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(54) **STOP COLLAR**

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E21B 33/14 (2006.01)

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CPC ***E21B 23/00*** (2013.01); ***E21B 17/1078*** (2013.01); *E21B 33/14* (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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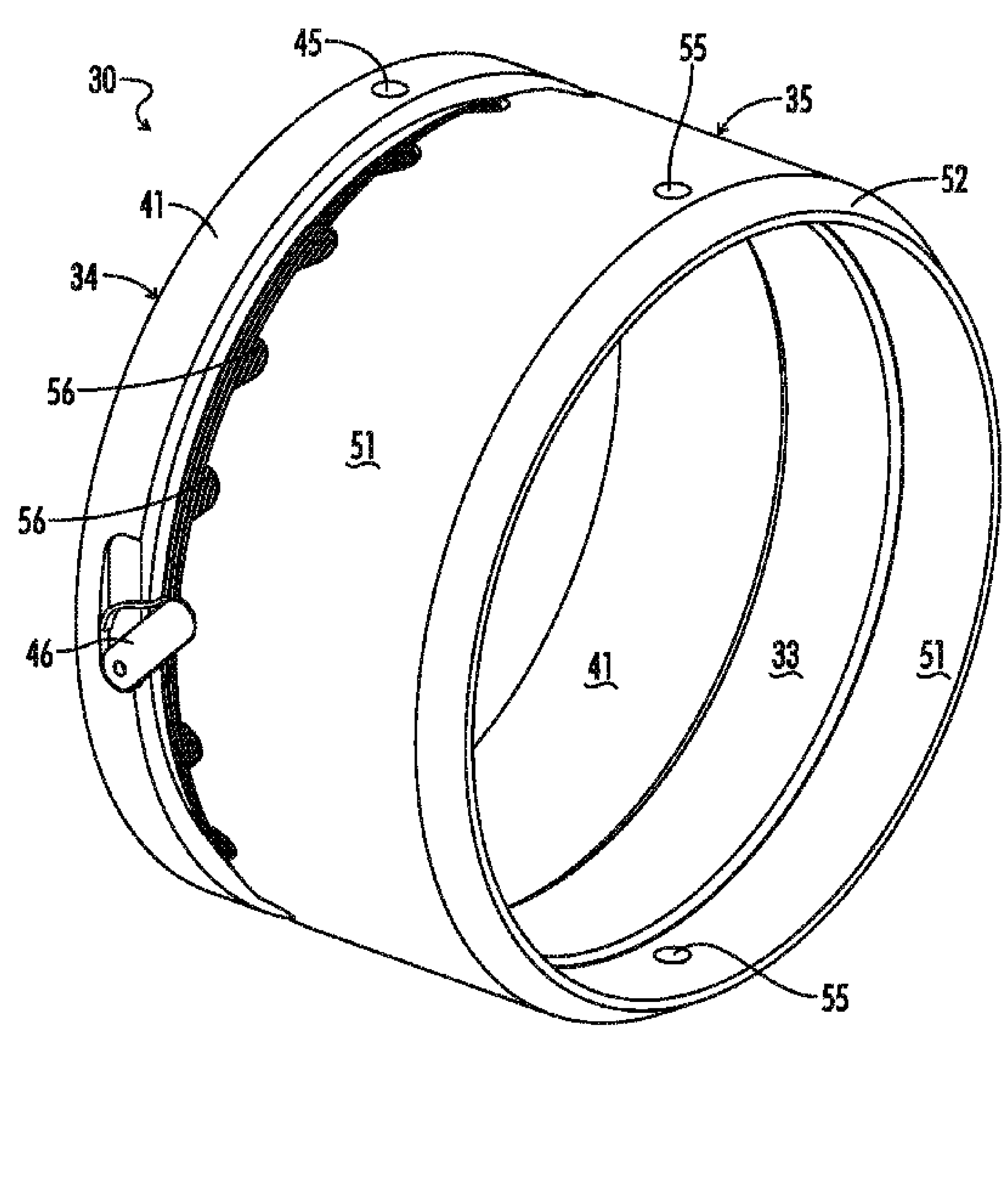
(57) **ABSTRACT**

Stop collars may be fixedly mounted on a liner or other tubular member. The stop collar comprises a first sleeve and a second sleeve. The sleeves are adapted to extend around the outer circumference of the tubular member and are engaged by threaded connections. The sleeves provide opposing inner thrust surfaces. The collar further comprises a radially expandable gripping member disposed between the opposing thrust surfaces. The sleeves may be drawn together by rotation about the threaded connection to cause the thrust surfaces to bear on the gripping member and expand the gripping member radially inward into frictional engagement with the tubular member.

24 Claims, 5 Drawing Sheets



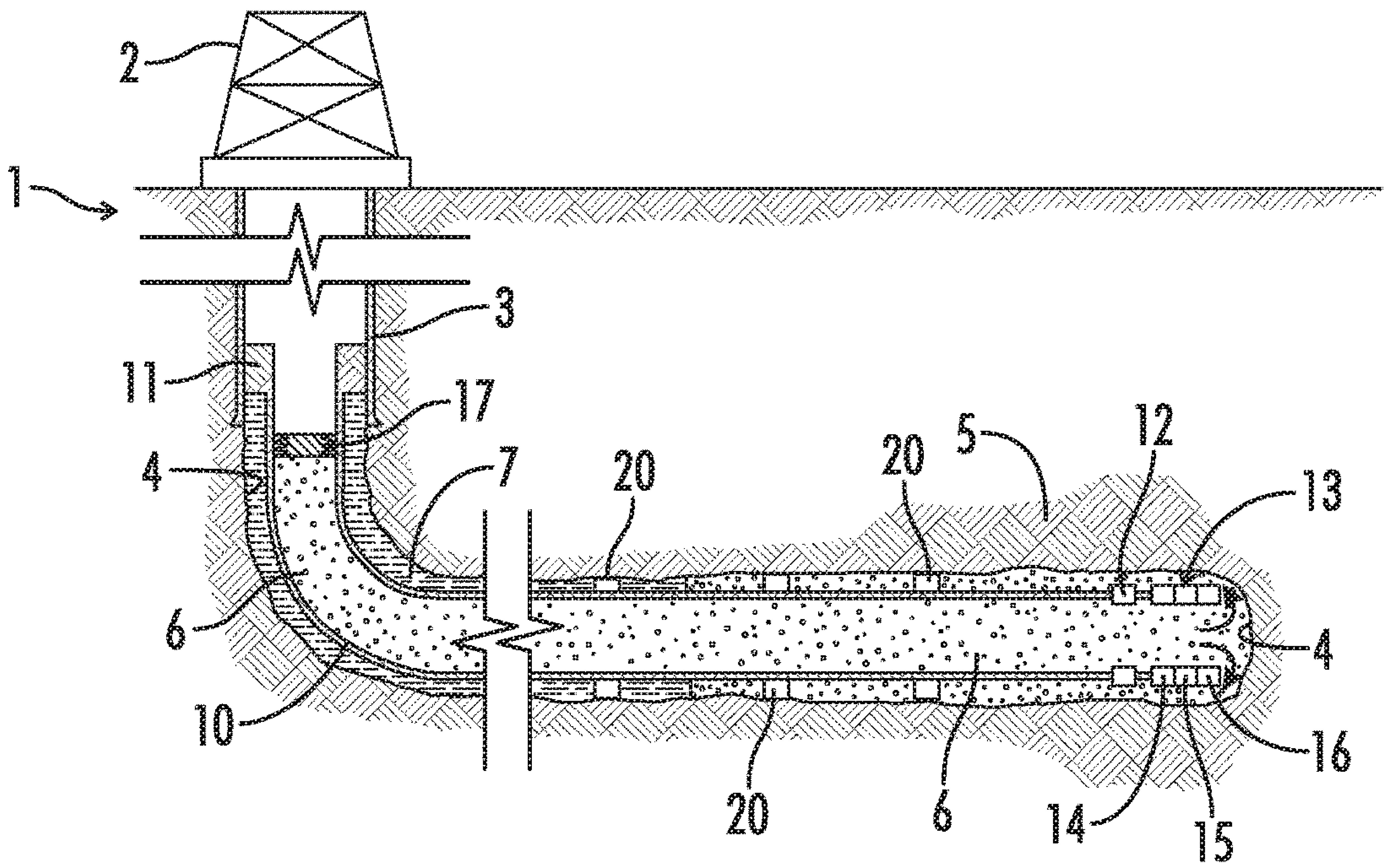

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FIG. 1A

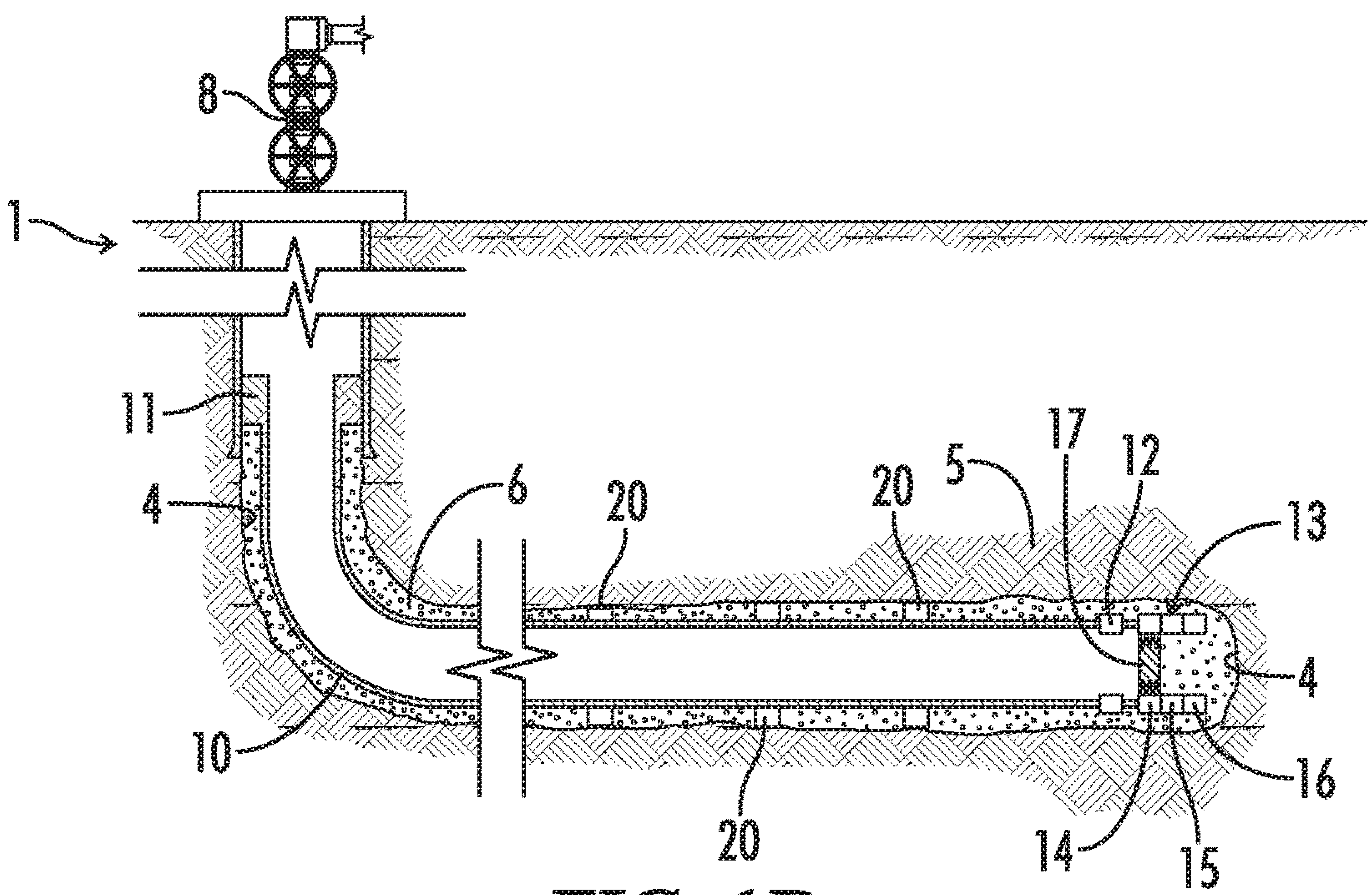
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FIG. 1B

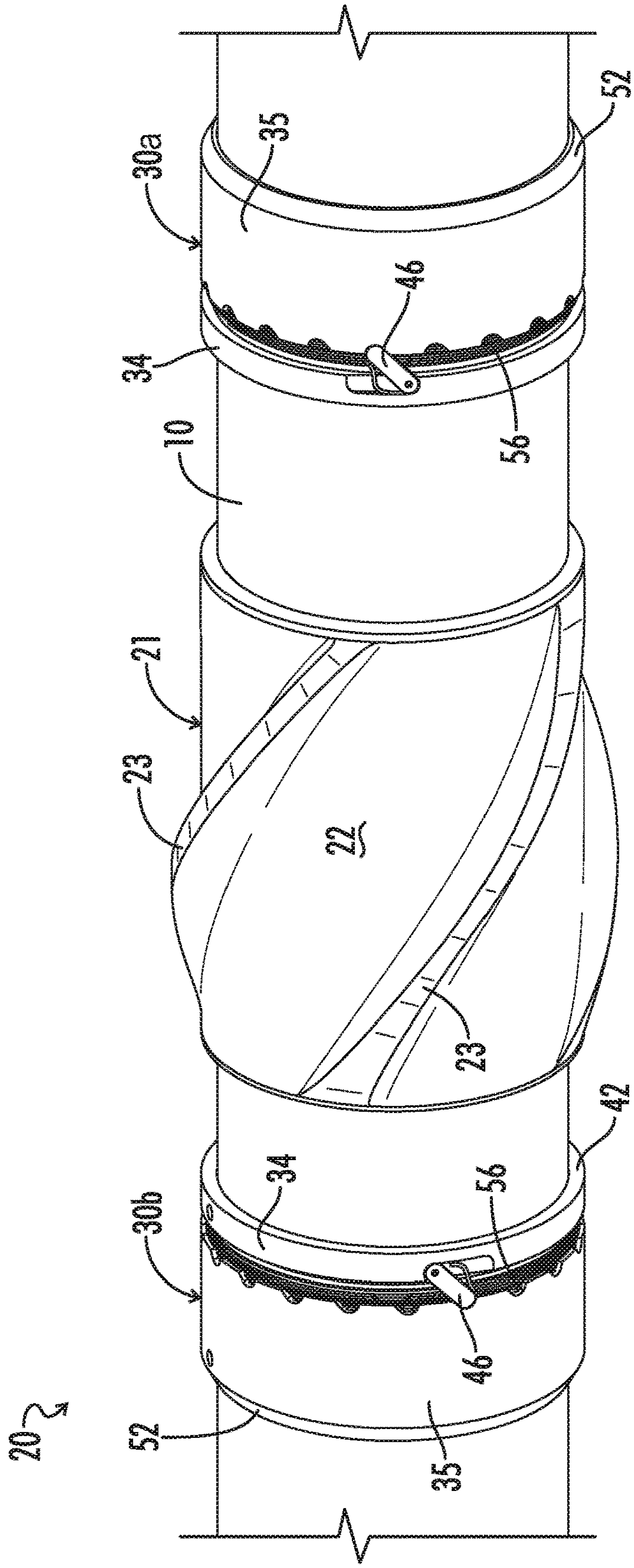

FIG. 2

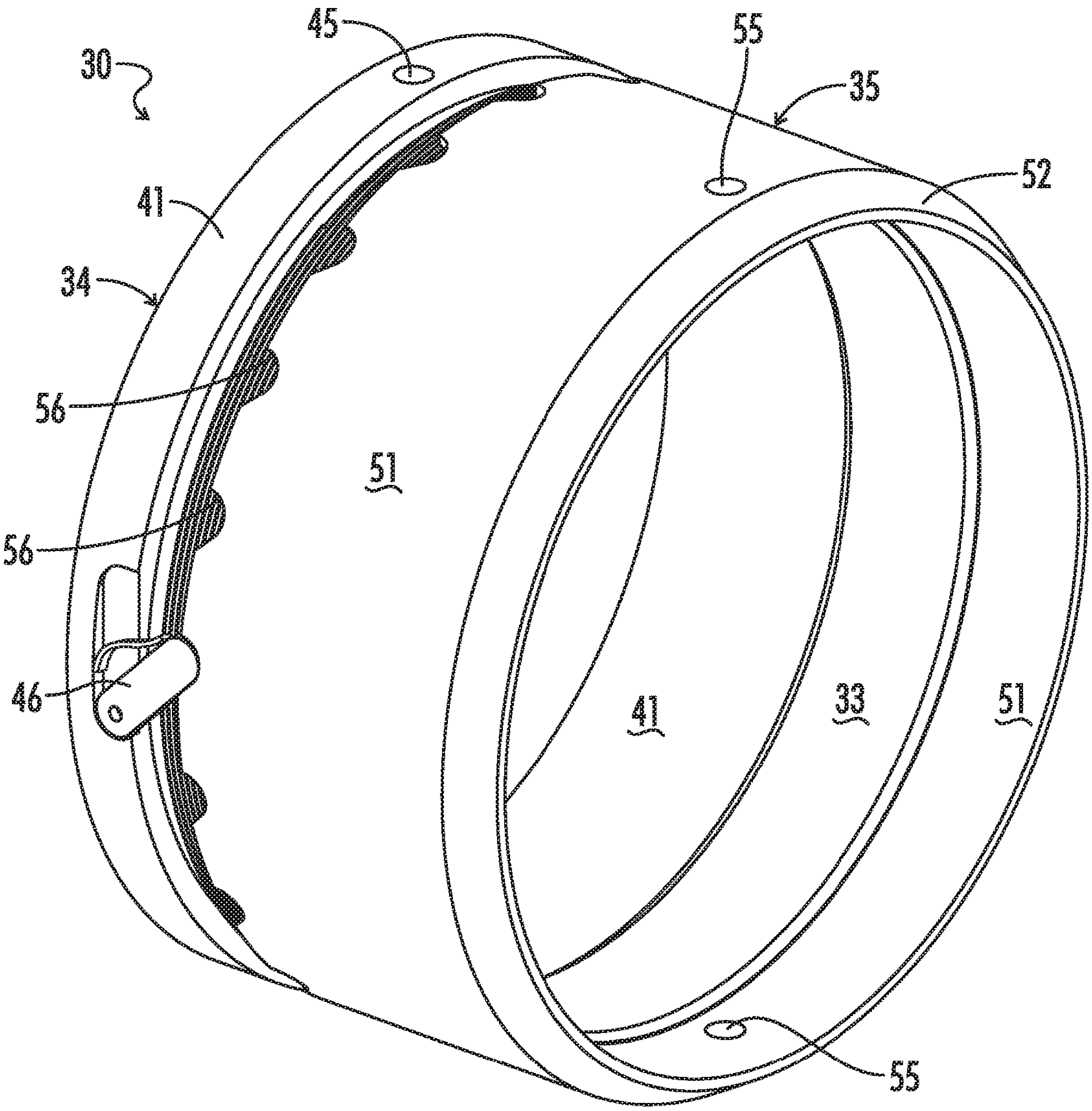

FIG. 3

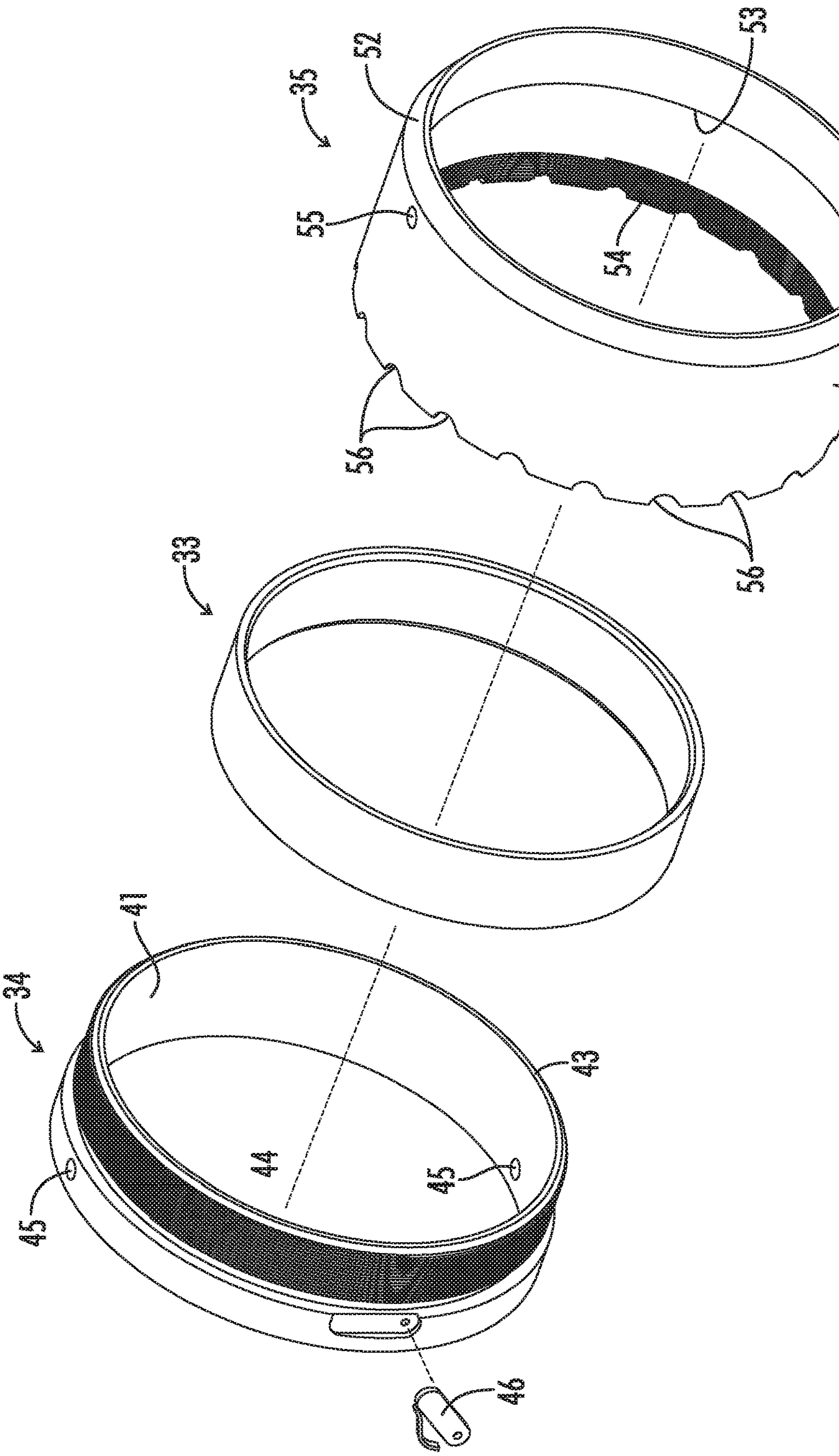

FIG. 4

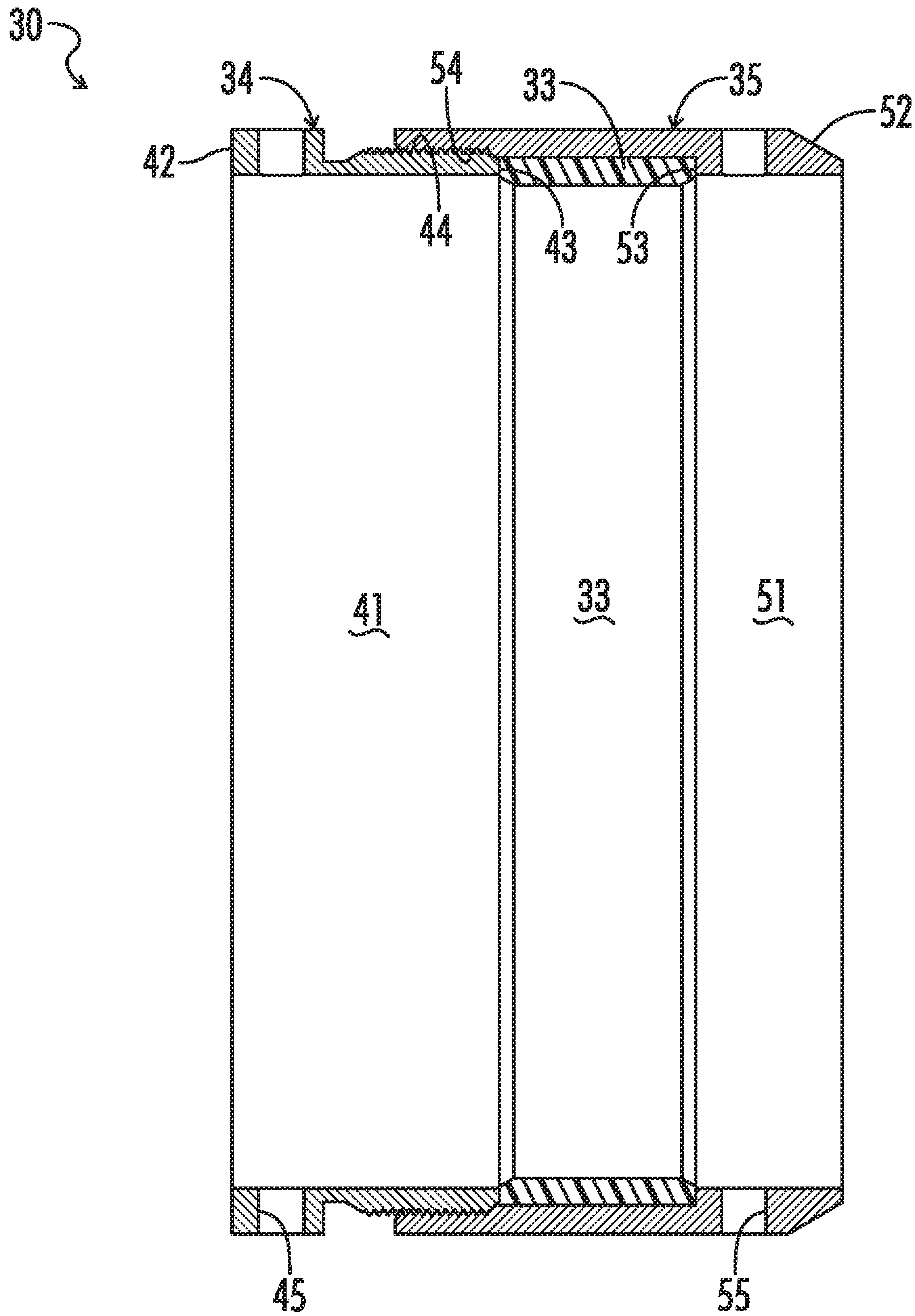

FIG. 5

STOP COLLAR

FIELD OF THE INVENTION

The present invention relates to downhole tools used in oil and gas well drilling operations and, and more particularly, to tool assemblies and stop collars that may be mounted on a liner or other tubular used in oil and gas wells.

BACKGROUND OF THE INVENTION

Hydrocarbons, such as oil and gas, may be recovered from various types of subsurface geological formations. The formations typically consist of a porous layer, such as limestone and sands, overlaid by a nonporous layer. Hydrocarbons cannot rise through the nonporous layer. Thus, the porous layer forms a reservoir, that is, a volume in which hydrocarbons accumulate. A well is drilled through the earth until the hydrocarbon bearing formation is reached. Hydrocarbons then are able to flow from the porous formation into the well.

In what is perhaps the most basic form of rotary drilling methods, a drill bit is attached to a series of pipe sections or "joints" referred to as a drill string. The drill string is suspended from a derrick and rotated by a motor in the derrick. A drilling fluid or "mud" is pumped down the drill string, through the bit, and into the bore of the well. This fluid serves to lubricate the bit. The drilling mud also carries cuttings from the drilling process back to the surface as it travels up the wellbore. As the drilling progresses downward, the drill string is extended by adding more joints of pipe.

A modern oil well typically includes a number of tubes extending wholly or partially within other tubes. That is, a well is first drilled to a certain depth. Large diameter pipes, or casings, are placed in the well and cemented in place to prevent the sides of the borehole from caving in. After the initial section has been drilled, cased, and cemented, drilling will proceed with a somewhat smaller wellbore. The smaller bore is lined with somewhat smaller pipes or "liners." The liner is suspended from the original or "host" casing by an anchor or "hanger." A well may include a series of smaller liners, and may extend for many thousands of feet, commonly up to and over 25,000 feet.

The liners are cemented in the wellbore as the well is constructed. That is, the liner necessarily is smaller than the bore in which it is installed. The gap between the liner and the wellbore is referred to as the annulus, and it is filled with cement after the liner has been installed. The cement helps secure the liner in the wellbore and protect it against corrosion and erosion. It also supports the borehole walls from collapse. If fluids will be produced through the liner, cement also helps ensure more precise control over stimulation processes, such as fracturing and acidizing.

Most importantly, the cement is intended to form a continuous sheath, that is, a complete seal around the liner. If the liner leaks, the cement sheath will help ensure that fluids flowing through the liner do not contaminate the surrounding formation, and especially water-bearing formations. The cement sheath also ensures that hydrocarbons and other fluids in the formation are not able to migrate to other parts of the formation or to the surface.

The liner is cemented in the wellbore by injecting a cementitious, settable slurry down the liner and allowing it to flow up the annulus. The cement then is allowed to set, that is, solidify and harden into what hopefully will be a continuous seal throughout the annulus. There are a number of challenges, however, in ensuring that the sheath is continuous and that a complete seal is established between the bore and liner. Some issues arise from the chemical and physical nature of the cement slurry and how it interacts with other fluids in the well or the formation. The position of a liner in the bore also can create significant impediments to forming a complete seal.

That is, oil wells are commonly depicted as extending straight down into the earth with a tube running right down the middle of the bore. The truth is far from that. Because it is formed with a rotating drill bit, the bore will tend to corkscrew as it is extended. Moreover, in order to increase production, the bore commonly will be deviated from a nominal vertical bearing to extend it along, rather than through a hydrocarbon-beating formation. So-called "horizontal" wells constitute most of the wells being drilled in the United States today.

A liner, therefore, will not necessarily be centered within a wellbore. It may tend to rest against the side of a bore, especially in horizontal extensions. A cement slurry may not be able to flow into the area where a liner rests against the borehole. Thus, when set, voids may be left in the cement sheath, or it may have thin, weak portions. Fluids from the formation may be able to migrate from one area of the formation to another or may even reach the surface.

In an effort to mitigate such problems, a liner typically will be provided with centralizers. The centralizers are intended to maintain a minimum clearance between the liner and the bore, while at the same time providing paths which allow cement slurry to flow past them. "Bow-spring" centralizers are one common type of centralizer. They have a pair of relatively short sleeves that fit around the outside of a liner. A number of relatively stiff, narrow bow springs extend between the sleeves. The bow springs curve away from the liner and keep the liner spaced from the walls of the bore. The springs are spaced angularly around the circumference of the sleeves so that cement slurry can flow around and through the centralizer.

"Spiral-blade" centralizers are another common type. They incorporate a single longer sleeve. The sleeve has raised, rounded blades that extend along the sleeve in a loose helix. The blunt blades maintain clearance with the bore while providing channels through which cement may flow. Centralizers, therefore, can greatly reduce or eliminate contact between a liner and the bore, and help ensure that the cement sheath will have sufficient thickness throughout the annulus to provide an effective seal.

Centralizers may be mounted on a liner in a fixed position. For example, U.S. Pat. Pub. No. 2013/0160993 of J. Davilla et al. discloses a spiral-blade centralizer that is fixedly mounted on a liner. It generally comprises a body and a pair of wedge rings. The body is generally cylindrical and fits around a liner. Blunt blades are provided around its circumference to keep the liner spaced from the bore and provide channels for cement flow. Each end of the centralizer body has internal threads. The threads are opposed. That is, the threads on one end of the body are right-hander and those at the other end are left-handed. The internal threads on the body engage external threads on a tapered surface of the wedge rings. Thus, the body may be rotated to draw the wedge rings together. As they draw together, teeth on the inner surface of the wedge rings bite into the liner, securing the centralizer in place.

Providing a centralizer with some freedom of movement, however, can make it much easier to run a liner into a well. Thus, other centralizers, including bow-spring and spiral-blade type centralizers, are mounted such that they are free to rotate and travel a certain distance along a liner. Sliding centralizers are widely available on the market, including slip-on bow-spring and spiral-blade centralizers distributed by Top-Co, Houston, Tex., and MSIS-B bow spring centralizers available from Weatherford. Movement of the centralizer along a liner will be limited by what are referred to as thrust or stop collars. A stop collar will be placed above and below the centralizer as a joint of liner is run into the well. The stop collars are securely mounted to the liner to provide mechanical stops limiting travel of the centralizer along the liner.

Stop collars may simply comprise a collar which is slid on a liner and secured in place with set screws. Other designs utilize a hinged collar or a split collar. The collar is opened to place it around a liner. The ends then are brought together and latched or otherwise secured. Such designs may have metal gripping features which bite into the liner, or they may have an elastomeric layer concentrically disposed within the collar. Some designs incorporate both metal gripping features and elastomers, such as the stop collars disclosed in U.S. Pat. No. 3,652,138 to C. Collett. Other designs rely on a layer of swellable elastomer disposed on the inside surface of the collar, such as those disclosed in U.S. Pat. No. 7,942,199 to P. Angman. The collar is dipped into an activating solution and then slipped onto the liner. The elastomer swells and grips the liner.

The statements in this section are intended to provide background information related to the invention disclosed and claimed herein. Such information may or may not constitute prior art. It will be appreciated from the foregoing, however, that there remains a need for new and improved systems and apparatus for mounting stop collars and other tool assemblies in a fixed position on liners and other tubular members. Such disadvantages and others inherent in the prior art are addressed by various aspects and embodiments of the subject invention.

SUMMARY OF THE INVENTION

The subject invention, in its various aspects and embodiments, relates generally to assemblies and stop collars that may be mounted in a fixed position on tubular members, such as liners, that are used in oil and gas wells. It encompasses various embodiments and aspects, some of which are specifically described and illustrated herein.

One broad embodiment of the subject invention provides a collar for mounting on a tubular member. The collar comprises a first member and a second member. The two members are adapted for lateral displacement relative to each other and provide opposing inner thrust surfaces. The collar also comprises a radially expandable gripping member which is disposed between the opposing thrust surfaces. The members may be drawn laterally together to cause the thrust surfaces to bear on the gripping member. As the thrust surfaces bear on the gripping member that will expand it radially inward into frictional engagement with the tubular member.

Other broad embodiments and aspects are directed to a collar that is mountable on a tubular member. The collar comprises a first sleeve and a second sleeve. The two sleeves are adapted to extend around the outer circumference of the tubular member. The sleeves are engaged with each other by threaded connections and provide opposing inner thrust surfaces. The collar also comprises a radially expandable gripping member which is disposed between the opposing thrust surfaces. The sleeves may be drawn together by rotating them relative to each other about the threaded connection. The relative rotation will cause the thrust surfaces to bear on the gripping member and expand the gripping member radially inward into frictional engagement with the tubular member.

In other aspects, the invention provides for such collars where the gripping member engages the tubular member without penetrating the member, where it engages the tubular member without creating electrolytic contact between the collar and tubular member, or where it engages the tubular member without penetration and without creating electrolytic contact.

Other aspects are directed to such collars where the first sleeve is provided with external threads engaging internal threads on the second sleeve and the gripping member is disposed between the inner end of the first sleeve and an annular shoulder in the second sleeve. Still other embodiments are directed to such collars where the second sleeve provides radial support for the gripping member. Yet other embodiments provide such collars where the gripping member is carried in an expanded diameter portion of the second sleeve

Additional embodiments and aspects provide such collars where the gripping member is a compressible band, preferably an elastomer band.

In still other embodiments, the invention provides such collars having a mechanism to restrict loosening of the threaded engagement between the sleeves. In some embodiments, the mechanism comprises a pawl on one sleeve and detents angularly spaced along the inner end of the other sleeve. The pawl selectively engaging the detents to restrict loosening of the threaded engagement between the sleeves. In other embodiments, the mechanism is a set screw extending through one sleeve and frictionally engaging the other sleeve.

The subject invention also is directed to stop collars and other tools for mounting on a tubular. Broad embodiments of the novel tools comprise a novel collar. Other broad embodiments are directed to a centralizing assembly. The assembly comprises a centralizer tool. The centralizer tool comprises spacing members which extend radially outward beyond the tubular member and define lateral channels. The assembly further comprises a novel stop collar. Still other broad embodiments are directed to tubular assemblies. The tubular assemblies comprise a novel centralizing assembly or other novel tool.

The subject invention also provides novel methods for conducting well operations. Such methods include methods for centralizing liners or other tubulars in a well. The methods comprise installing a novel centralizing assembly on the tubular and running the tubular into the well.

Finally, still other aspects and embodiments of the invention will have various combinations of such features as will be apparent to workers in the art.

Thus, the present invention in its various aspects and embodiments comprises a combination of features and characteristics that are directed to overcoming various shortcomings of the prior art. The various features and characteristics described above, as well as other features and characteristics, will be readily apparent to those skilled in the art upon reading the following detailed description of the preferred embodiments and by reference to the appended drawings.

Since the description and drawings that follow are directed to particular embodiments, however, they shall not be understood as limiting the scope of the invention. They are included to provide a better understanding of the invention and the way it may be practiced. The subject invention encompasses other embodiments consistent with the claims set forth herein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a schematic illustration of a liner assembly **10** being cemented in a bore **4** of a well **1**, which liner assembly **10** includes first preferred embodiments **20** of centralizing assemblies of the subject invention.

FIG. **1**B is a schematic illustration showing liner assembly **10** after it has been cemented in bore **4**.

FIG. **2** is an isometric view of a centralizing assembly **20** shown schematically in FIG. **1**, which centralizing assembly **20** is assembled on a portion of liner **10** and includes a pair of first embodiments **30** of the stop collars of the subject invention.

FIG. **3** is an isometric view of stop collar **30**.

FIG. **4** is an exploded, isometric view of stop collar **30** showing a male sleeve **34**, a compressible band **33**, and a female sleeve **35** from which stop collar **30** is assembled.

FIG. **5** is an axial cross-sectional view of stop collar **30** in its set or installed state.

In the drawings and description that follows, like parts are identified by the same reference numerals. The drawing figures are not necessarily to scale. Certain features of the embodiments may be shown exaggerated in scale or in somewhat schematic form and some details of conventional design and construction may not be shown in the interest of clarity and conciseness.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The subject invention relates generally to tool assemblies and stop collars that may be mounted on a liner or other tubular member in a fixed position and encompasses various embodiments and aspects. Some of those embodiments are described is some detail herein. For the sake of conciseness, however, all features of an actual implementation may not be described or illustrated. In developing any actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve a developers' specific goals. Decisions usually will be made consistent within system-related and business-related constraints, and specific goals may vary from one implementation to another. Development efforts might be complex and time consuming and may involve many aspects of design, fabrication, and manufacture. Nevertheless, it should be appreciated that such development projects would be a routine effort for those of ordinary skill having the benefit of this disclosure.

Overview of Cementing Operations

The novel centralizing assemblies may be used, for example, to help improve the quality of a cement sheath that will be formed around a liner. Thus, a first preferred centralizing assembly **20** incorporating a first preferred stop collar **30** will be described by reference to FIG. **1**. FIG. **1** are schematic depictions of a liner assembly **10** being cemented in an oil and gas well **1**. Liner assembly **10** incorporates a number of centralizing assemblies **20**.

Referring first to FIG. **1**A, well **1** is serviced by a derrick **2** and various surface and downhole equipment for pumping cement and circulating fluids (not shown). The upper portion of well **1** is provided with a casing **3**, while the lower portion is an open bore **4** extending generally horizontally through a hydrocarbon bearing formation **5**.

Liner assembly **10** has been suspended from casing **3** by a liner hanger **11** and extends through open bore **4**. Liner assembly **10** includes various tools, including a toe valve **12** and a float assembly **13**. Float assembly **13** typically includes various tools that assist in running liner **10** into well **1** and cementing it in bore **4**, such as a landing collar **14**, a float collar **15**, and a float shoe **16**. Centralizing assemblies **20** are mounted around liner **10** and serve to maintain clearance between liner **10** and bore **4**.

FIG. **1**A depicts well **1** as liner **10** is being cemented in bore **4**. A quantity or "pad" of cement **6** is being pumped into liner **10**, out its lower end, and into the annulus between liner **10** and bore **4**. As cement **6** is pumped, it displaces drilling fluids **7** already present in liner **10** and the annulus. Cement **6** and fluids **7** are able to flow through the annulus and past centralizing assemblies **20**.

A wiper plug **17** is being pumped behind cement **6**. It follows the pad of cement **6** as it flows through liner **10**. Wiper plug **13** will help clean and remove cement **6** from the inside of liner **10**. It will pass through toe valve **12** and eventually seat on landing collar **14** in float assembly **13**. Pumping will continue until cement **6** completely fills the annulus between liner **10** and bore **4**.

FIG. **1**B shows well **1** after completion of the cementing operation. Cement **6** has been allowed to set. Centralizing assemblies **20** have enabled cement **6** to form a sheath completely around liner **10**. Derrick **2** and the cementing equipment have been replaced by well head **8** and other surface equipment (not shown). The equipment may be used, for example, to perforate liner **10** and to penetrate cement sheath **6** in selected areas to allow hydrocarbons to flow from formation **5** into liner **10**.

The terms "upper" and "lower" and "uphole" and "downhole" as used herein to describe location or orientation are relative to the well and to the tool as run into and installed in the well. Thus, "upper" and "uphole" refers to a location or orientation toward the upper or surface end of the well. "Lower" or "downhole" is relative to the lower end or bottom of the well. It also will be appreciated that the course of the wellbore may not necessarily be as depicted schematically in FIG. **1**. Depending on the location and orientation of the hydrocarbon bearing formation to be accessed, the course of the wellbore may be more or less deviated in any number of directions. "Axial," "radial," "angularly," and forms thereof reference the central axis of the tools. For example, axial movement or position refers to movement or position generally along or parallel to the central axis. "Lateral" movement and the like also generally refers to up and down movement or positions up and down the tool. "Radial" will refer to positions or movement toward or away from the central axis.

Overview of Preferred Centralizing Assemblies

As noted above, the novel centralizing assemblies may be used to ensure that there is sufficient clearance between a liner and a wellbore so that a continuous sheath of cement may be formed. Broad embodiments incorporate a centralizer and one or more novel stop collars. For example, centralizing assembly **20** is shown in greater detail in FIG. **2**. As illustrated therein, centralizing assembly **20** comprises a centralizer **21** which is mounted between a pair of first preferred embodiments **30** of the stop collars of the subject invention.

Centralizer **21** is a spiral-blade type centralizer. It has a generally cylindrical body **22** that may be mounted on a portion of liner **10**, for example, by sliding it over a joint of liner **10** as it is made up and run into well **1**. The outer surface of body **22** is provided with raised features to space liner **10** from bore **4**, such as four rounded, rather blunt blades **23**. Blades **23** extend laterally between the two ends of body **22**, generally along the line of a loose helix. The height of blades **23** is greatest in their mid-region and tapers toward both ends of body **22**. Blades **23** serve to maintain clearance between liner **10** and bore **4** while at the same time allowing cement **6** to flow laterally past and around body **22**.

Centralizer **21** is not fixedly carried on liner **10**. It is free to rotate about liner **10** and to move laterally along liner **10**. A first stop collar **30***a* is mounted above centralizer **21**, and a second stop collar **30***b* is mounted below centralizer **21**. Stop collars **30** are fixedly mounted to liner **10**. Lateral movement of centralizer **21** along liner **10**, therefore, is limited by stop collars **30**. Allowing such freedom of movement helps minimize the risk that centralizer **21** will hang up in casing **3** or wellbore **4** as liner **10** is run into well **1**. It will be appreciated that for some applications only a single stop collar **30** may be required to restrict lateral movement of centralizer **21**. For example, centralizer **21** may be mounted on liner **10** between a single stop collar **30** and a threaded box or other enlarged portion of a liner joint.

It will be appreciated that the novel centralizing assemblies may incorporate any conventional centralizer requiring the use of stop collars. Such centralizers include not only spiral blade centralizers, such as centralizer **21**, but also slip-on bow spring centralizers. Many different centralizers are available from Top-Co, Weatherford, and other manufacturers and suppliers.

Overview of First Preferred Stop Collar

As noted above, the novel stop collars may be mounted on a liner or other tubular member and used, for example, to limit the lateral movement of a tool such as a centralizer. Broad embodiments of the novel stop collars comprise first and second members which may be displaced laterally relative to each other. A radially expandable gripping member is disposed between opposing thrust surfaces on the displaceable members. The members may be drawn together to expand the gripping member radially inward into frictional engagement with a liner.

Stop collar **30**, for example, is incorporated into centralizing assembly **20** to limit the lateral movement of centralizer **21**. Stop collar **30** is shown in greater detail in FIGS. **3-5**. As shown therein, stop collar **30** generally comprises a male sleeve **34**, a compressible band **33**, and a female sleeve **35**. Compressible band **33** is carried within stop collar **30** between male sleeve **34** and female sleeve **35**. Stop collar **30** may be slid over liner **10** (not shown in FIGS. **3-5**). Male sleeve **34** and female sleeve **35** may be threaded together to compress band **33** and expand it radially inward into frictional engagement with liner **10**.

More specifically, male sleeve **34** has a generally cylindrical body **41**. The inner diameter of body **41** is substantially uniform and is slightly larger than the outer diameter of liner **10**. Male sleeve **34** will fit closely, but still loose enough that it can slide easily along liner **10**. The outer end **42** of male body **41** has a radial thickness and provides an annular surface normal to the circumference of liner **10**. As will be appreciated from FIG. **2**, stop collar **30** preferably will be mounted on liner **10** such that outer end **42** of male body **41** provides a stop surface limiting travel of centralizer

21 along liner **10**. The inner end of body **41** has a reduced outer diameter and terminates in an annular thrust surface **43** extending radially and normal to the outer circumference of liner **10**. A substantial portion of the reduced diameter portion of the inner end of body **41** is provided with external threads **44**.

Female sleeve **35** also has a generally cylindrical body **51**. The inner diameter of body **51** is sized to allow female sleeve **35**, like male sleeve **34**, to slide easily along liner **10**. The outer end **52** of female body **51** preferably is chamfered to provide stop collar **30** with a tapered leading edge to reduce the risk of centralizing assembly **20** hanging up as liner **10** is run into or out of well **1**. The inner end of body **51** has an area of increased inner diameter forming an internal, inward-facing annular shoulder or thrust surface **53**. The inner end of body **51** is provided with internal threads **54**.

Compressible band **33** is an annular body which, in its uncompressed, as-assembled state, is sized to fit loosely around liner **10**. Band **33** is carried radially within the enlarged inner diameter portion of body **51** of female sleeve **35**. It is disposed axially between thrust surface **43** in male sleeve **34** and thrust surface **53** in female sleeve **35**. Male sleeve **34** is assembled to female sleeve **35** by the engagement of their respective threads **44** and **54**. Thus, when male sleeve **34** and female sleeve **35** are relatively loosely engaged and compressible band **33** is relatively uncompressed, stop collar **30** may be slid over liner **10** for installation.

Once it is slid around liner **10**, stop collar **30** may be fixedly mounted to liner **10** by rotating the threaded connection to draw male sleeve **34** and female sleeve **35** together. As male sleeve **34** and female sleeve **35** are drawn together, they will begin to compress compressible hand **33**. Band **33** is radially supported along its width by the enlarged diameter portion of female sleeve **35**. Thus, as compressible band **33** is compressed between thrust surfaces **43** and **53**, it will tend to expand radially inward and into engagement with liner **10**, gripping it and fixedly securing stop collar **30** on liner **10**.

The gripping member preferably will establish non-corrosive contact between the stop collar and liner. The contact may be non-corrosive in the sense that it is non-penetrating. That is, the gripping member does not significantly abrade or score the liner. It may be non-corrosive in the sense that it does not create electrolytic contact between the stop collar and liner. That is, the gripping member will not create significant electrolysis between the stop collar and liner. Preferably, the contact will be both non-penetrating and non-electrolytic.

Compressible band **33**, for example, may be made from any material capable of radially expanding into a state of elastic compression. Preferably, however, band **33** is fabricated from elastomers, such as nitrile butadiene rubber (NBR), hydrogenated nitrile butadiene nitrile rubber (HNBR), and fluoroelastomers such as Viton®, or polytetrafluoroethylene. Such materials may allow stop collar **30** to be securely mounted without damaging the surface of liner **10** and potentially shortening its service life.

That is, it will be appreciated that conventional collars may employ set screws, or they may have metal teeth or other gripping features that bite into liner **10**. Liner **10** typically will be made of very hard, durable steel, but nevertheless, it will be exposed to harsh fluids, potentially from within and without, and potentially over a long service life. Abrasion and scoring of the metal may make liner **10** more susceptible to corrosion and, if there is contact between dissimilar metals, to electrolytic corrosion. When compressible band **33** is fabricated from elastomers, such issues may be avoided. Other materials, however, may be used to establish non-penetrating or non-electrolytic contact between the stop collar and liner.

In some applications, it may be acceptable to use soft, ductile metals such as brass and aluminum alloys to fabricate gripping members. Such materials generally are not preferred. While they typically will be non-penetrating and may not significantly score or otherwise damage a liner during installation, they still create issues of electrolytic corrosion. Thus, as a general matter, gripping members, like an elastomer band, which establish non-electrolytic contact between the liner and the stop collar as well as non-penetrating contact are preferred.

An elastomeric band **33** also may provide stop collar **30** with a "self-energizing" grip on liner **10**. That is, as centralizer **21** bears on bottom end **42** of male sleeve **34** it will tend to urge stop collar **30** to travel along liner **10**. Male sleeve **34** and female sleeve **35** fit loosely around liner **10**. They may be displaced fairly easily, especially if significant torque is not created through stop collar **30**. Elastomeric band **33**, however, is frictionally engaged with liner **10** and will resist displacement. Thrust surface **54** on female sleeve **35**, therefore, may pull away from band **33**. Thrust surface **44**, however, will bear on band **33**, compressing it, further expanding it radially inward, and increasing its coefficient of friction. The load on stop collar **30**, of course, may become so high that it will force elastomer band **33** to skip or extrude. Until it reaches that point, however, the grip on liner **10** will increase with load. Such dynamics also can provide a shock absorbing effect, and help minimize the risk of damage to centralizer **21** and stop collar **30** as liner **10** travels through the well.

A band, such as band **33**, also may be preferred as it provides a relatively large area of contact around liner **10** and correspondingly more frictional resistance to movement. Band **33** also may be provided with various features, such as raised nubs, ridges, or other embossments to facilitate a frictional engagement between band **33** and liner **10**. The gripping member, however, may have various other configurations. For example, a plurality of discrete gripping members also may be provided and arrayed angularly about the inner circumference of the stop collars.

Similarly, the threaded connection between male sleeve **34** and female sleeve **35** provide a simple, effective mechanism for drawing their thrust surfaces **43** and **53** together to compress and radially expand band **33** radially inward. Other mechanisms, however, may be used. For example, the stop collars may incorporate a pair of terminal or end sleeves, each having a threaded end. The threads on the end sleeves may spiral in opposite directions—the threads on one sleeve being right-handed, and the threads on the other being left-handed. A central or connection sleeve may be provided with opposing internal threads on each end. The connection sleeve may be used to connect and draw the two end sleeves together. Other conventional means of drawing opposing thrust surfaces together may be used.

It also will be appreciated that the novel collars may be provided with other features that may make installation easier or enhance their reliability. For example, holes **45** and **55** may be provided, respectively, on male sleeve **34** and female sleeve **35**. Pins on a spanner tool may be inserted into holes **45** and **55** to rotate sleeves **34** and **35** during installation or to remove them from liner **10**. The novel stop collars also preferably will have a mechanism to ensure that once they are installed on liner **10**, the threaded connection between male sleeve **34** and female sleeve **35** will not loosen to the point where stop collar **30** will slide along liner **10**.

For example, as best seen in FIGS. **3**-**4**, female sleeve **35** is provided with a series of notches or detents **56** arrayed angularly around its inner end. Male sleeve **34** is provided with one or more pivoting pawls **46** mounted in its mid-region. Pawl **46** is spring-load to bias it into detents **56**. Detents **56** are shaped such that, when male sleeve **34** and female sleeve **35** are rotated to draw them together, pawl **46** will pivot into and then ramp out of detents **56**. Instead of a ramp, the other face of detents **56** is designed to fit and catch pawl **46**. Thus, once male sleeve **34** and female sleeve **35** have been drawn together fully to mount stop collar **30** on liner **10**, pawl **46** will catch in a decent **56** and prevent significant separation of male sleeve **34** and female sleeve **35** or relaxation of band **33**.

It will be appreciated, of course, that suitable pawl-decent mechanisms may have other designs and effectively prevent loosening of stop collar **30**. Likewise, other mechanisms for preventing relative rotation between male sleeve **34** and female sleeve **35** once they have been drawn together may be used. For example, a set screw may be threaded through female sleeve **35** and driven into frictional engagement with male sleeve **34**. Other designs are known in the art and may be used.

In general, the novel stop collars may be fabricated from materials typically used in stop collars of this type. Given the extreme stress and the corrosive and abrasive fluids to which they may be exposed, suitable materials will be hard and strong. For example, excepting their gripping member as discussed above, the components of novel stop collars may be fabricated from 4130 and 4140 chromoly steel or from somewhat harder, stronger steel such as 4130M7, high end nickel alloys, and stainless steel. The components may be made by any number of conventional techniques, but typically and in large part will be made by forging, extruding, or mold casting a blank part and then machining the required features into the part.

The novel stop collars have been described as being mounted on a liner and, more specifically, a production liner. A "liner," however, can have a fairly specific meaning within the industry, as do "casing" and "tubing." In its narrow sense, a "casing" is generally considered to be a relatively large tubular conduit, usually greater than 4.5" in diameter, that extends into a well from the surface. A. "liner" is generally considered to be a relatively large tubular conduit that does not extend from the surface of the well, and instead is supported within an existing casing or another liner. In essence, it is a "casing" that does not extend from the surface. "Tubing" refers to a smaller tubular conduit, usually less than 4.5" in diameter. The novel stop collars, however, are not limited in their application to liners as that term may be understood in its narrow sense. They may be used to advantage in liners, casings, tubing, and other tubular conduits or "tubulars" as are commonly employed in oil and gas wells.

The novel stop collars also have been described in the context of centralizing assemblies used in cementing operations. They may be used in centralizing assemblies for other applications, such as "casing-while-drilling" operations where a bit is attached at the end of a liner to drill a bore and install a liner at the same time. They may be used to limit the travel of centralizers, but they also may be incorporated into centralizers which are fixedly mounted on a liner. For example, a pair of novel stop collars may be joined by bow springs to provide a centralizer that may be mounted securely in a particular location along a liner. A more elongated sleeve may be provided with spiral blades, and each end configured generally as is the inner end of female sleeve **35**. A male sleeve **34** then may be assembled to each end of the spiral-blade sleeve to mount it in a fixed location on a liner.

Moreover, while they are particularly useful in centralizing assemblies, the novel stop collars have other applications. They may be used in or with other tools, such as cement baskets and scrapers. They also may be used as guides or protectors for sucker rods and tubing. In general, they may be adapted and employed for many different applications calling for a fixedly mounted collar around a tubular member.

While this invention has been disclosed and discussed primarily in terms of specific embodiments thereof, it is not intended to be limited thereto. Other modifications and embodiments will be apparent to the worker in the art.

What is claimed is:

1. A collar for mounting on a tubular member, said mountable collar comprising:

(a) a first sleeve and a second sleeve, said sleeves:
   i) extending around the outer circumference of said tubular member;
   ii) being engaged by threaded connections; and
   iii) providing opposing inner thrust surfaces;

(b) a radially expandable gripping member disposed between said opposing thrust surfaces;

(c) wherein said sleeves are capable of being drawn together by rotation about said threaded connection to cause said thrust surfaces to bear on said gripping member and expand said gripping member radially inward into frictional engagement with said tubular member.

2. The collar of claim **1**, wherein said gripping member engages said tubular member without penetrating said tubular member.

3. The collar of claim **1**, wherein said gripping member engages said tubular member without creating electrolytic contact between said collar and tubular member.

4. The collar of claim **1**, wherein said first sleeve is provided with external threads engaging internal threads on said second sleeve and said gripping member is disposed between the inner end of said first sleeve and an annular shoulder in said second sleeve.

5. The collar of claim **4**, wherein said gripping member is a compressible band.

6. The collar of claim **5**, wherein said compressible band is fabricated from an elastomer.

7. The collar of claim **1**, wherein said second sleeve provides radial support for said gripping member.

8. The collar of claim **7**, wherein said gripping member is a compressible band.

9. The collar of claim **8**, wherein said compressible band is fabricated from an elastomer.

10. The collar of claim **1**, wherein said gripping member is carried in an expanded diameter portion of said second sleeve.

11. The collar of claim **1**, wherein said collar comprises means for restricting loosening of said threaded engagement between said sleeves.

12. The collar of claim **11**, wherein said first sleeve comprises a pawl and said second sleeve comprises detents angularly spaced along the inner end of said second sleeve, said pawl selectively engaging said detents to restrict loosening of said threaded engagement between said sleeves.

13. The collar of claim **11**, wherein a set screw is provided to restrict loosening of said threaded engagement between said sleeves.

14. A tool for mounting on a tubular; said tool comprising a collar of claim **1**.

15. The tool of claim **14**, wherein said tool is a stop collar.

16. A centralizing assembly for a tubular member, said assembly comprising:

(a) a centralizer tool comprising spacing members, said spacing members extending radially outward beyond said tubular member and defining lateral channels; and

(b) a stop collar of claim **1**.

17. A tubular assembly, said tubular assembly comprising a tubular and a centralizer assembly of claim **16**.

18. A collar for mounting on a tubular member, said mountable collar comprising:

(a) a first member and a second member, said members being:
   i) adapted for lateral displacement relative to each other; and
   ii) providing opposing inner thrust surfaces; and

(b) a radially expandable gripping member disposed between said opposing thrust surfaces;

(c) wherein said members are capable of being drawn laterally together to cause said thrust surfaces to bear on said gripping member and expand said gripping member radially inward into frictional engagement with said tubular member; and

(d) wherein said collar is mounted on said tubular member without penetrating said tubular member.

19. The collar of claim **18**, wherein said gripping member is a compressible band.

20. The collar of claim **19**, wherein said compressible band is fabricated from an elastomer.

21. A tool for mounting on a tubular; said tool comprising a collar of claim **18**.

22. The tool of claim **21**, wherein said tool is a stop collar.

23. A centralizing assembly for a tubular member, said assembly comprising:

(a) a centralizer tool comprising spacing members, said spacing members extending radially outward beyond said tubular member and defining lateral channels; and

(b) a stop collar of claim **18**.

24. A tubular assembly, said tubular assembly comprising a tubular and a centralizer assembly of claim **23**.

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