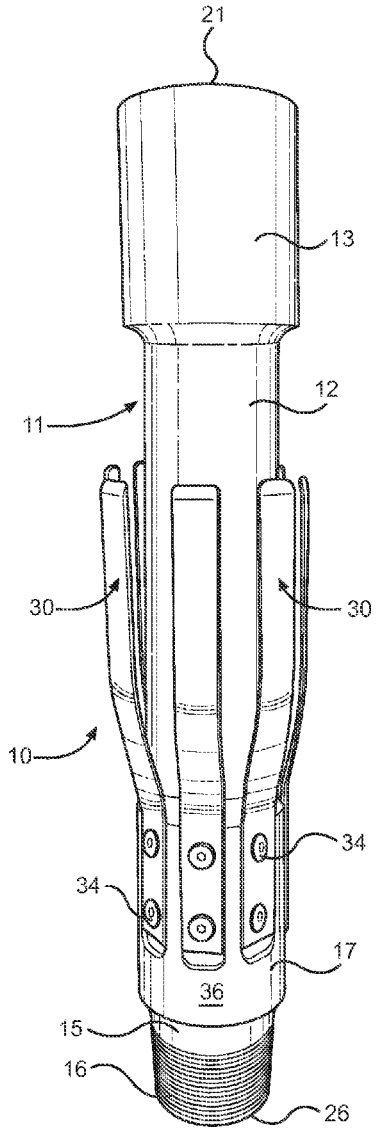
(57) **ABSTRACT**

A pipe joint debris catching tool for oil and gas wells including a monolithic and integrally formed pipe joint having a central body portion, opposite female and male end connector portions and an enlarged outwardly extending tubular sleeve space between the male end connector and the central body portion and wherein guide blades are removably mounted with parallel grooves formed in an outer tubular wall of the tubular sleeve and which blade extend along a length of the central body portion but spaced therefrom.



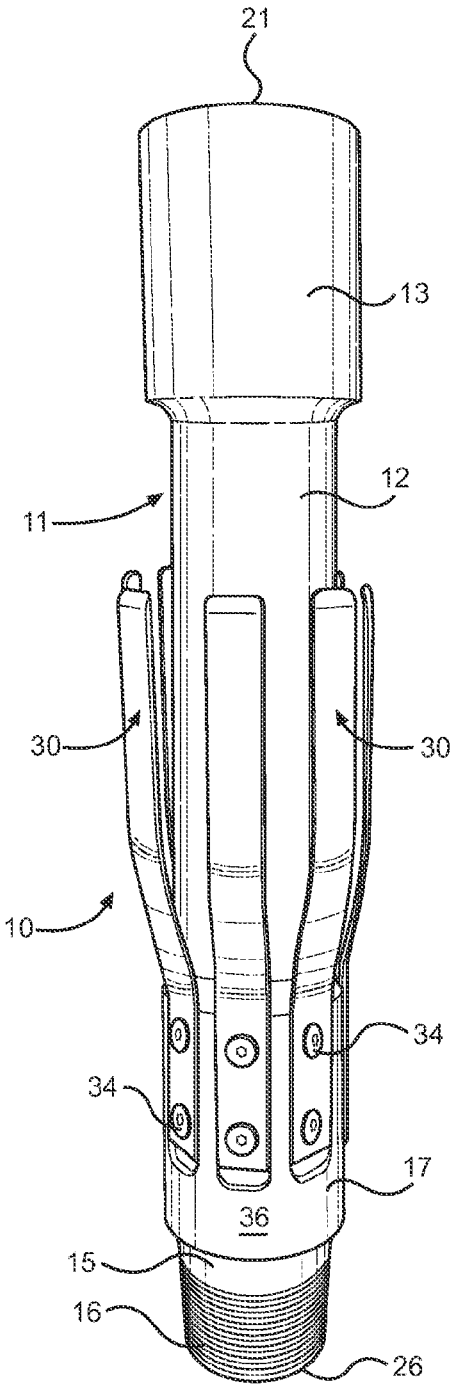

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FIG. 1

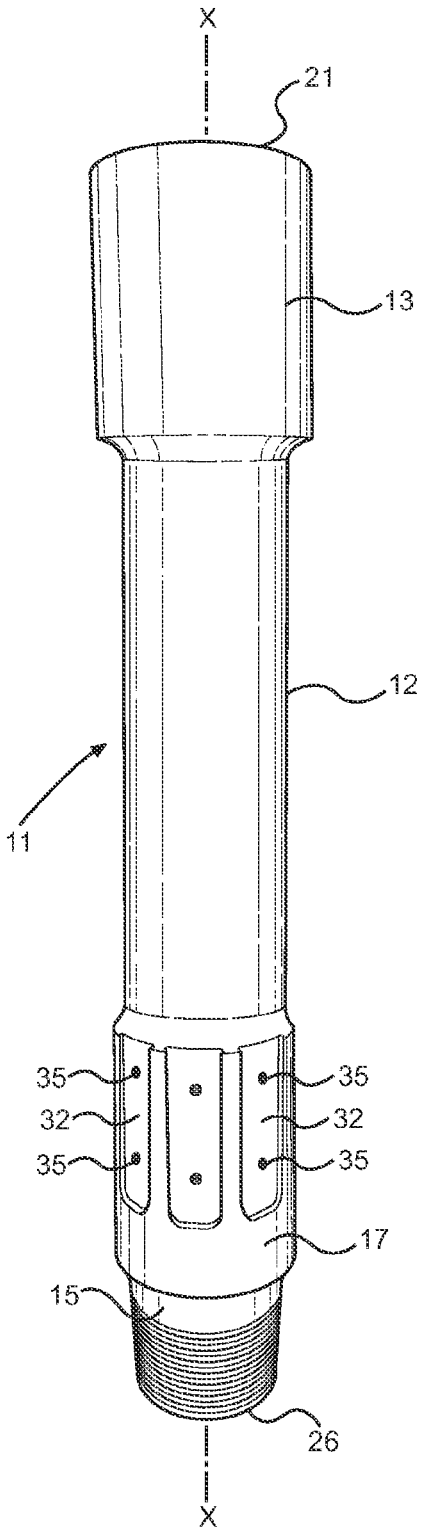
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FIG. 2

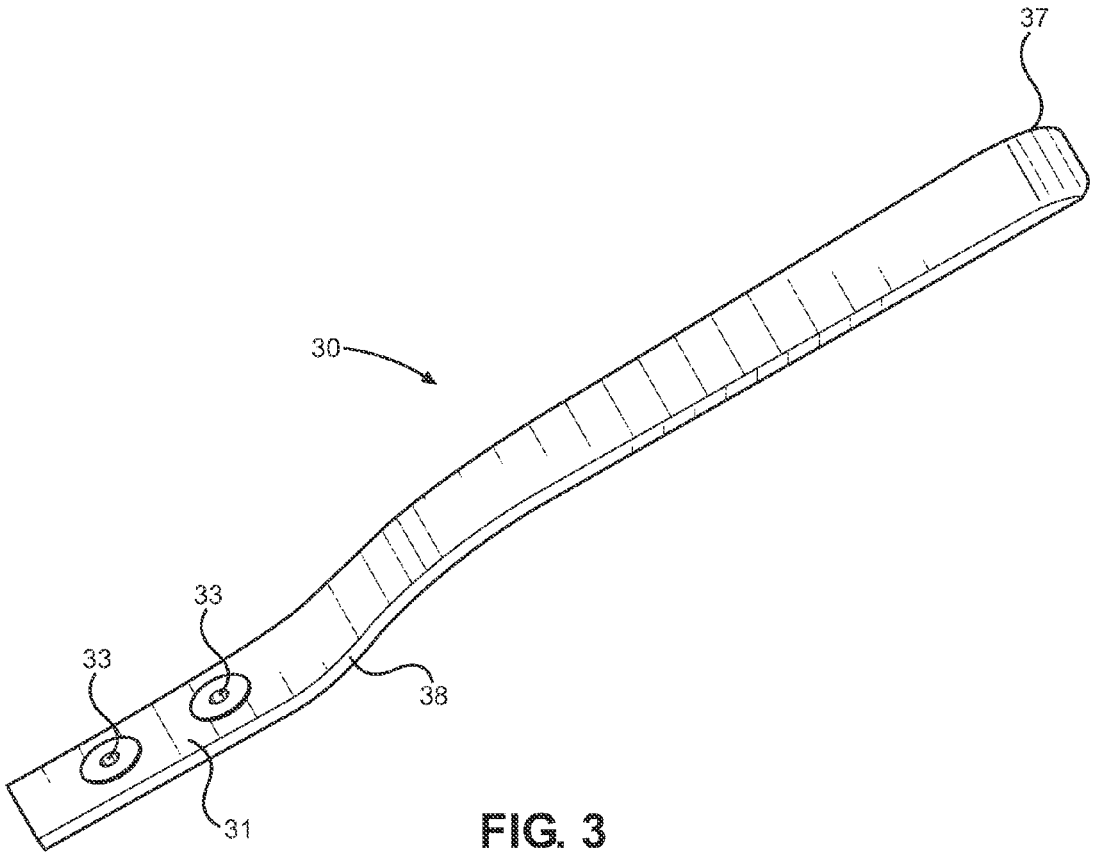

FIG. 3

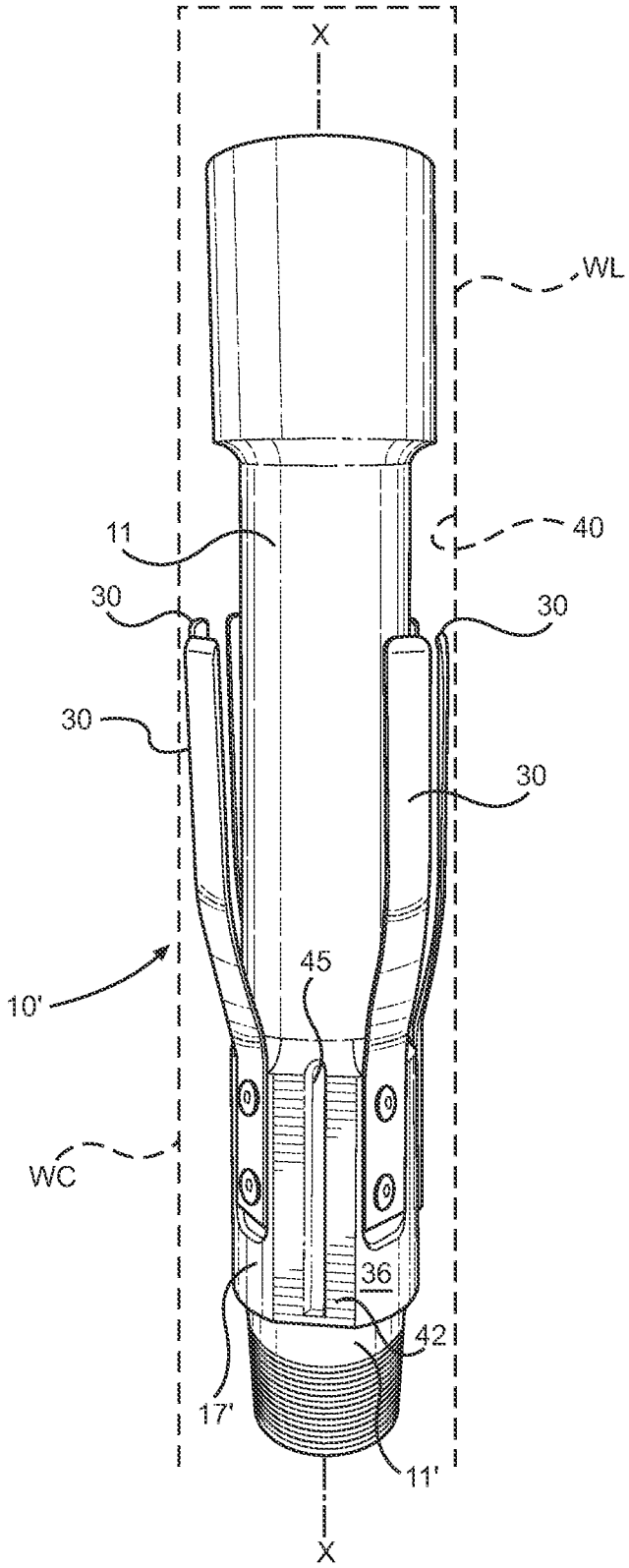

FIG. 4

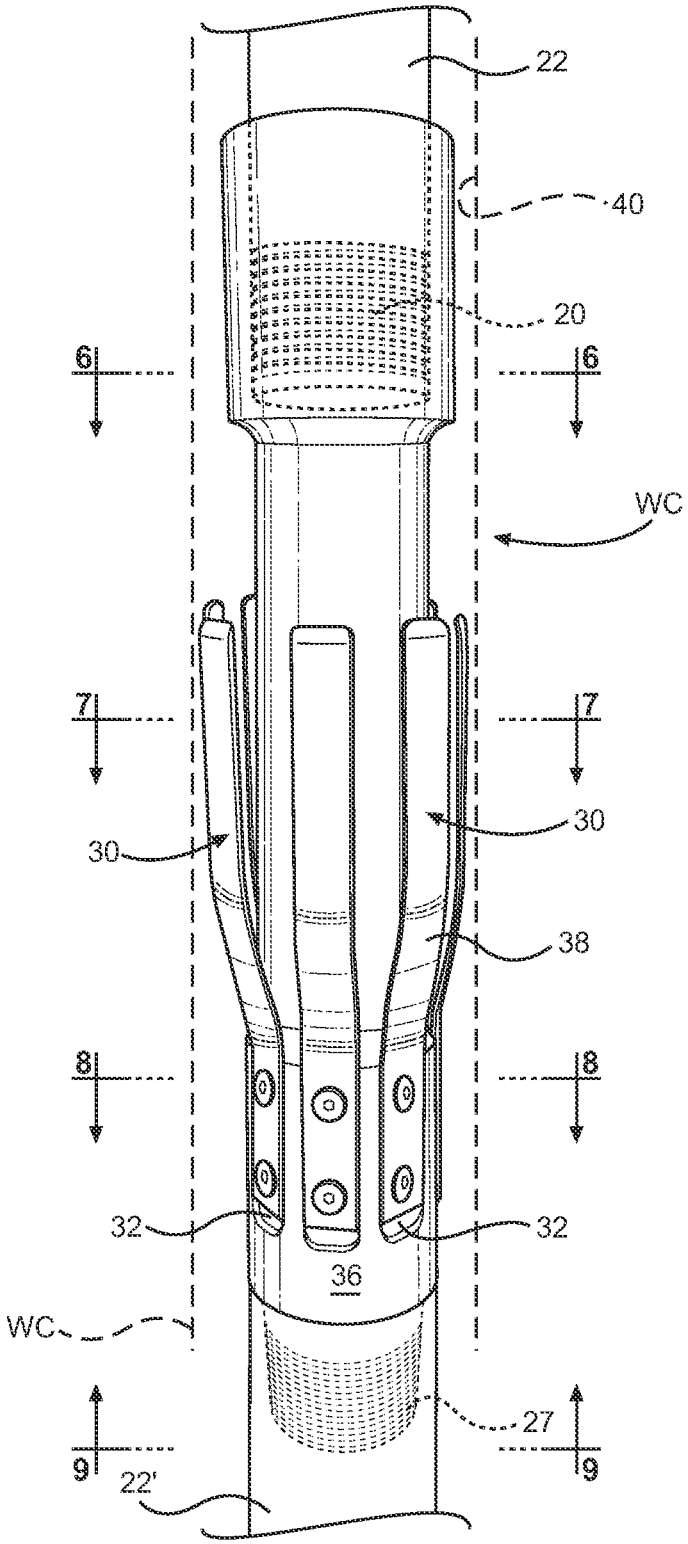

FIG. 5

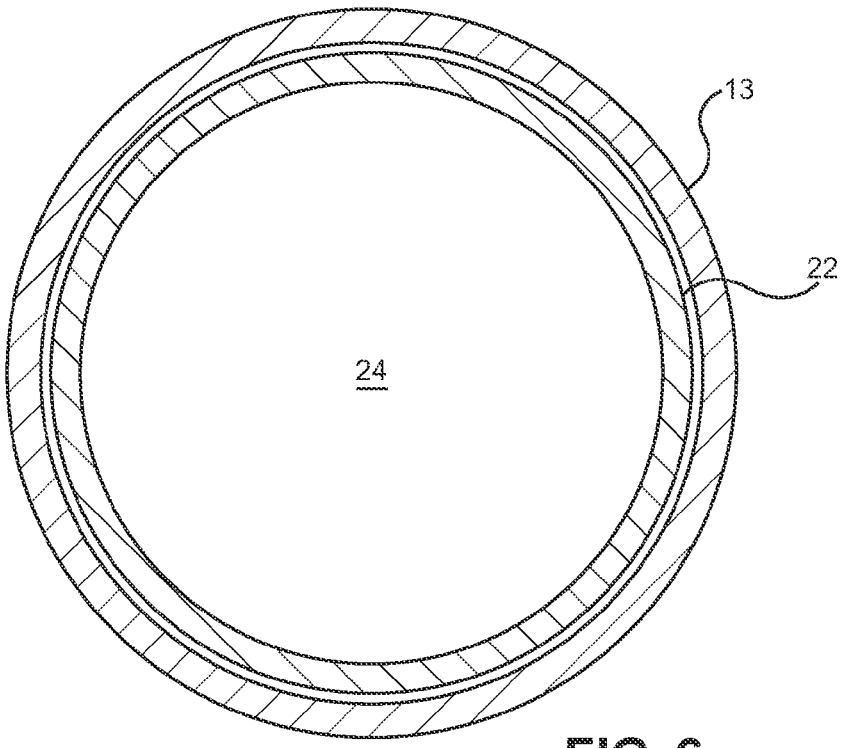

FIG. 6

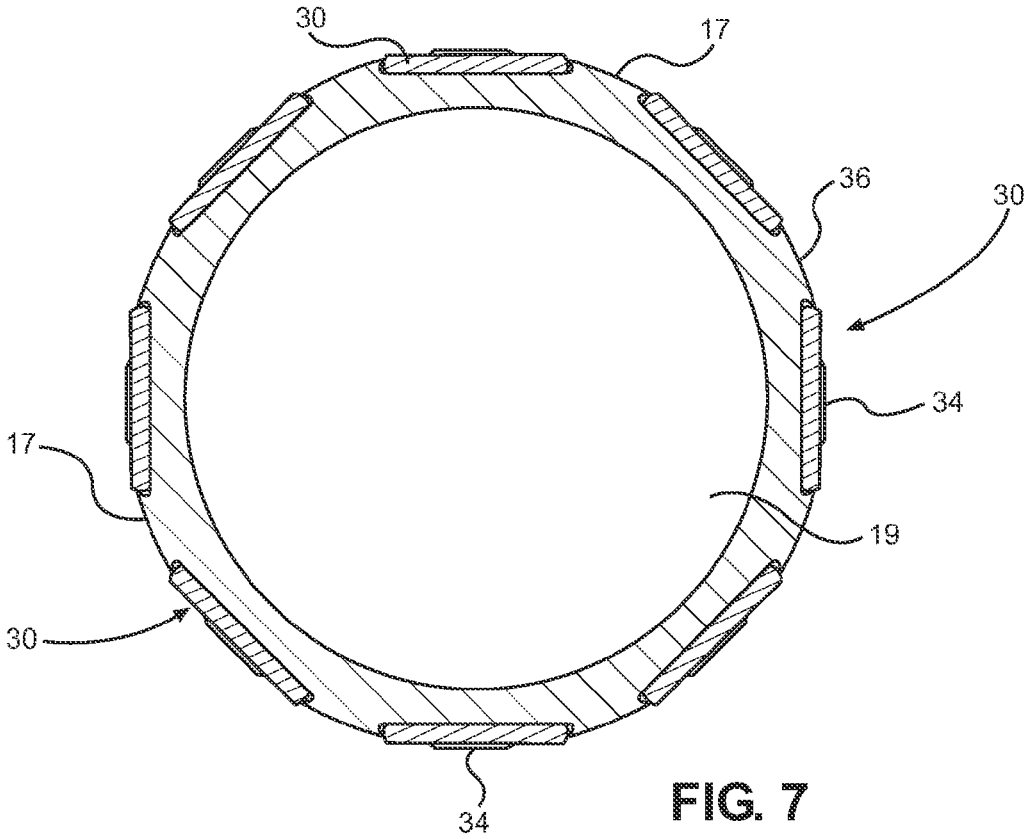

FIG. 7

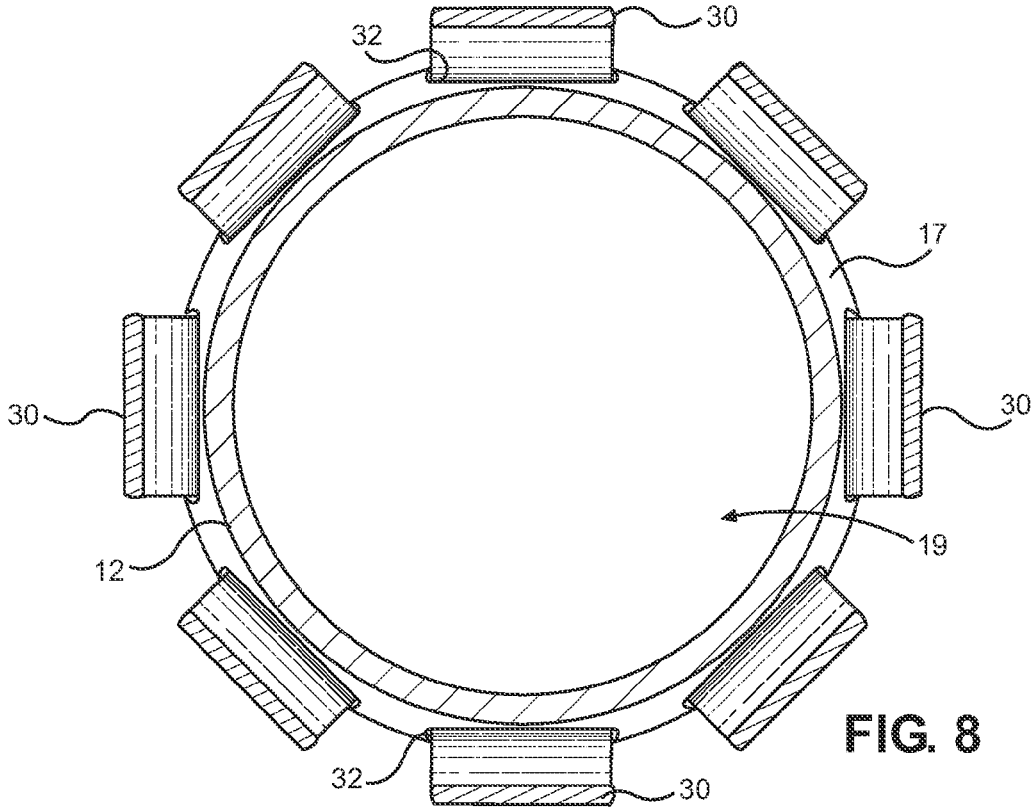

FIG. 8

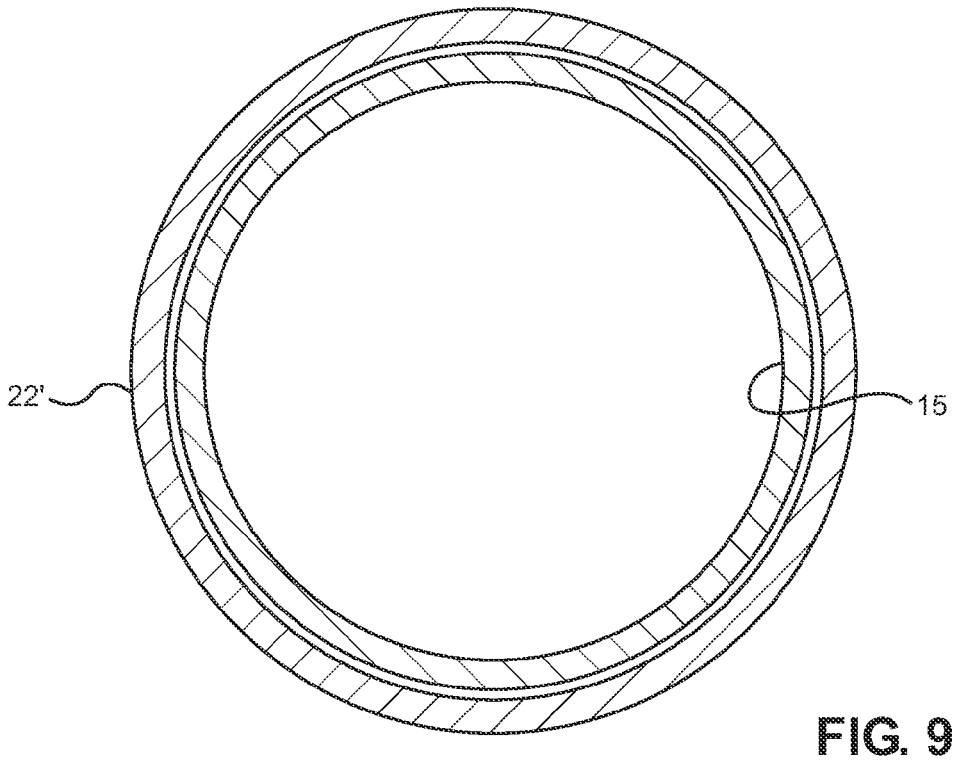

FIG. 9

PIPE JOINT CATCHING TOOL WITH REPLACEABLE BLADES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention is general directed to the field of tools used to trap or retain debris as production tubing is removed from a casing of an oil or gas well. More particularly, the invention is directed to a catching tool formed as a monolithic integral steel pipe joint which is connectable between two sections of production tubing and wherein a plurality of replaceable spring blades are attached to a body of the catching tool and have outer free ends and wherein the blades are configured to flexibly engage against the casing during use such that debris within the casing may be trapped and retained between the spring blades and the body of the catching tool as the production tubing is raised relative to the well casing.

Brief Description of the Related Art

[0002] The debris catchers or baskets have been developed due to a need to protect electrical submersible pumps (ESP) of the type used in oil and gas wells from being obstructed or damaged by debris within a well casing. The debris may include broken or dislodged clamping bands that are used to retain electrical lines or cable to production tubing so that the lines or cables will not become twisted or obstruct movement of the production tubing as the tubing is moved within a well casing. The bands may also be used to secure capillary tubes relative to production tubing if such tubes are necessary in a given well.

[0003] One example of debris catcher or basket is disclosed in U.S. Published Patent Application 2012/0024522, published Feb. 2, 2012 to Ronald E. Dobson et al. As described in this published application, the catcher includes a plurality of blades that are mounted within slots formed in a generally cylindrical collar of a size to fit within well casings having inside diameters from 7 to $9^{5/8}$ inches. The collar includes oppositely oriented interior female screw threads formed within the inner bore of the collar for connecting to mating male threads of pup joints connected along a production tube stand or string. Semi-circular wings are welded to the exterior of the collar so as to extend outwardly relative to an elongated central axis thereof in order to function as a "No-Go" to prevent the collar from slipping into a liner section of the well.

[0004] Unfortunately, the catcher disclosed in the published application is not constructed or suitable for use in wells having smaller inside casing diameters, such as those which are less than **6.0** inches in inside diameter, which wells are common in many areas.

SUMMARY OF THE INVENTION

[0005] The present invention was developed to provide for a debris catching tool, that may be used in a variety and wide range of sizes of oil and gas wells including those having interior casing diameters of less than 5.013 inches and yet having sufficient strength to prevent failure of the tool during use. The catching tool is formed as a monolithic integral steel pipe joint having a tubular central body portion and oppositely oriented integrally formed male and female ends for allowing the catching tool to be cooperatively threaded between two sections of production tubing. The central body portion defines a flow passage having a diameter equal to a diameter of the production tubing. The female end is also tubular but flares outwardly relative to the central body portion and defines an inner passageway having a diameter that is larger than the flow passage of the central portion. Screw threads are formed within the female end so as to cooperative receive a threaded male end of a section of production tubing such that, after the production tubing is secured to the female end of the catching tool, the effective diameter of a resulting flow passage through the joint is the same as the diameter of the central body portion of the tool. The male end of the tool has an inner flow passage having a diameter equal to the diameter of the inner flow passage of the central body portion of the tool and has outer screw threads for cooperatively engaging threads on a female end of a section of production tubing.

[0006] The catching tool also includes an outwardly flared integral generally tubular sleeve portion spaced between the male end of the tool and the central body portion thereof. The sleeve portion defines an inner flow passage having a diameter equal to the inner flow passage of both the central body portion and the male end of the tool.

[0007] However, an outer diameter of the sleeve is greater than outer diameters of both the central body portion and the male end of the tool and may be generally equal to an outer diameter of the female end of the tool.

[0008] A plurality of generally equally spaced and parallel slots are formed in an outer wall of the sleeve portion and open toward the central body portion of the tool. The width and depth of each slot is such as to cooperative receive a base portion of one of a plurality of replaceable spring blades therein such that outer surfaces of the base portions of the spring blades are generally flush with the outer surface of the sleeve portion when the spring blades are mounted within the slots.

[0009] As noted, the plurality of replaceable spring blades are attached at their base within the slots of the sleeve portion of the catching. The blades have outer portions that are spaced outwardly relative to the sleeve and body portions of the tool and that are configured to flexibly engage against well casing during use such that debris within the casing and located above the catching tool cannot pass between the blades and the casing but will be trapped and retained between the spring blades and the body of the catching tool as the production tubing is raised relative to the well casing. Outer free ends of the blades are preferably slightly tapered toward the central body portion of the tool with the outer portions of each blade between the base and the free end being somewhat concave toward the body of the tool. In the preferred embodiments, the free ends of the blades do not extend to the female end of the catching tool.

[0010] In one embodiment of the invention the blades are equally spaced about the sleeve and central body portion of the tool, such as by way of example only, eight (8) blades spaced at every 45 degrees relative to one another. However, in other embodiments, in order to created space along the outer surface of the sleeve portion of the tool for passage of a capillary tube or space for ESP cable between the tool and the casing, the space for one blade may be removed and a flat formed in the outer surface of the sleeve between two blades. Thus, the flat would be formed as opposed to a slot for the blade.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] A better understanding of the invention will be had with reference to the accompanying drawings wherein:

[0012] FIG. **1** is a side perspective view of a first embodiment of a monolithic pipe joint catching tool of the present invention showing a plurality of spring-like blades secured to an enlarged tubular band of the body of the tool;

[0013] FIG. **2** is a side perspective view of the embodiment of catching tool shown in FIG. **1** with the spring-like blades removed to show blade receiving slots formed in the enlarged tubular band portion of the body of the catching tool;

[0014] FIG. **3** is an enlarged perspective view of one of the spring-like blades of the catching tool of the invention;

[0015] FIG. **4** is a side perspective view of a second embodiment of the invention showing a flat formed on the enlarged tubular band of the body of the tool for purposes of providing passage spade for capillary tubes or ESP cable between the tool and a well casing in which the tool is used;

[0016] FIG. **5** is perspective illustrational view similar to FIG. **1** showing the pipe joint catching tool connected between two sections of conventional production piping;

[0017] FIG. **6** is a cross-sectional view taken along line **6-6** of FIG. **5**;

[0018] FIG. **7** is a cross-sectional view taken along line **7-7** of FIG. **5**;

[0019] FIG. **8** is a cross-sectional view taken along line **8-8** of FIG. **5**; and

[0020] FIG. **9** is a cross-sectional view taken along line **9-9** of FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] With continued reference to the drawings, a debris catcher **10** for use in gas and oil wells is disclosed which includes a monolithic integrally formed steel pipe joint **11** having a continuous fluid passage **19** extending along a central axis X-X thereof. The fluid passage is preferably of equal diameter along the length of the pipe joint with the diameter being equal to fluid passages associated with production pipes that will be connected to the debris catcher. The pipe joint includes a tubular central body portion **12**, a female connector end portion **13** having internal screw threads, not shown, a male connector end portion **15** having exterior screw threads **16** and an outwardly flared generally tubular sleeve portion **17**. The tubular sleeve portion defines thicker tubular walls than the tubular wall defined by the central body portion **12** for creating extra strength for mounting guide blades for the catcher as will be described herein. Also, the female end connector is defined having enlarged and outwardly extending walls **18** making the, walls of the female connector end portion thicker in dimension that the tubular wall **12** of the central body portion of the pipe joint.

[0022] The screw threads **14** of the female connector end portion are tapered outward from adjacent the central body portion toward an outer end **21** of the female connector end portion and relative to the central axis X-X of the pipe joint so as to cooperatively receive a thread end **20** of a section **22** of a production pipe string so that when the section **22** is secured to the female connector end portion **13**, a flow passage **24** through the female connector end portion will have a diameter equal to the diameter of the remaining portion of the flow passage **19** through the pipe joint.

[0023] Also, the screw threads **16** of the male connector end portion are tapered inwardly toward the central axis X-X toward an outer end **26** of the male connector end portion to cooperatively mate with inner threads **27** of another section **22'** of the production pipe string.

[0024] With reference to FIGS. **1** and **2**, the debris catcher **10** also includes a plurality of generally equally spaced spring-like guide blades **30** having generally flat base portions **31** mounted within generally parallel grooves **32** formed in the tubular sleeve portion **17** of the pipe joint **11**. The grooves extend parallel to the central axis of the pipe joint. In the embodiment shown, the blades are spaced at **45** degrees relative to one another about the central axis X-X such that eight blades are used. However, the number of blades and spacing between blades may be changed. The blades are secured such as be using threaded lock nuts **34** that are mounted in pairs of openings **33** in each blade which are secured to threaded openings **34** formed in the tubular sleeve. It should be noted that the size of screws that may be used is increased due to the thicker walls of the tubular sleeve.

[0025] The size and depth of the grooves **32** is such that the outer surface of the base of each blade is generally flush with the outer tubular surface **36** of the tubular sleeve portion **17**. The blades **30** are formed of stainless steel and have outer free ends **37** that are tapered toward the tip edge thereof and which are slightly curved toward the central body portion **12** of the pipe joint **11**. Each blade **30** is also flared outwardly from the base portion thereof as shown at **38** and is generally concavely configured relative to the central body portion **12**. As the blades are spaced from the central body portion along the length thereof, they are spring-like so that they yieldably engage inner side walls **40** of a surrounding well casing "WC" as illustrated in dotted lines in FIGS. **4** and **5**. In this manner, any debris in the well above the debris catcher will be engaged and retained by the blades of the catcher as the catcher and production pipe string are raised from a well casing.

[0026] With reference to FIG. **4**, another embodiment of the invention is shown which has been modified to allow for passage of larger dimensioned electrical cables and capillary tubes between the debris catcher **10'** and the well casing "WC". In this embodiment, one of the blades **30** has been removed from the steel pipe joint **11'** and a portion of the outer tubular surface **36'** of the tubular sleeve portion **17'** has been formed either as a flat surface **42** or as slot **45**. The flat surface permits greater open space to be created between the steel pipe joint **11'** and the well casing to permit passage of larger electrical cables and conduits. The slot **45** may also be provided in order to provide a seat or passage for conduits, such as capillary tubes. It should be noted that, in accordance with the invention, additional blades may be removed to create additional spaced passages between the steel pipe joint **11'** and the well casing. However, the positioning of the remaining blades should be symmetrical relative to the central axis X-X of the debris catcher so that the catcher remains centered with respect to the well casing during use.

[0027] By way of example only, a basket catching tool having a steel pipe joint **11** such as shown in FIG. **1** for use in a 51 inch outside diameter casing, was formed from a billet of API L-80 Spec. 6A/16A, or NACE M%0176, or ASTM 4130 that is arc furnace processed, normalized,

quenched and tempered steel, having a yield of 78,467 psi. The billet was spade drilled to form a continuous flow passage of approximately 2.438 inch inside diameter. The spring-like blades **30** were formed of 1" by ⅛th" 316 stainless steel. The resultant tool had a tensile strength of 100,078 PSI while being subjected to 2, 300 foot pounds maximum torque. The 5½ outside diameter casings may have an inner diameter range of 5.012 to 4.670 inches.

We claim:

1. A catching tool for use in catching debris within a well casing of an oil or gas well, the tool comprising a monolithic integrally formed pipe joint having a female end connector and an opposite male end connector and oriented at opposite ends of a tubular central body portion, a tubular sleeve spaced between the central body portion and the male end connector, the tubular sleeve having an outer tubular surface diameter greater than a diameter of an outer surface of the central body portion spaced such that a thickness of a tubular wall defining the tubular sleeve is greater than a thickness of a tubular wall defining the central body portion, a fluid passage extending along a central axis of the pipe joint and through the pipe joint from the female end connector, the central body portion, the tubular sleeve and male end connector, a plurality of spaced grooves formed in the outer surface of the tubular sleeve so as to be parallel to the central axis of the pipe joint, and a plurality of spacing spring-like blades secured with the grooves, and wherein the plurality of blades extend along but spaced from the central body portion of the pipe joint.

2. The catching tool of claim **1** including fasteners for removably mounting the spring-like blades within the grooves.

3. The catching tool of claim **1** wherein the outer tubular surface of the tubular sleeve includes at least one flat form therein between at least two of the blades.

4. The catching tool of claim **1** wherein the outer tubular surface of the tubular sleeve includes at least one slot for receiving a conduit therein between at least two of the blades.

5. The catching tool of claim **1** wherein the blades are formed of stainless steel.

6. The catching tool of claim **1** wherein the female end connector is defined by a tubular outer wall having a diameter greater than a diameter of an outer surface of the central body portion, and the tubular outer wall of the female end connector having a greater thickness dimension than a thickness of a tubular wall defining the central body portion.

7. The catching tool of claim **1** of a dimension to be used within well casings of up to 5.5 inch OD.

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