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(54) METHOD FOR ENABLING MOVEMENT OF A CENTRALIZED PIPE THROUGH A REDUCED DIAMETER RESTRICTION AND APPARATUS THEREFOR

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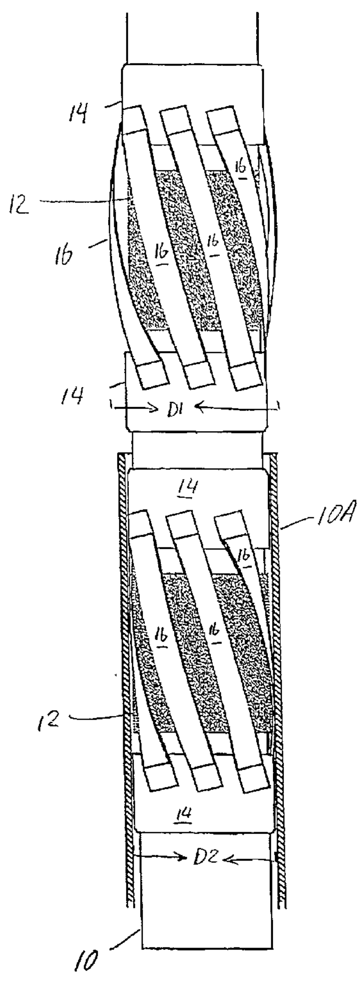
Publication Classification

(51) **Int. Cl.**[7] **E21B 17/10**

(52) **U.S. Cl.** **166/378**; 166/241.6

(57) **ABSTRACT**

A centralizer for laterally positioning a pipe in an opening larger in diameter than an opening through which the centralizer may freely pass is disclosed. The centralizer includes a plurality of helically shaped spring blades affixed at each end thereof to a slip collar. The slip collars are adapted to slide and rotate about the exterior surface of the pipe. A retaining device is disposed axially between the slip collars and is adapted to limit axial motion of the slip collars. One embodiment of the retaining device is a sleeve which is adapted to be affixed to the exterior surface of the pipe at a selected axial position.



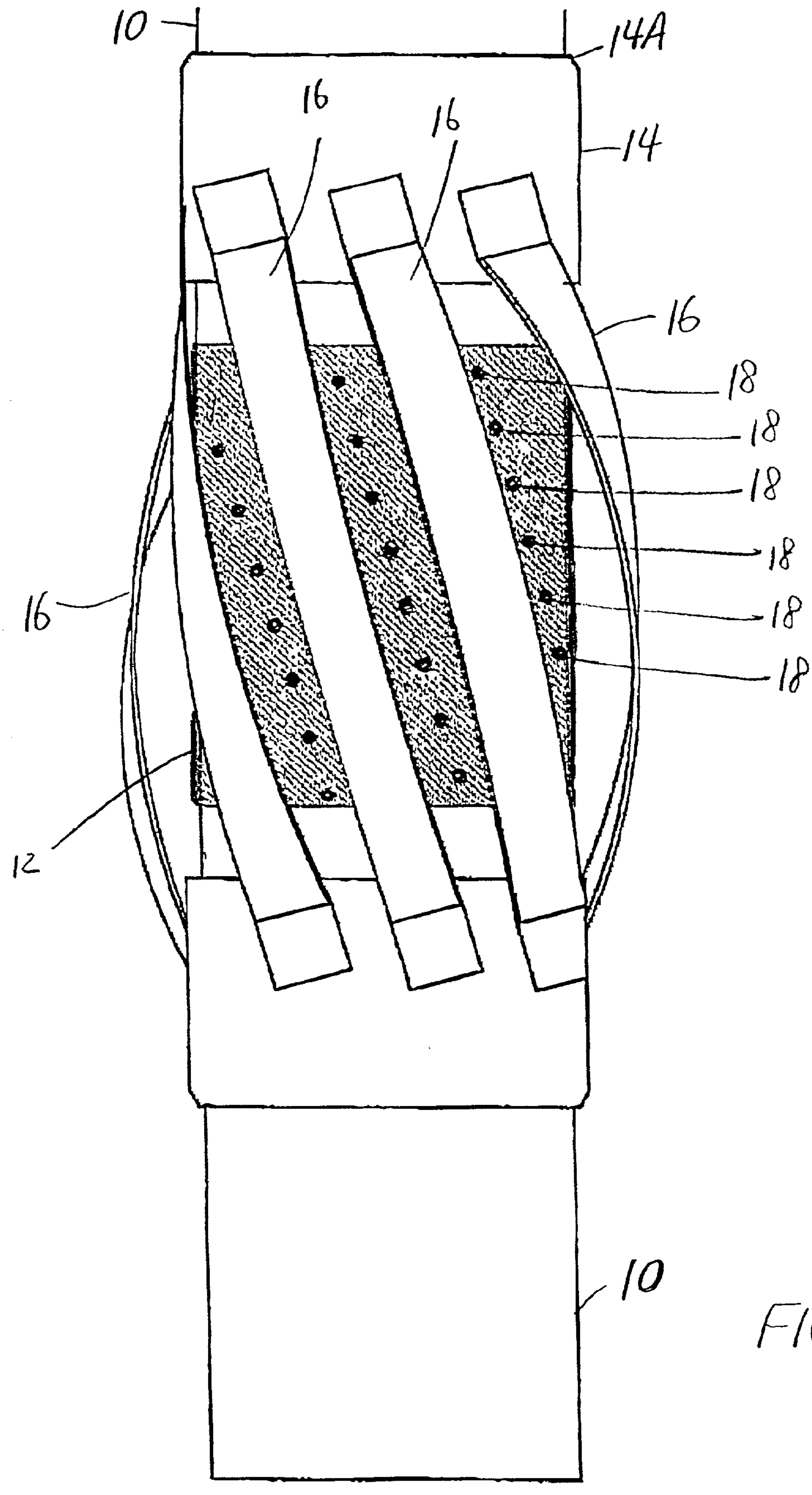


FIG 1

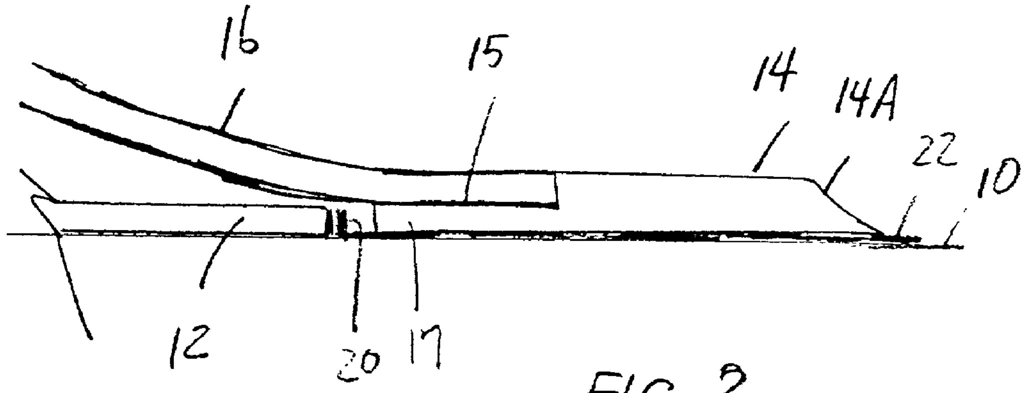


FIG 2

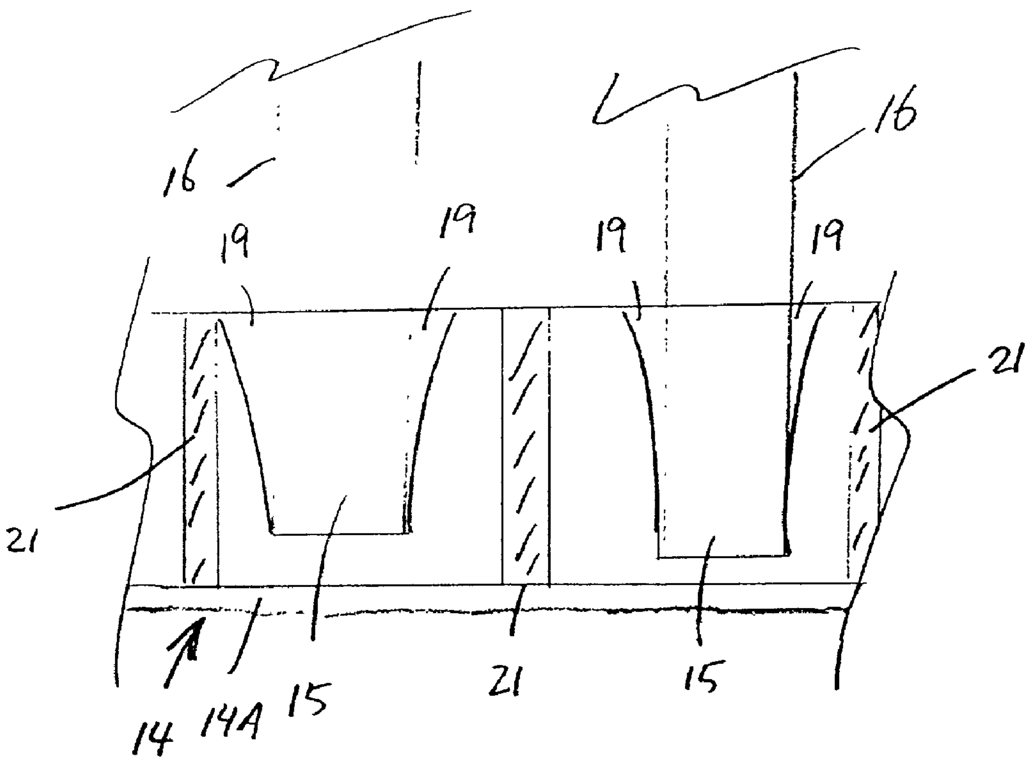


FIG 3

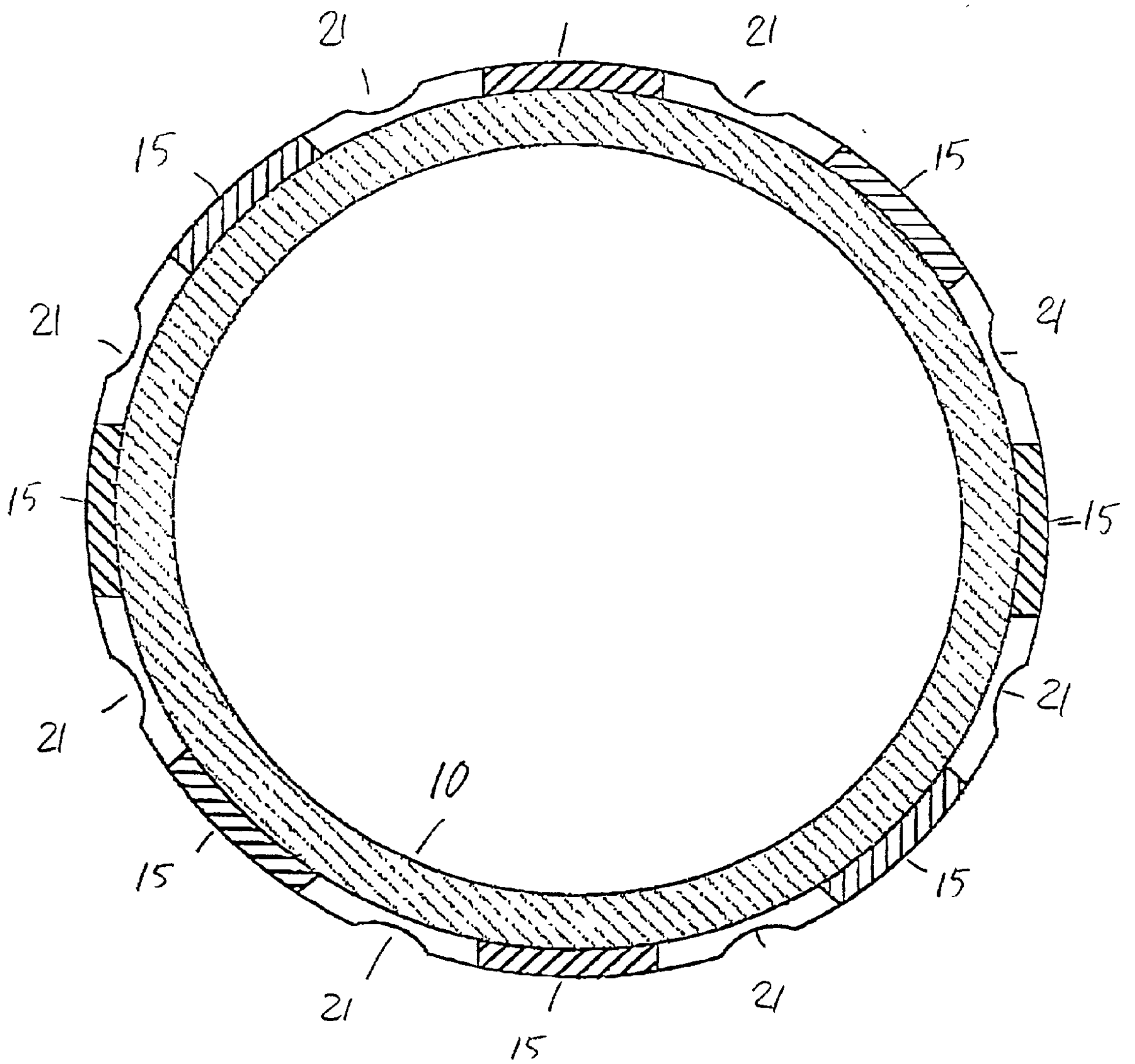


FIG 4

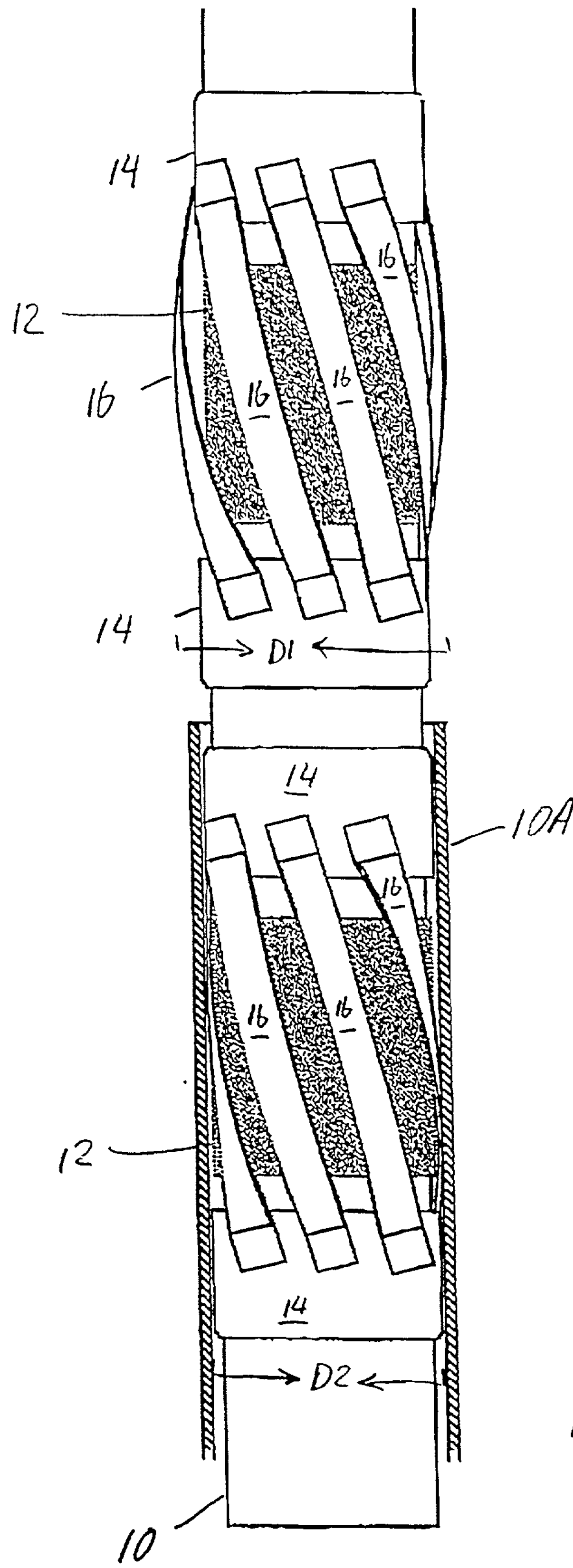


FIG 5

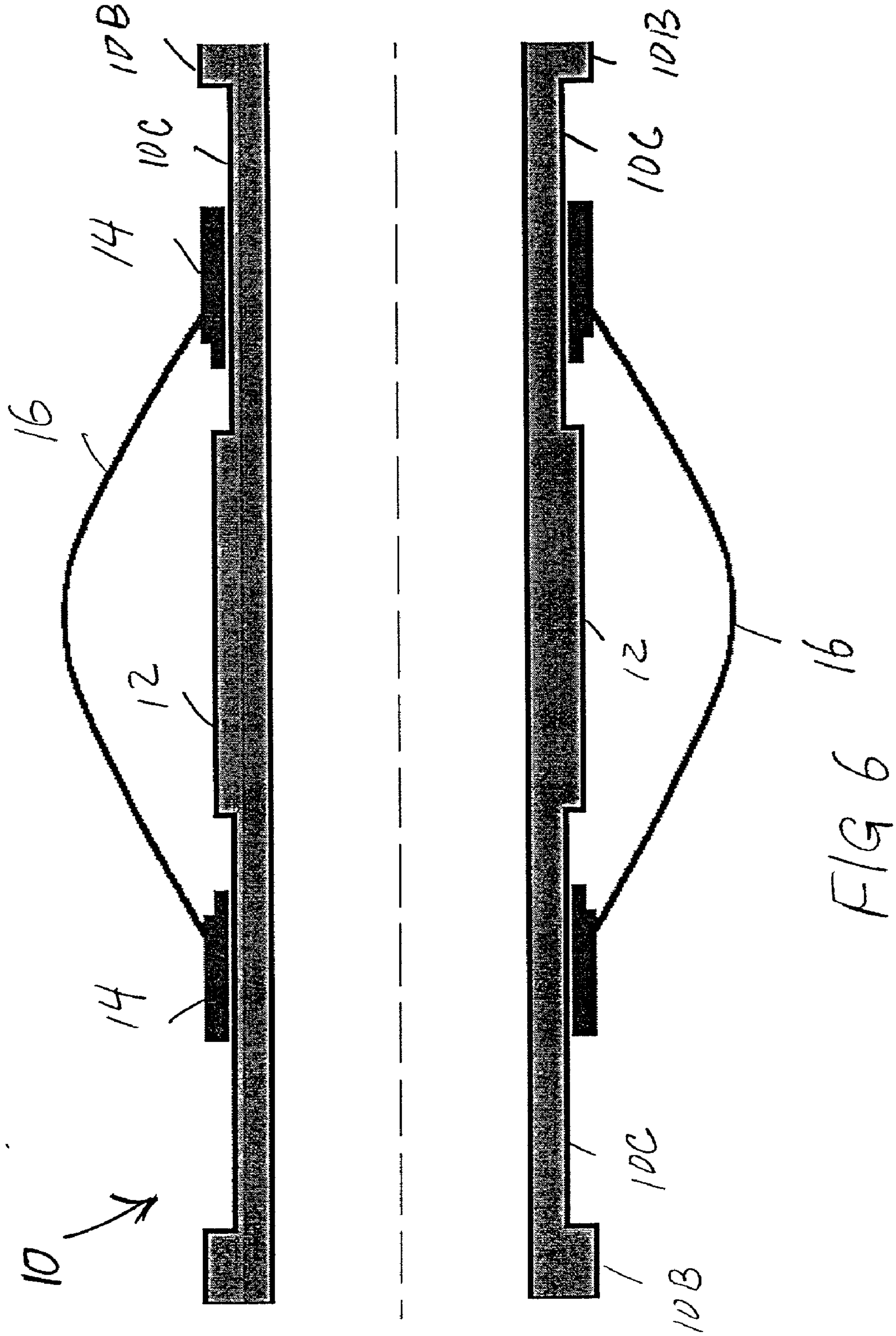
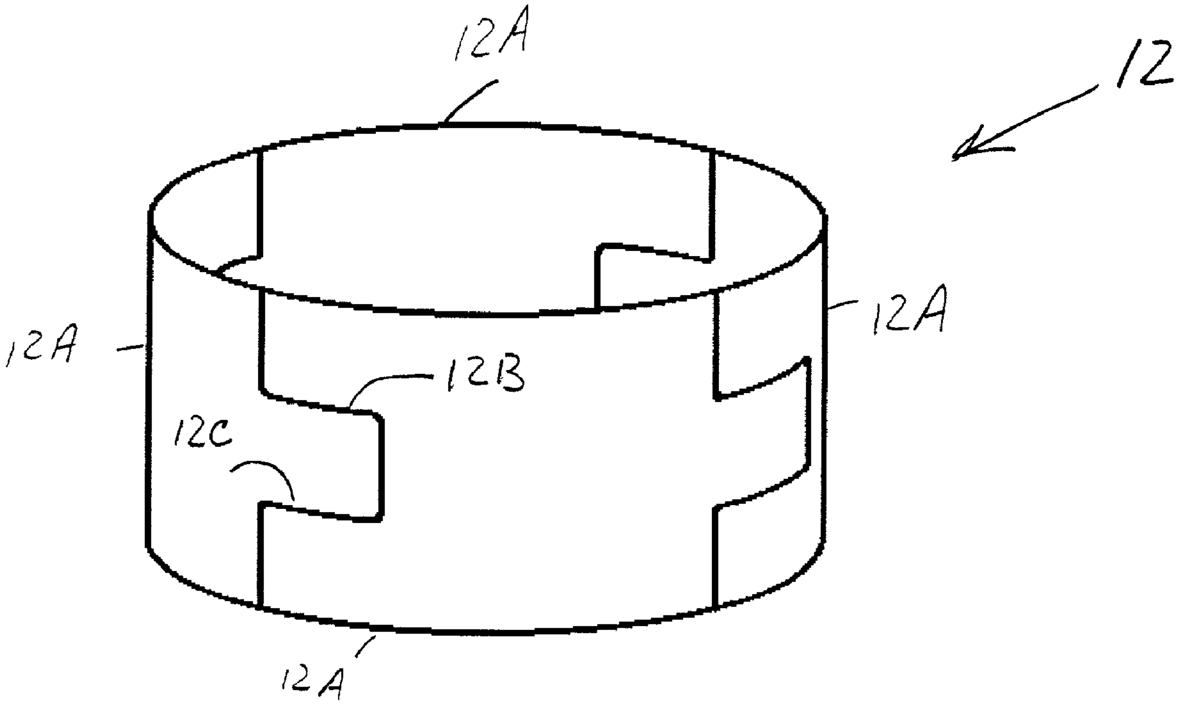


FIG 6



Stop Collar Elements

FIG 7

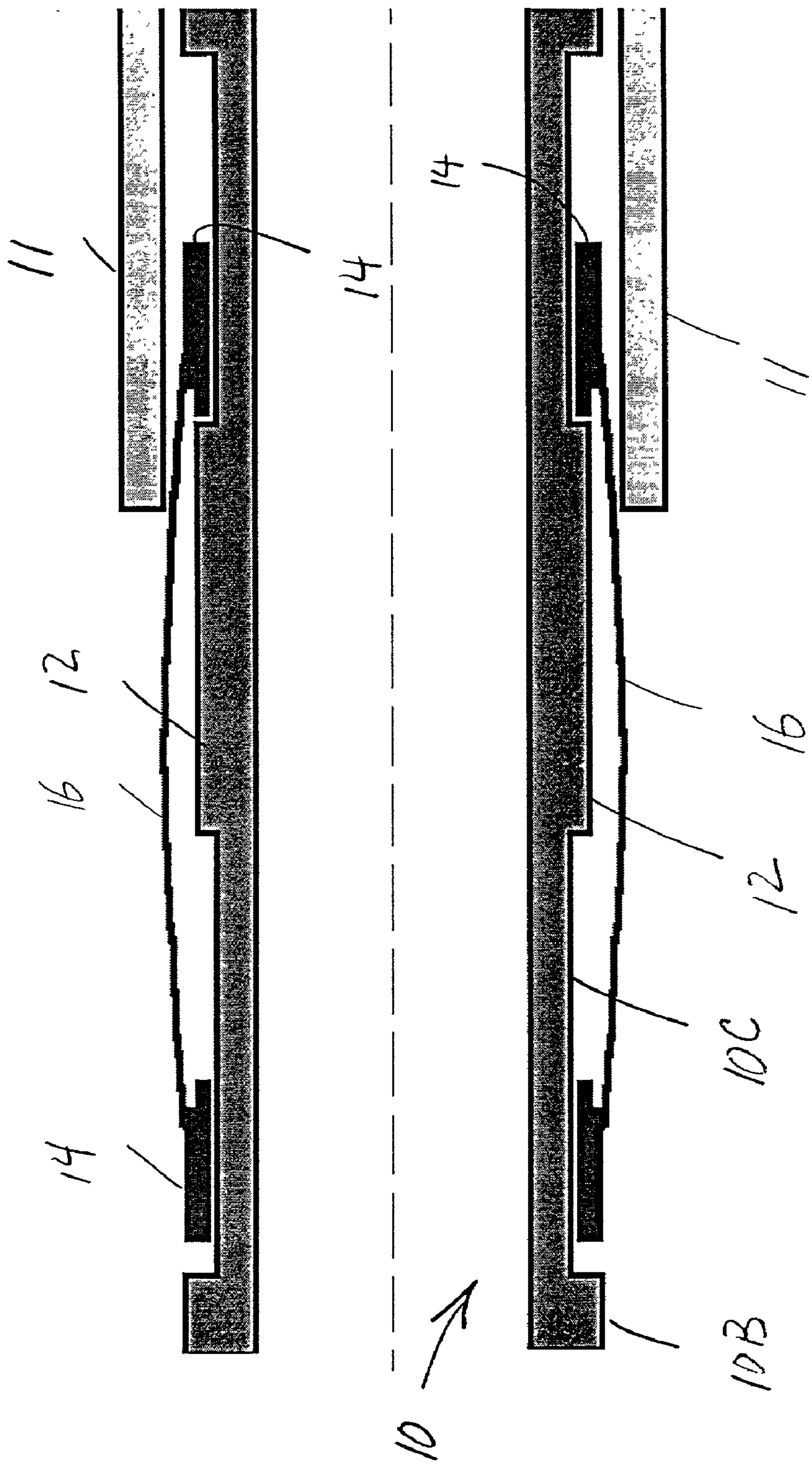


FIG 8

METHOD FOR ENABLING MOVEMENT OF A CENTRALIZED PIPE THROUGH A REDUCED DIAMETER RESTRICTION AND APPARATUS THEREFOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation in part of application serial No. 09/824,928 filed on Apr. 3, 2001 and assigned to the assignee of the present invention.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The invention is related generally to the field of centralizers, such as used on casing inserted in wellbores drilled through the earth. More specifically, the invention is related to centralizers which can pass through an opening that is smaller than the opening in which a device is to be centralized.

[0005] 2. Background Art

[0006] Wellbores drilled through the earth to extract petroleum and the like are commonly "completed" by cementing a steel pipe or casing in the wellbore after it is drilled. The casing serves to maintain the mechanical integrity of the wellbore, provides a conduit for produced fluids to move to the earth's surface, and hydraulically isolates earth formations from each other so that high fluid pressure earth formations do not discharge fluid into lower fluid pressure earth formations.

[0007] The casing is typically inserted into the drilled wellbore by coupling segments of the casing together and lowering the coupled segments into the wellbore. To cement the casing in place in the wellbore, cement is typically pumped through the interior of the casing, and is discharged into an annular space between the casing and the wellbore from the bottom of the casing. An important aspect of properly cementing the casing in place to complete a wellbore is that the casing have a substantially uniform annular space around it at all places along the length of the wellbore. Uniformity of the annular space increases the likelihood that the cement will completely and uniformly fill the annular space, thereby ensuring that the wellbore properly hydraulically isolates earth formations from each other. Uniformity of the annular space is affected by the trajectory of the wellbore and the final shape of the wellbore, among other factors. Frequently wellbores are drilled along trajectories other than vertical, so earth's gravity and bends in the wellbore cause the casing to rest on the wall of the wellbore in some places along the wellbore. In other cases, the wall of the wellbore may include out of round sections, for example washouts or keyseats, which make cementing operations more difficult.

[0008] It is known in the art to use centralizers to keep the casing as close as possible to the center of the wellbore for proper cementing. Typical centralizers known in the art are shown, for example, in a sales brochure published by Antelope Oil Tool & Manufacturing Company, Mineral Wells, Tex. (not dated). Centralizers are typically coupled to the exterior surface of the casing at selected locations along the casing prior to inserting the casing into the wellbore. Spring blades on the centralizers provide a restoring force which tends to push the casing into the center of the wellbore. Specifications for the amount of restoring force, and proper use of centralizers are described in a document entitled, *Specifications for Bow-Spring Centralizers, API Specification* 10*D,* fifth edition, American Petroleum Institute, Wash., D. C. (1994). Generally speaking, casing centralizers are made to center a particular outside diameter (OD) casing within a particular nominal diameter wellbore. The casing OD is selected by the wellbore operator to closely match the wellbore diameter, which is primarily related to the diameter of the drill bit used to drill that segment of the wellbore.

[0009] More recently, it has become known in the art to drill wellbores to a depth greater than a depth to which casing has been set, in which the greater depth portion of the wellbore has a diameter larger than the diameter of the casing. This type of drilling can be performed using various types of reaming tools such as hydraulic underreamers or specialized drill bits known as bi-center bits. See, for example, U.S. Pat. No. 6,039,131 issued to Beaton. Drilling this type of wellbore makes it possible to insert a larger completion device in the deeper portion of the wellbore, such as gravel pack or sand screens, than would be possible using conventional drilling techniques. Completing wellbores having such deeper sections including oversize diameters using centralizers known in the art has proven difficult because it is impracticable to move a larger outside diameter centralizer through a smaller internal diameter casing or other opening.

[0010] It is desirable to have a centralizer which can position a casing inside a larger diameter wellbore than the opening through which the centralizer can freely pass. One such type of centralizer known in the art includes a plurality of bow shaped spring blades coupled at each end thereof to a collar. One of the collars is affixed to an exterior surface of the casing. The other collar is allowed to "float" or move axially along the outer surface of the casing. Typically, the exterior surface of the casing will be machined or otherwise reduced in diameter under the position of the spring blades. The centralizer is thus able to laterally compress when the centralizer is pushed through an opening smaller than the uncompressed diameter of the spring blades. When the spring blades are compressed, they extend a longer distance along the length of the casing. The floating collar is able to move in response thereto. When the compressible centralizer is moved into a larger diameter opening after passing through the restriction, the spring blades expand laterally, providing a restoring force to centralize the casing inside the larger diameter opening.

[0011] A limitation to the laterally compressible centralizer known in the art is that it requires a relatively high starting force and running force to move axially through the restricted diameter opening.

SUMMARY OF THE INVENTION

[0012] One aspect of the invention is a centralizer for laterally positioning a pipe in an opening larger in diameter than an opening through which the centralizer may freely pass. The centralizer includes a plurality of helically shaped spring blades affixed at each end thereof to a slip collar. The slip collars are adapted to slide and rotate about the exterior surface of the pipe. A retaining device is disposed axially between the slip collars, and is adapted to limit axial motion of the slip collars. In one embodiment, the retaining device is a sleeve which is adapted to be affixed to the exterior surface of the pipe at a selected axial position.

[**0013**] In one embodiment, the slip collars include grooves in the exterior surface adapted to receive the ends of the spring blades. In one embodiment, the sides of the grooves are radiused to avoid distorting the slip collars. In one embodiment, a thickness of the slip collar material below the groove is substantially the same as that of the retaining sleeve. In one embodiment, the centralizer includes an anti-friction bearing between at least one of the slip collars and the retaining device. The anti-friction bearing is adapted to reduce rotational friction of the slip collar about the casing when the spring blades are laterally compressed. In one embodiment of a sleeve type retaining device, the, a sleeve includes a plurality of set screws arranged in a helical pattern corresponding to the shape of the spring blades to enable access to the set screws. In one embodiment, the retaining device is a sleeve assembled from circumferential segments. In this embodiment, the segments are affixed to the exterior surface of the pipe using an adhesive such as epoxy, or by welding. In one embodiment, the slip collars include mud channels on an exterior surface to avoid surge and swab effects when running the centralizer.

[**0014**] Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[**0015**] **FIG. 1** shows a laterally compressible centralizer assembly according to one aspect of the invention.

[**0016**] **FIG. 2** shows a cross section of one end of an embodiment of the centralizer.

[**0017**] **FIG. 3** shows a partial side view of a particular embodiment of one of the slip collars.

[**0018**] **FIG. 4** shows an end view of the slip collar embodiment shown in **FIG. 3**.

[**0019**] **FIG. 5** shows two centralizers according to the invention affixed to a pipe being passed through a restricted diameter opening.

[**0020**] **FIG. 6** shows a particular embodiment adapted to pass through an opening substantially smaller than the opening in which the pipe is to be laterally positioned.

[**0021**] **FIG. 7** shows a particular embodiment of the retaining sleeve.

[**0022**] **FIG. 8** shows the embodiment of **FIG. 6** partially disposed inside one end of an outer casing string.

DETAILED DESCRIPTION

[**0023**] **FIG. 1** shows a laterally compressible centralizer according to one aspect of the invention. The centralizer is placed on the exterior of a joint of casing **10** which is to be moved through an opening having a smaller diameter than the opening in which the centralizer ultimately will be positioned. Such smaller diameter openings may include, for example, a casing string in a wellbore drilled through the earth, below which open wellbore is "underreamed" to a larger diameter than the internal diameter of the casing string. The centralizer includes slip collars **14** disposed on the exterior of the casing **10** at axially spaced apart locations thereon. The slip collars **14** are interconnected by "bow" shaped spring blades **16**, of a type conventional for bow spring type centralizers. Each of the spring blades **16** is affixed at each of its ends to one of the slip collars **14**. In their uncompressed state, the spring blades **16** extend laterally a predetermined radial distance beyond the radius of the casing **10**. This distance, and the number of spring blades **16** are selected based on factors such as the diameter of the opening into which the casing **10** is to be centralized and the weight of the casing **10**, among other factors. In this embodiment, the spring blades **16** are preferably helically shaped. More preferably, the helical angle of each spring blade **16** is within a range of about 15 to 20 degrees away from being parallel to the longitudinal axis (not shown) of the casing **10**. The spring blades **16** may be welded, adhesively bonded, or otherwise affixed to the slip collars **14**. The spring blades **16** and slip collars **14** may also be formed from a single sheet, tube, or other piece of material. The material from which the spring blades **16** are formed is typically steel, but may be any other suitable material capable of providing the required restoring force.

[**0024**] The centralizer in this embodiment includes a retaining device adapted to be affixed to the exterior surface of the casing **10** at a selected axial position along the exterior surface. In this embodiment, the retaining device is a sleeve **12** which is affixed to the exterior surface of the casing **10**. The retaining sleeve **12** in this embodiment includes a plurality of set screws **18** which are disposed inside threaded holes to enable tightening against the exterior of the casing **10**. In this embodiment, the set screws **18** are disposed in a helical pattern about the exterior of the sleeve **12**. The helical pattern of the set screws **18** is preferably selected so that they are easily accessible between the individual spring blades **16**. Although set screws are shown in this embodiment to retain the sleeve **12** on the exterior of the casing **10**, other means for retaining the retaining sleeve may be used, including welding and/or adhesive. Other embodiments of the retaining sleeve **12** will be further explained. The retaining sleeve shown in **FIG. 1** is only one embodiment of a retaining device. Other embodiments of retaining device may be used in accordance with the invention. Generally speaking, the retaining device is intended to limit axial motion of the slip collars **14**, while presenting an external diameter sufficiently small to enable lateral compression of the spring blades **16** when the centralizer is moved through a small diameter opening. Other embodiments of the retaining device will be further explained.

[**0025**] An outer edge of at least the lowermost slip collar **14** preferably includes thereon a beveled or tapered edge **14A** to reduce the possibility of the centralizer becoming caught on any protrusions or shoulders in a wellbore (not shown) during movement of the casing **10** therethrough.

[**0026**] The edges of the retaining sleeve **12** preferably include thereon an anti-friction bearing **20** which may be a roller or ball bearing, a low friction coating or any other device which is adapted to reduce friction of rotation between the slip collar **14** and the retaining sleeve **12** when the edges of the slip collar **14** and retaining sleeve **12** come into contact. The reason for this contact will be further explained. Alternatively, the anti-friction bearing **20** may be formed or attached to the corresponding edge of the slip collars **14**. Additionally, an anti-friction bearing surface **22** may be applied to or otherwise formed into the exterior surface of the casing **10**, or on a corresponding interior surface of the slip collars **14**, to enable the slip collars **14** to slide axially along the casing **10** and to rotate about the exterior of the casing **10**.

[**0027**] A cross-sectional view of one end of the centralizer as affixed to the exterior of the casing **10** is shown in **FIG. 2**. In the embodiment shown in **FIG. 2**, the slip collars **14** preferably include therein a slot or groove **15** adapted to receive the end of each one of the spring blades **16**. As shown in **FIG. 2**, preferably, the groove **15** is formed in the outer surface of the slip collar **14**, such as by milling, grinding, cutting (such as by laser) or preforming into the exterior surface of the slip collar material, so that the spring blade **16** is substantially flush with the exterior surface of the remainder of the slip collar **14** when inserted into the groove **15**. The groove **15** preferably also has a depth selected so that the thickness of a tongue portion **17** therein substantially matches the thickness of the retaining sleeve **12**. This configuration enables the spring blades **16** to compress laterally to nearly as small a diameter as the external diameter of the slip collars **14**, without binding or sticking on the outer surface of the sleeve **12**. Because in this embodiment, the spring blades **16** are flush with the exterior of the slip collars **14**, the diameter of the restricted opening through which the centralizer may pass in its compressed state is minimized. This feature increases the useful diameter range of the centralizer.

[**0028**] **FIG. 3** shows a side view of a segment of one of the slip collars **14** to explain another aspect of a centralizer according to the invention. The grooves **15** in this embodiment of the slip collar **14** have therein radiused sides **19**. The radiused sides **19** preferably have substantially the same width as the spring blades **16** at the ends of the blades, but increase in width towards the tongue end (**17** in **FIG. 2**). The radiused sides **19** better enable twisting of the spring blades **16**, as a result of relative rotation of the slip collars **14**, without distorting the shape of the slip collars **14**. The term "radiused" as used herein to describe the shape of the sides of the grooves **15** is meant to include within its scope any form of curved or tapered change in width along the length of the groove such that the spring blades **16** may twist around the axis (not shown) of the casing (**10** in **FIG. 1**) substantially without distorting the shape of the slip collars **14**. Accordingly, the exact shape of the radius in the grooves shown in **FIG. 3** is not intended to limit the scope of the invention.

[**0029**] The embodiment shown in **FIG. 3** also includes "mud channels" shown at **21**, which may be slots or grooves, cut or otherwise formed into the exterior surface of the slip collar **14**. The mud channels **21** are preferably located on the circumference of the slip collars **14** between the spring blade grooves **15**, and are cut to a depth such that the thickness of the remaining portion of the slip collars **14** underneath the mud channels **21** is substantially the same as that of the retaining sleeve (**12** in **FIG. 1**). The mud channels **21** enable passage of fluid by the slip collars **14** when the centralizer is inserted into a restricted opening having an internal diameter only slightly larger than the external diameter of the slip collars **14**. The mud channels therefore reduce "surge" and "swab" effects as the centralizer is moved along the inside of the restricted opening (not shown). Surge and swab are terms used in the art to describe a piston-like hydraulic action when a member is moved inside a wellbore. An end view of the embodiment of the slip collar **14** is shown in **FIG. 4**.

[**0030**] Another embodiment of the retaining sleeve is shown in more detail in **FIG. 7**. In this embodiment, the retaining sleeve **12** is formed from a plurality, in this case four, interlocking segments **12A**. The segments **12A** may be affixed to the exterior surface of the casing (**10** in **FIG. 1**) using epoxy or similar adhesive, or may be welded or otherwise affixed to the exterior surface of the casing (**10** in **FIG. 1**). The embodiment of the segments **12A** shown in **FIG. 7** includes interlocking structures on circumferential ends of each of the segments **12A**. Such structures may be in the form of a tongue **12C** at one circumferential end of the segment **12A** which fits into a corresponding slot **12B** in a mating circumferential end of another segment **12A**. Tongue and slot interlocking structures are only one example of interlocking structures which may be used in other embodiments of the retaining sleeve. Generally speaking, the interlocking structures are intended to maintain proper axial and circumferential alignment of the segments **12A** as they are affixed to the exterior surface of the casing (**10** in **FIG. 1**). By maintaining proper axial and circumferential alignment, the bonding of the segments **12A** to the casing can be improved, particularly when the segments are bonded to the casing using adhesive such as epoxy.

[**0031**] Having explained the general structure of a centralizer according to the various aspects of this invention, the manner in which the invention is used in a wellbore will now be explained. Referring to **FIG. 5**, when the sleeve **12** and centralizer (including slip collars **14** and spring blades **16**) are attached to a joint of casing **10**, the spring blades extend to an uncompressed diameter D1. When the joint of casing **10** is to be passed through a restricted diameter opening (such as a casing string **10A** in a wellbore), typically the joint of casing **10** will be coupled to similar joints of casing, some of which may include centralizers such as shown in **FIG. 1** and previously explained. As the joint of casing **10** is moved into the restricted diameter opening **10A**, the spring blades **16** are laterally compressed, to D2 in **FIG. 5**, which is the internal diameter of the restricted diameter opening **10A**. Lateral compression extends the blades **16** axially along the joint of casing **10**. Because the slip collars **14** are free to slide along the casing **10**, axial extension of the spring blades **16** is substantially unhindered. Further, the bearing surface (**22** in **FIG. 2**) used in some embodiments reduces axial friction between the slip collars **14** and the joint of casing **10**. Note that the retaining sleeve **12** limits the axial movement of one of the slip collars **14**, but does not limit the axial separation between the slip collars **14**. Therefore, the axial position of the centralizer is ultimately limited, but the spring blades **16** are substantially free to compress because the axial separation of the slip collars is not limited by the retaining sleeve **12**. Because the spring blades **16** of the embodiment shown in **FIG. 5** are also helically shaped, lateral compression of the spring blades **16** also results in some rotation of the slip collars **14** about the exterior of the casing **10**, as the spring blades **16** twist under the lateral compression. The slip collars **14**, as previously explained, are also free to rotate about the casing joint **10**. Further, as one of the slip collars **14** comes into contact with the edge of the sleeve **12**, the anti-friction bearing used in some embodiments (**20** in **FIG. 2**) reduces rotational friction between the sleeve **12** and the slip collar **14**. The combination of axial extension and twisting of the spring blades **16** enables the spring blades **16** to more easily compress to fit within the restricted diameter opening (not shown), and then to laterally expand as the centralizer is moved into a larger diameter opening (not shown).

[**0032**] In the invention, it has been determined that using helical spring blades **16** on a centralizer such as shown in **FIG. 1** reduces the amount of axial force needed to move the centralizer and casing (**10** in **FIG. 1**) through any particular restricted diameter opening, while retaining enough lateral expansion force to provide enough restoring force to lift the casing **10** away from the wall of the larger diameter opening. Such forces are referred to in the art as "starting force" for initiating movement into the restricted diameter opening, and "running force" to continue movement along the restricted diameter opening.

[**0033**] As a practical matter, a centralizer as shown in **FIG. 1** including the sleeve **12** therein may be made, for example, by welding or otherwise affixing the spring blades **16** to the slip collars **14** while the sleeve **12** is disposed axially between the slip collars **14**. This may be performed, for example, on a suitable diameter mandrel (not shown) for convenience of positioning the sleeve **12** and slip collars **14** prior to welding the spring blades **16** thereon. The mandrel (not shown) may also be used to store and transport the centralizer including the sleeve **12** therein until it is to be affixed to the casing **10**.

[**0034**] It is known in the art to affix a helical bow spring blade centralizer so as to straddle a casing collar (not shown in the Figures) wherein the slip collars are free both to rotate and slide along the casing. Typically, the centralizer used to straddle a casing collar is in the form of "half shells" or a "clam shell" which is opened to clamp around the casing. The centralizer and method for attaching to the casing in the invention are different from the prior art "straddle" type centralizers in that the straddle type centralizer is limited as to its amount of lateral compressibility by the diameter of the casing collar. Typically, straddle type centralizers are not intended to be moved through a restricted diameter opening and therefore do not have the useful diameter range of the centralizer of the present invention. Further, the position along the exterior of the casing is limited, when using straddle type centralizers, to the position of the casing collar itself. In embodiments of the invention, the retaining sleeve and the centralizer can be positioned at any selected location along a "joint" of casing.

[**0035**] An embodiment of the invention which is adapted to pass through an opening substantially smaller than the diameter of the opening in which a pipe is to be laterally positioned is shown in **FIG. 6**. The pipe to be laterally positioned may be a casing, for example, just as in the previous embodiments. In **FIG. 6, a** segment of this casing on which a centralizer according to one embodiment of the invention is mounted is shown at **10**B. In this embodiment, the segment of casing **10**B may be a full length joint (about 30 feet or 10 meters in length) or may be a special, short-length segment ("pup joint"). In order to enable the centralizer to be able to pass through an opening having a substantially smaller diameter than the opening in which the pipe **10**B is ultimately to be positioned, the present embodiment includes a reduced diameter section **10**C formed on the exterior surface of the pipe segment **10**B. The reduced diameter section **10**C may be formed by any method known in the art, including milling or grinding. Having the reduced diameter section **10**C enables the centralizer to be formed using blades **18** having sufficient thickness to provide adequate strength and restoring force, while enabling, in some embodiments, compression of the centralizer to a diameter of not more than the nominal outer diameter of the pipe or casing **10**B. An example of the embodiment shown in **FIG. 6** includes casing having a nominal outer diameter of 11.875 inches, wherein the casing having centralizers according to the invention pass through a pipe string having a drift (minimum) internal diameter of 12.25 inches. The casing is to be laterally positioned (centralized) within a hole, below the pipe string, having a nominal diameter of about 14.75 inches. In this example, it is contemplated that the reduced diameter section **10**C has a nominal outside diameter of about 11.5 inches. The foregoing diameters and pipe sizes are meant only to be illustrative and are not in any way intended to limit the scope of the invention.

[**0036**] As in the other embodiments of the invention, the embodiment shown in **FIG. 6** includes slip collars **14** adapted to slidingly, rotatably fit on the exterior of the pipe **10**B, a retaining device, which may be a retaining sleeve **12** mounted between the slip collars **14** on the exterior of the pipe **10**B, and helical bow springs **16** interconnecting the slip collars **14**. In some adaptations of the embodiment of **FIG. 6**, the slip collars **14** may be adapted to fit on the reduced diameter section **10**C. In other adaptations, the slip collars **14** may be adapted to fit on the full-diameter part of the pipe section **10**B.

[**0037**] Another embodiment which can be inferred by viewing **FIG. 6** includes the retaining device **12** being integrally formed with the casing **10**. The retaining device **12** may be formed simply by leaving metal on the exterior of the casing **10** substantially undisturbed, while forming, such as by grinding or milling, the reduced diameter section **10**C on either side of the preferred position of the retaining sleeve. In such embodiments using an integral retaining device, the slip collars **14** and affixed bow springs are preferably assembled to the reduced diameter section **10**C by coupling the slip collars **14** together from circumferential segments (not shown). Assembly of the slip collars may be performed by welding the slip collar segments (not shown) together. If the slip collars are assembled from segments, preferably the segments include interlocking structures on the circumferential ends thereof to improve axial and circumferential alignment during assembly. As in other embodiments of the invention, the integrally formed retaining device may be positioned at a selected axial location along the exterior surface of the casing.

[**0038**] The embodiment of **FIG. 6** is shown in **FIG. 8** as being moved into an opening having a smaller internal diameter than the opening (borehole) in which the casing **10** is ultimately expected to be centralized or laterally positioned. The opening shown in **FIG. 8** is one end of an outer casing string **11**. Typically, the internal diameter of the outer casing string **11** will be smaller than the hole in which the casing **10** will be laterally positioned. As can be seen in **FIG. 8**, the spring blades **16** are laterally compressed by being moved into the outer casing string **11**. Lateral compression of the spring blades **16** causes the slip collars **14** to move apart axially. Axial movement of the slip collars **14** is limited by the retaining device **12**. Advantageously, having the axial movement limited by the retaining device **12** enables relatively free and easy compression of the spring blades **16** irrespective of the direction of motion of the casing **10** within the outer casing string **11**. Some prior art compressible centralizers limited axial motion by affixing one end of the spring blades to the outer surface of the casing, or used the shoulder of a groove to limit axial motion. Such devices may have more difficulty in compressing the spring blades in one or the other direction of motion.

[**0039**] While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the spirit of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

What is claimed is:

1. A centralizer for laterally positioning a pipe in an opening larger in diameter than an opening through which the centralizer may freely pass, comprising:

a plurality of helically shaped spring blades affixed at each end thereof to a slip collar, the slip collars adapted to slide and rotate about an exterior surface of the pipe; and

a retaining device disposed axially between the slip collars at a selected axial position along the exterior surface of the pipe so as to limit axial motion of the slip collars.

2. The centralizer as defined in claim 1 wherein an axial outermost edge of at least one of the slip collars comprises a taper adapted to reduce sticking of the slip collar as it is moved through the opening through which the centralizer may freely pass.

3. The centralizer as defined in claim 1 wherein the retaining device comprises a sleeve including a plurality of set screws therein to affix the sleeve to the pipe, the set screws arranged in a pattern substantially conforming to a shape of the spring blades whereby the set screws may be accessed through the blades.

4. The centralizer as defined in claim 1 wherein the retaining device comprises a sleeve adapted to be affixed to the exterior surface of the pipe.

5. The centralizer as defined in claim 4 wherein the sleeve is formed from a plurality of circumferential segments.

6. The centralizer as defined in claim 5 wherein the segments comprise interlocking structures on circumferential ends thereof.

7. The centralizer as defined in claim 1 wherein the spring blades define an angle of about 15 to 20 degrees with respect to a longitudinal axis of the pipe.

8. The centralizer as defined in claim 1 further comprising an anti-friction bearing disposed between an edge of the retaining device and at least one of the slip collars.

9. The centralizer as defined in claim 1 further comprising an anti-friction bearing surface disposed between the retaining device and at least one of the slip collars.

10. The centralizer as defined in claim 1 wherein the spring blades are affixed to the slip collars in corresponding grooves on an exterior surface thereof, the corresponding grooves having a depth selected to make an exterior surface of the spring blades substantially flush with an exterior surface of the slip collars.

11. The centralizer as defined in claim 10 wherein the depth of the corresponding grooves is selected so that a material thickness of the slip collar therein is substantially equal to a thickness of the retaining sleeve.

12. The centralizer as defined in claim 10 wherein sides of the grooves are radiused.

13. The centralizer as defined in claim 1 wherein the slip collars comprise mud channels in an exterior surface thereof.

14. The centralizer as defined in claim 1 wherein the spring blades and the slip collars are formed from a single piece of material.

15. The centralizer as defined in claim 1 wherein the retaining device is adapted to fit on a pipe section having a smaller outer diameter than an outer diameter of the pipe to be laterally positioned.

16. The centralizer as defined in claim 15 wherein the slip collars are adapted to fit on the pipe section.

17. The centralizer as defined in claim 16 wherein the slip collars and the spring blades are adapted to compress to at most the outer diameter of the pipe to be laterally positioned.

18. The centralizer as defined in claim 1 further comprising a pipe section having an outer diameter smaller than an outer diameter of the pipe to be laterally positioned, and wherein the retaining device is disposed on the pipe section.

19. The centralizer as defined in claim 18 wherein the slip collars are disposed on the pipe section.

20. A method for laterally positioning a pipe in an opening larger in diameter than an opening through which the pipe may freely pass, comprising:

sliding a bow spring centralizer and a retaining device onto an exterior surface of the pipe, the centralizer comprising a plurality of helically shaped spring blades affixed at each end thereof to a slip collar, the slip collars adapted to slide and rotate about the exterior surface of the pipe, the retaining sleeve disposed axially between the slip collars, the retaining sleeve adapted to be affixed to the pipe so as to limit axial motion of the slip collars;

affixing the retaining device to the exterior surface of the pipe; and

inserting the pipe having the centralizer and retaining device attached thereto into the opening through which the pipe may freely pass and thence into the opening having the larger diameter.

21. The method as defined in claim 20 wherein an axial outermost edge of at least one of the slip collars comprises a taper adapted to reduce sticking of the slip collar as it is moved through the opening through which the centralizer may freely pass.

22. The method as defined in claim 20 wherein the retaining device comprises a sleeve including a plurality of set screws therein to affix the sleeve to the pipe, the set screws arranged in a pattern substantially conforming to a shape of the spring blades whereby the set screws may be accessed through the blades.

23. The method as defined in claim 20 wherein the spring blades define an angle of about 15 to 20 degrees with respect to a longitudinal axis of the pipe.

24. The method as defined in claim 20 further comprising an anti-friction bearing disposed between an edge of the retaining device and at least one of the slip collars.

25. The method as defined in claim 20 further comprising an anti-friction bearing surface disposed between the retaining device and at least one of the slip collars.

26. The method as defined in claim 20 wherein the spring blades are affixed to the slip collars in corresponding grooves on an exterior surface thereof, the corresponding grooves having a depth selected to make an exterior surface of the spring blades substantially flush with an exterior surface of the slip collars.

27. The method as defined in claim 26 wherein the depth of the corresponding grooves is selected so that a material thickness of the slip collar therein is substantially equal to a thickness of the retaining device.

28. The method as defined in claim 26 wherein sides of the grooves are radiused.

29. The method as defined in claim 20 wherein the slip collars comprise mud channels in an exterior surface thereof.

30. The method as defined in claim 20 wherein the spring blades and slip collars are made from a single piece of material.

31. The method as defined in claim 20 further comprising a pipe section having an outer diameter smaller than an outer diameter of the pipe to be laterally positioned, and wherein the retaining device is disposed on the pipe section.

32. The method as defined in claim 31 wherein the slip collars are disposed on the pipe section.

33. The method as defined in claim 32 wherein the spring blades and slip collars are adapted to compress to a diameter at most equal to the outer diameter of the pipe to be laterally positioned.

34. A centralizer for laterally positioning a pipe in an opening larger in diameter than an opening through which the centralizer may freely pass, comprising:

a plurality of helically shaped spring blades affixed at each end thereof to a slip collar, the slip collars adapted to slide and rotate about an exterior surface of the pipe; and

a retaining device disposed axially between the slip collars, the retaining device formed integrally with the exterior surface of the pipe so as to limit axial motion of the slip collars.

35. The centralizer as defined in claim 34 wherein the pipe comprises reduced diameter segments on an exterior surface thereof, the reduced diameter segments adapted to receive the slip collars about an exterior surface thereof, the retaining sleeve formed by retaining at least part of an exterior diameter of the pipe in a location axially disposed between the reduced diameter segments.

36. The centralizer as defined in claim 34 wherein an axial outermost edge of at least one of the slip collars comprises a taper adapted to reduce sticking of the slip collar as it is moved through the opening through which the centralizer may freely pass.

37. The centralizer as defined in claim 34 wherein the spring blades define an angle of about 15 to 20 degrees with respect to a longitudinal axis of the pipe.

38. The centralizer as defined in claim 34 farther comprising an anti-friction bearing disposed between an edge of the retaining device and at least one of the slip collars.

39. The centralizer as defined in claim 34 further comprising an anti-friction bearing surface disposed between the retaining device and at least one of the slip collars.

40. The centralizer as defined in claim 34 wherein the spring blades are affixed to the slip collars in corresponding grooves on an exterior surface thereof, the corresponding grooves having a depth selected to make an exterior surface of the spring blades substantially flush with an exterior surface of the slip collars.

41. The centralizer as defined in claim 40 wherein the depth of the corresponding grooves is selected so that a material thickness of the slip collar therein is substantially equal to a thickness of the retaining device.

42. The centralizer as defined in claim 40 wherein sides of the grooves are radiused.

43. The centralizer as defined in claim 34 wherein the slip collars comprise mud channels in an exterior surface thereof.

44. The centralizer as defined in claim 34 wherein the spring blades and the slip collars are formed from a single piece of material.

45. The centralizer as defined in claim 34 wherein the slip collars and the spring blades are adapted to compress to at most the outer diameter of the pipe to be laterally positioned.

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