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Mullins et al.

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(54) **CASING GRAPPLE**

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(22) Filed: **Jun. 21, 2018**

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E21B 19/07 (2006.01)
E21B 31/20 (2006.01)
E21B 19/16 (2006.01)

(52) **U.S. Cl.**
CPC ***E21B 19/07*** (2013.01); ***E21B 19/16*** (2013.01); ***E21B 31/20*** (2013.01)

(58) **Field of Classification Search**
CPC E21B 19/07; E21B 19/16; E21B 31/20
See application file for complete search history.

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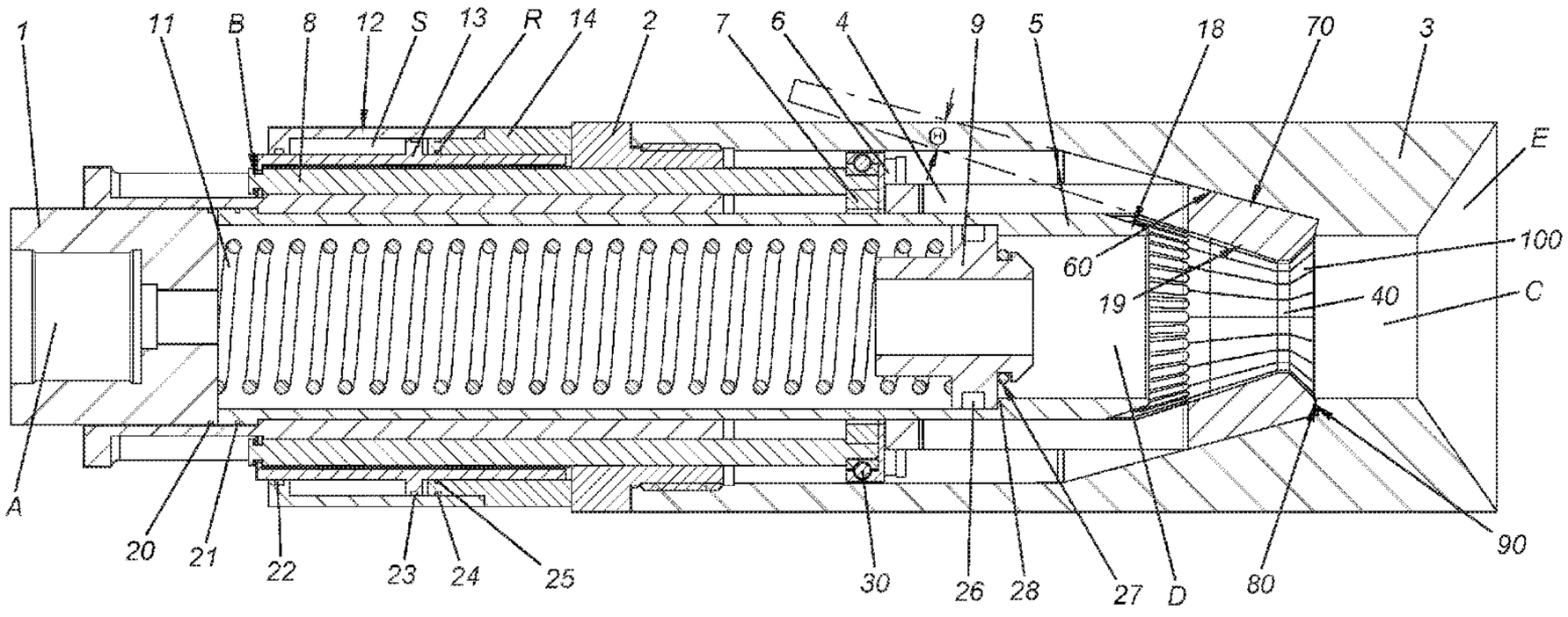
(57) **ABSTRACT**

A tubular is automatically gripped below an upset end or coupling and released mechanically or with the use of pressure or other devices such as motors and or gear arrangements. A mandrel connects to a traveling block and/or top drive and enables selective supporting and releasing of an "upset end" tubular (casing, tubing or drill pipe) by changing the load carrying element as well as sealing element, this allows supporting while running or pulling, filling, flow back and/or circulation.

21 Claims, 10 Drawing Sheets



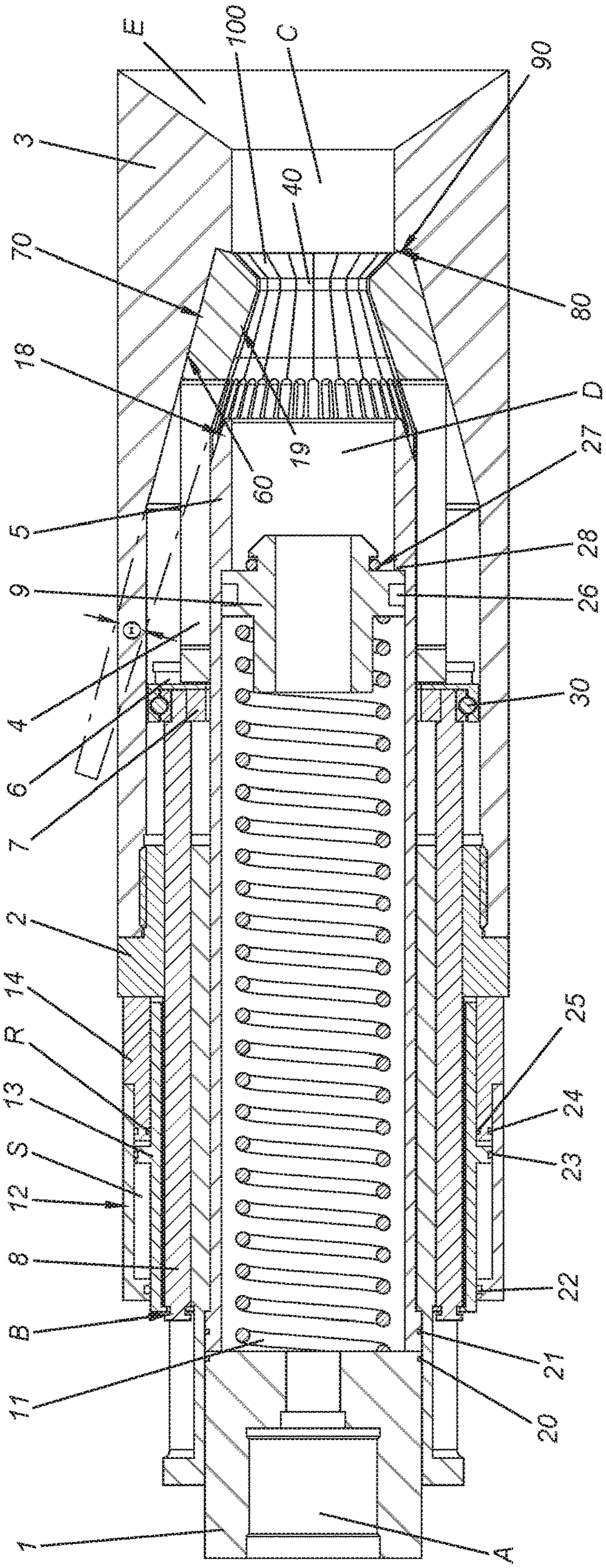

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FIG. 1

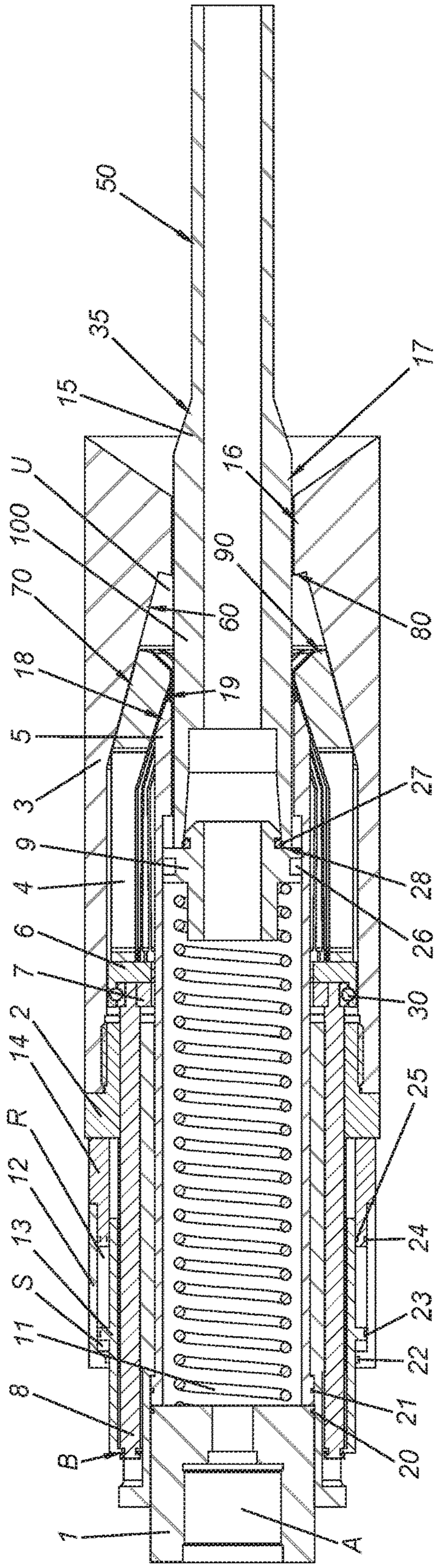
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FIG. 2

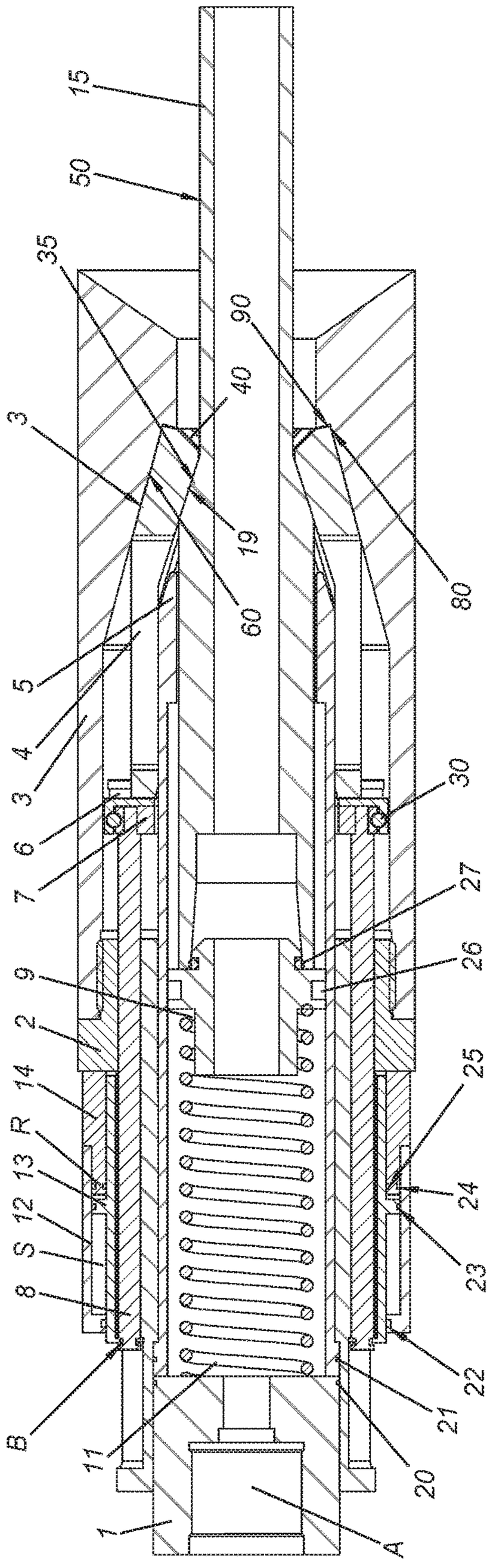
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FIG. 3

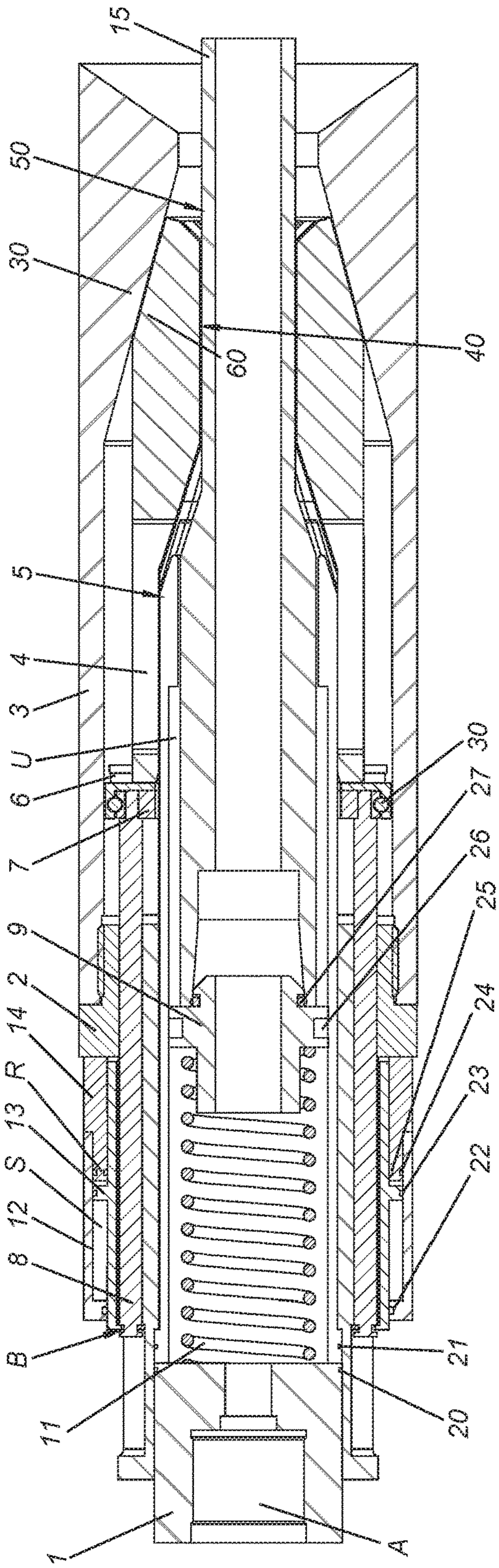
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FIG. 4

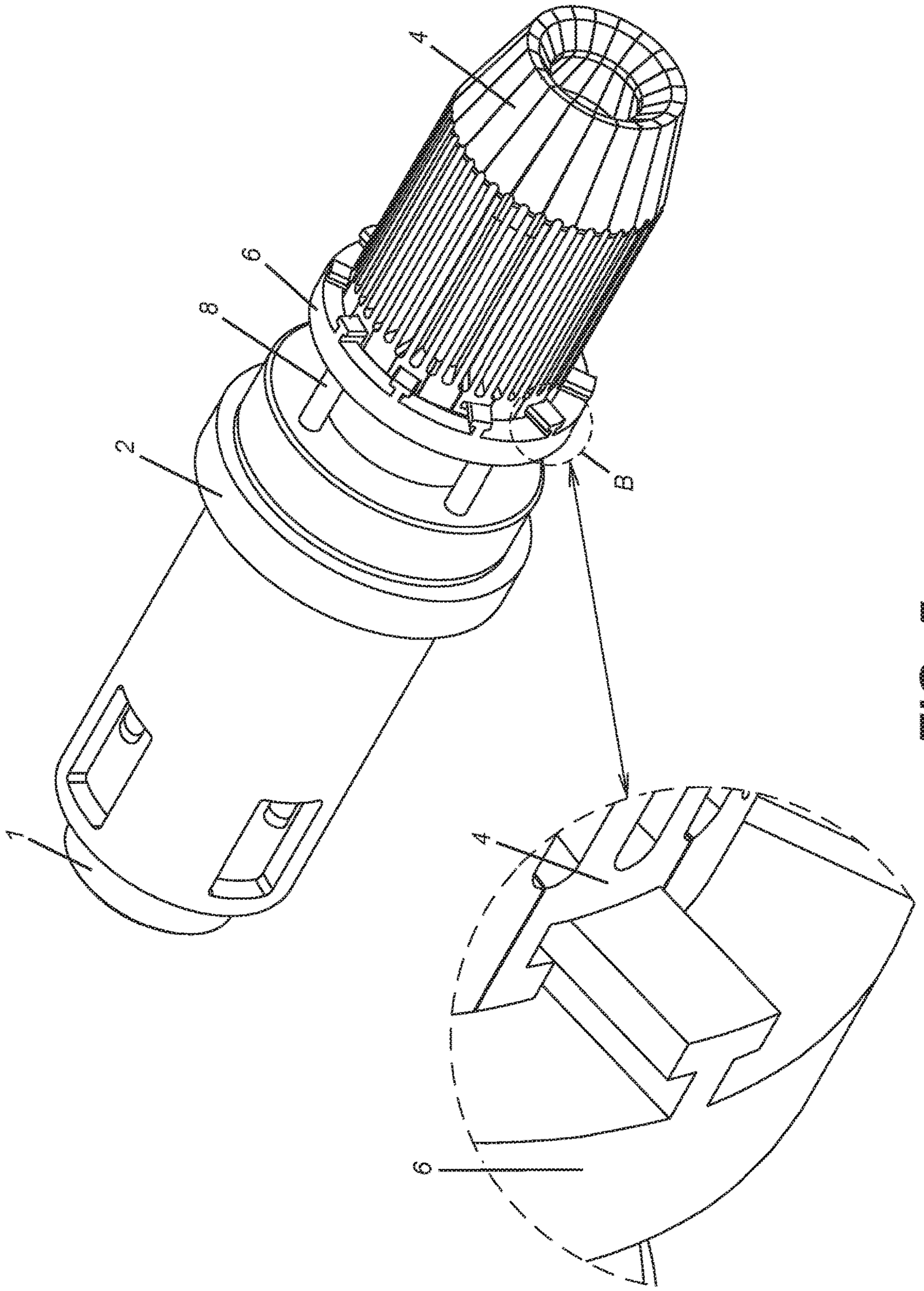

FIG. 5

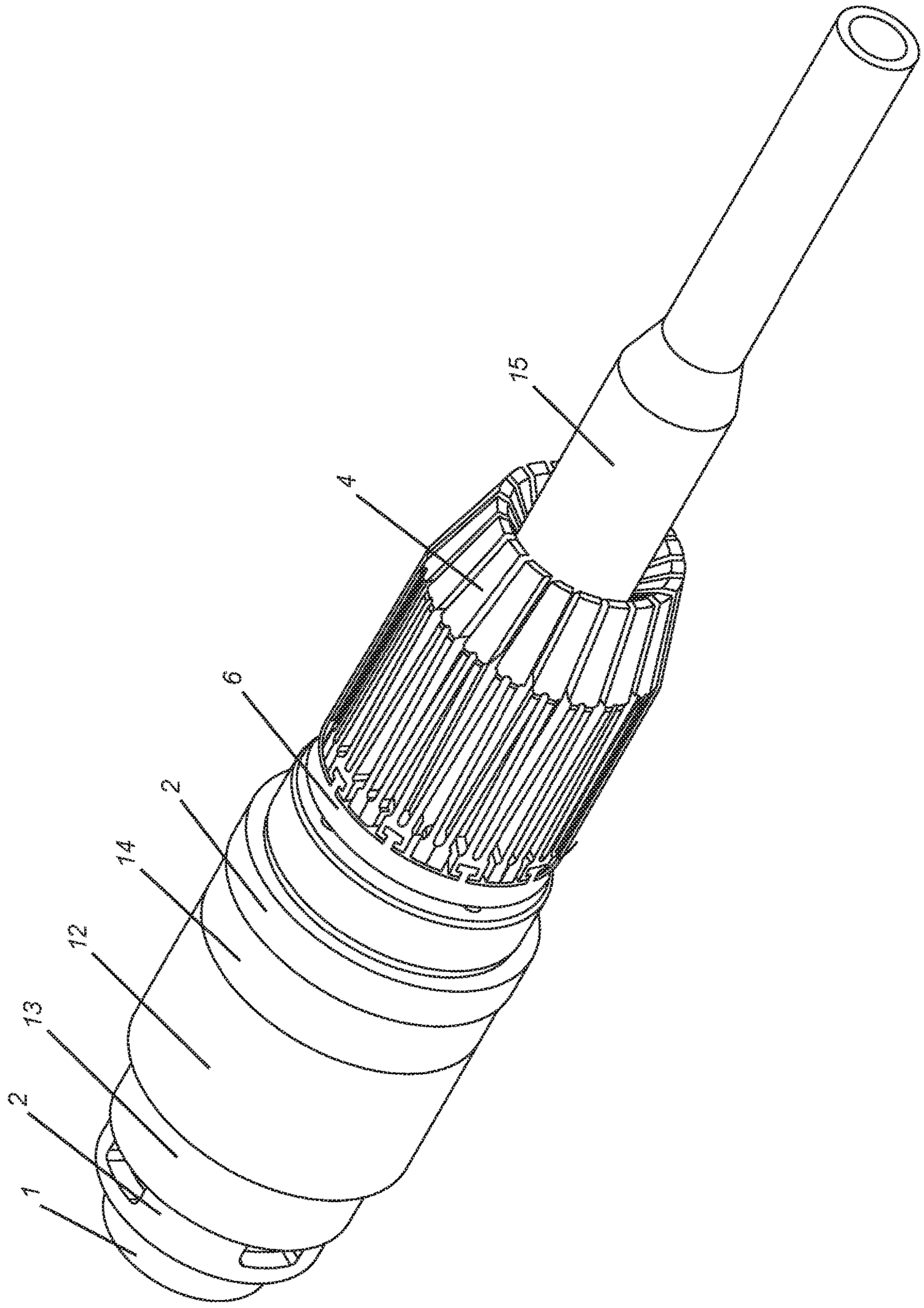

FIG. 5A

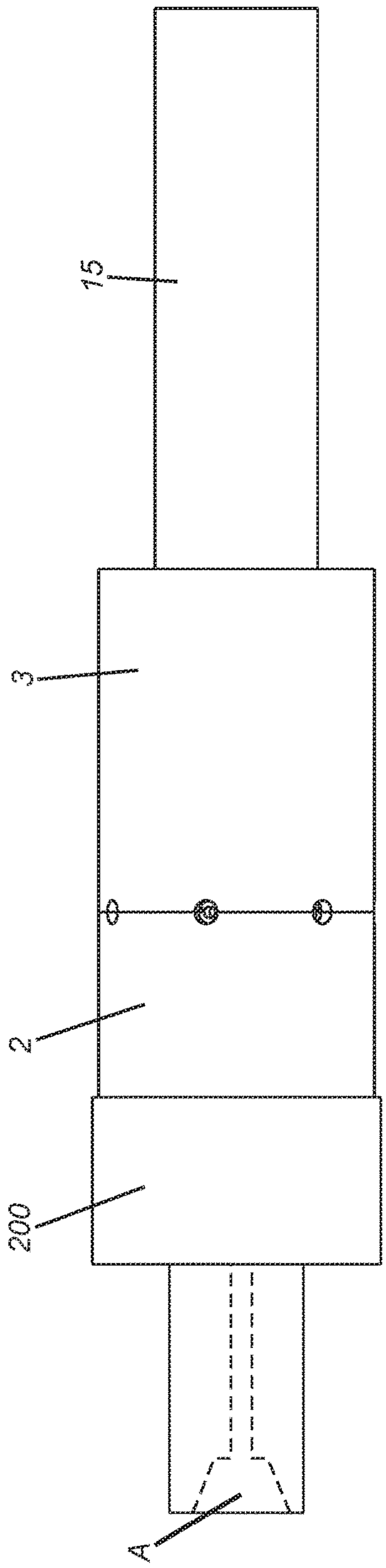

FIG. 6

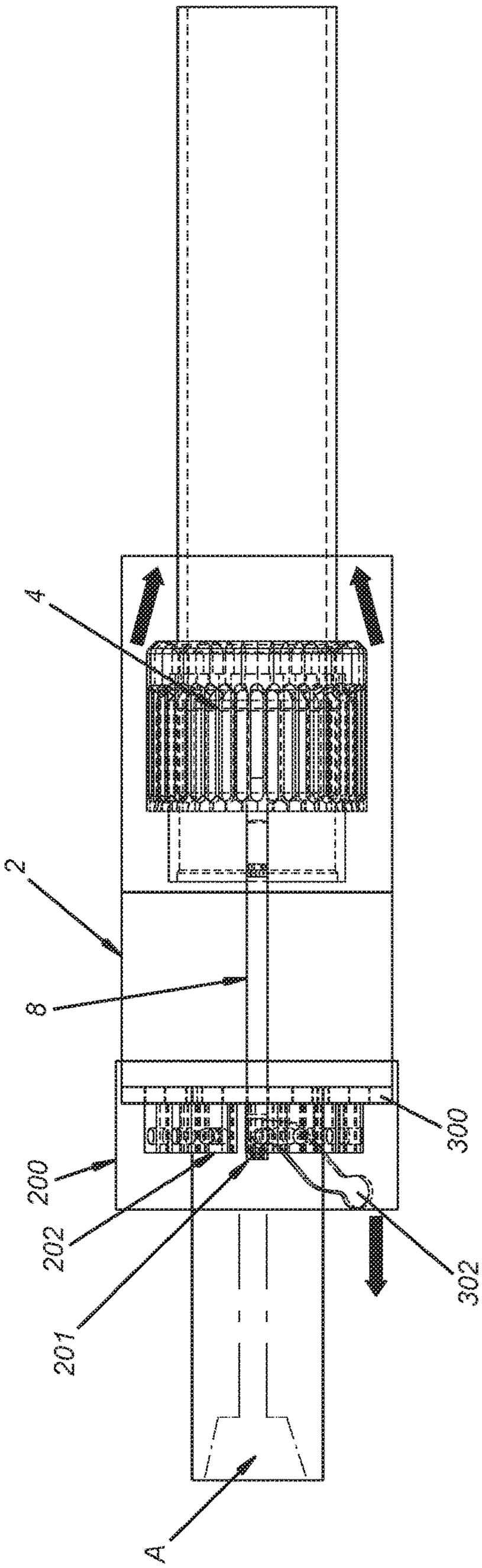

FIG. 7

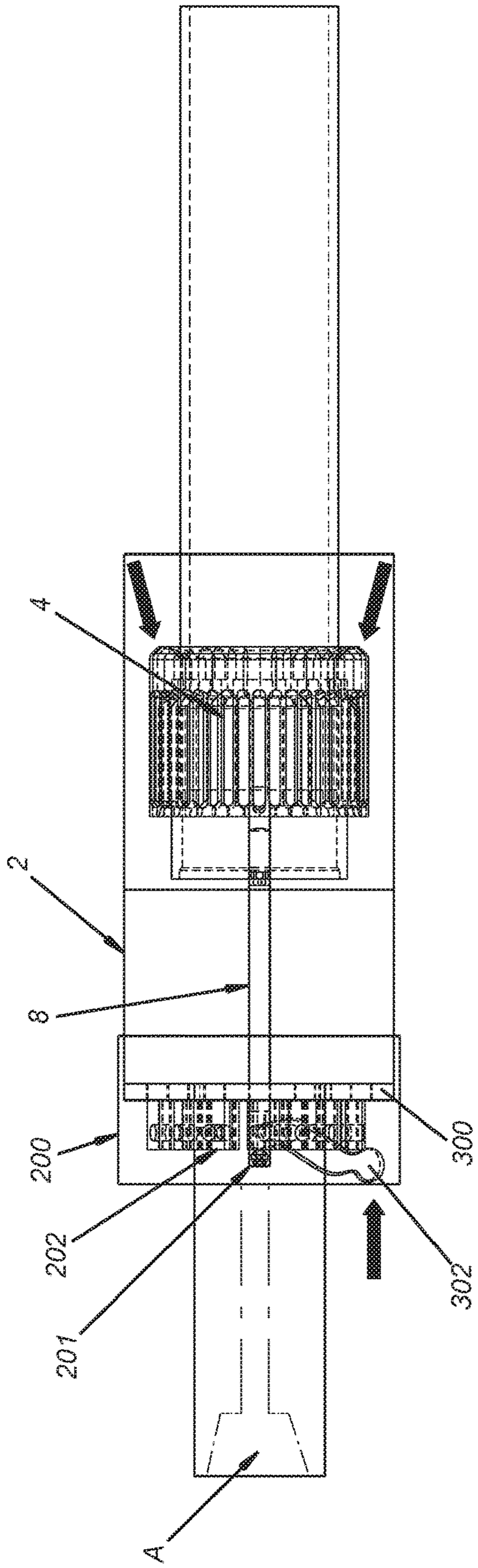

FIG. 8

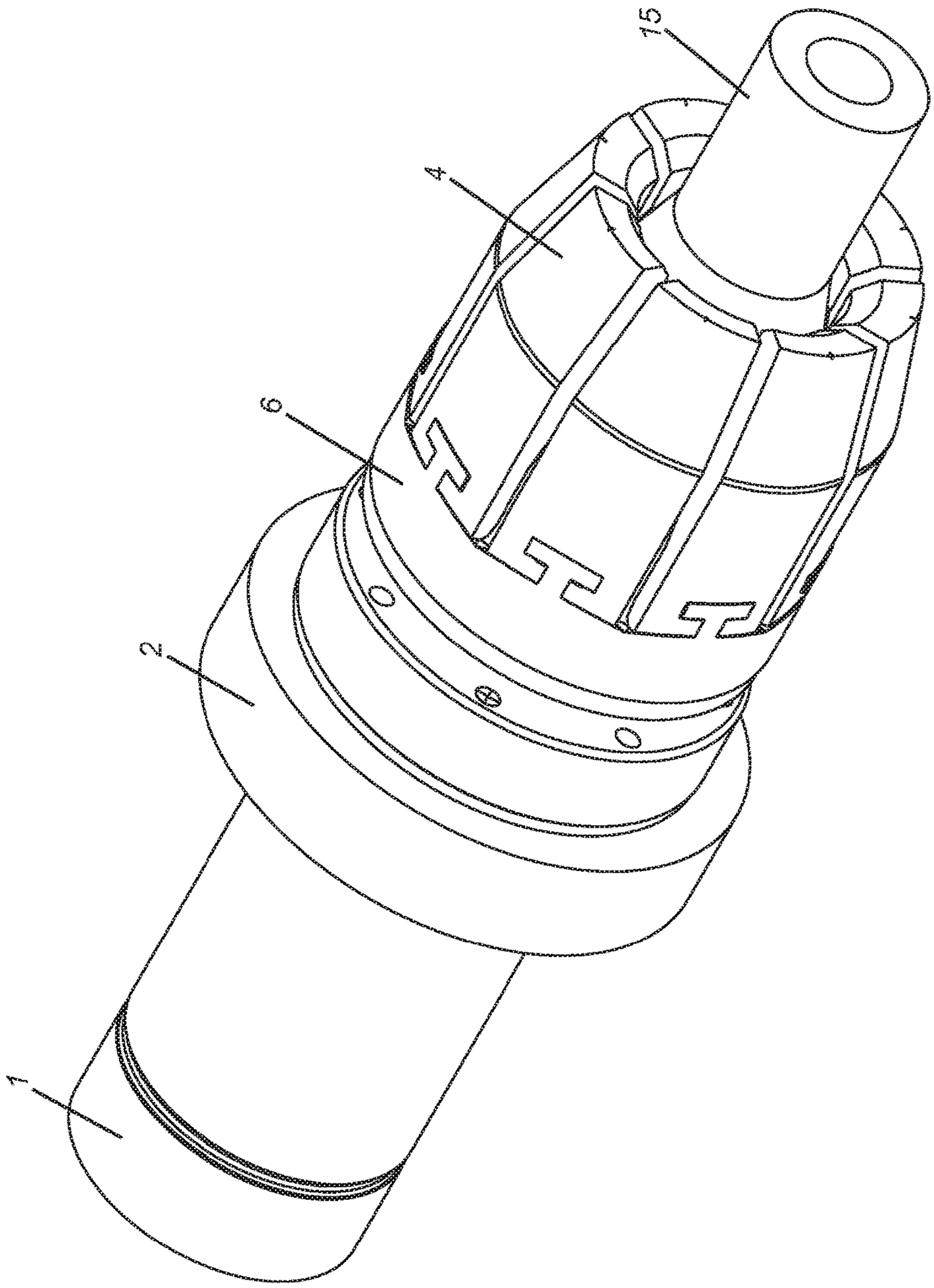

FIG. 9

CASING GRAPPLE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Provisional Patent Application No. 62/660,814 filed Apr. 20, 2018, which is incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The field of the invention is tools that assemble and deliver tubular strings into a borehole and more particularly tools that allow circulation and movement of the string as it is assembled into the borehole.

BACKGROUND OF THE INVENTION

In the past manipulation, threading and circulation of casing or tubulars was done with a variety of tools such as fill up and circulation tools that featured a seal to the inside or the outside of the tubular to be able to pump fluid as the tubular string was lowered into the borehole or to initially fill that last segment that was added to the string before running in. Typically, the handling of a joint to be added to a string was done with large and heavy casing elevators. Such tools are illustrated in U.S. Pat. Nos. 6,578,632, 5,971,079; 7,028,769; 7,665,515 and 6,173,777.

More recently systems have been developed that employ the top drive for rotation and axial movement of a tubular joint to be made up to an existing string and advanced into the borehole. These are rather complex devices that rely on cam pairs to convert rotation to axial movement of slips that cams the slips radially outwardly or inwardly to grip the inside or the outside of a tubular. They feature opposed cam pairs to allow slip actuation with bi-directional rotation and a lock position in between to allow for release. These designs are highly complex and expensive to produce and present complications that could require significant down-time for maintenance. The design is illustrated in U.S. Pat. Nos. 8,424,939 and 7,909,120.

These systems are very complex, heavy and have not been found to solve all the problems associated with making up and running a casing string and are not needed when there is not a need to rotate the casing while running, for example, where the casing strings are run in the vertical portion of the wellbore. It has also been found that using tongs to make up the casing joints as they are being run is much faster than using any of the methods referenced above.

Some of the same problems exist when running any tubular string such as drill pipe. In these cases, the makeup and break out the connections are done by special tongs, but the drill pipe or other tubular must be connected to the mud system through the top drive or mud hose. This connection is currently done by threadedly connecting the tubular to the top drive. This process does take more than 10 minutes when done on a deep water floating vessel in rough sea conditions.

When running casing many are not using the fill-up tools to fill or circulate fluid while running. It is now common to use the older method of handling a mud hose at the rig floor, inserting the end of the hose in the casing by hand and opening a valve to fill the casing. As before, this method is time-consuming and can be dangerous. There remains a need to handle the casing, fill and circulate that is not complex, heavy or dangerous. There is also a need for an improved method of filling, circulating or taking flow back while tripping drill pipe.

Other devices to assist in attaching to a tubular and cementing a well bore are illustrated in U.S. Pat. No. 4,246,967 Harris, U.S. Pat. No. 5,152,554 LaFleur, U.S. Pat. No. 5,348,351 LaFleur and U.S. Pat. No. 5,413,171 Womack. None of these devices teach lifting, manipulating or supporting the string of tubular while connected, they simply teach a method of quickly connecting to a tubular.

Grapples for borehole use are discussed in U.S. Pat. Nos. 4,127,297, 2,410,262; 2,184,681 and 7,578,348.

SUMMARY OF THE INVENTION

The present invention provides a method of automatically gripping a tubular below an upset end or coupling and releasing the tubular mechanically or with the use of pressure or other devices such as motors and or gear arrangements. The present invention connects to a traveling block and/or top drive and enables selective supporting and releasing of an "upset end" tubular (casing, tubing or drill pipe) by changing the load carrying element as well as sealing element, this allows supporting while running or pulling, filling, flow back and/or circulation.

The tubular supporting element of the invention is biased to the set position (collapsed below the upset). The bias can be created by the support element itself or by its own weight, springs or pneumatically. The support element will open as it is lowered over a tubular to allow passing over the upset portion of a tubular and collapse to latch below an upset in the tubular once the upset is above the load element. The current invention has the release system on the upper portion of the device thereby shortening the lower end to facilitate getting the tubular connection closer to the rig floor for ease of handling and connecting the next tubular member. The current invention may also have an indicator device such as a sleeve to assist in identifying whether the device is in the latched or released position. Having the release at the upper end also facilitates easy connection to the top drive to use air, hydraulics or mechanical release. The supporting element in the present invention is protected by lower entry housing and internal guide/shield members. The internal guide/shield also acts as the expanding device of the supporting member while the entry member (Bottom Sub) also acts as the primary load element for the supporting member.

Those skilled in the art will have a better understanding of the present invention from the description of the preferred embodiment and the associated drawings while recognizing that the full scope of the invention is to be found in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a cross-section of the invention;

FIG. **2** shows a cross-section of the invention with supporting member open and the tubular being inserted;

FIG. **3** shows a cross-section of the invention supporting and sealing on a typical upset tubular;

FIG. **4** shows a cross-section view of the invention with the supporting member gripping the tubular body below the upset;

FIG. **5** shows a view of the "T" slot arrangement with the load carrying member in the set position;

FIG. **5***a* is a view of the supporting element and the "T" slot arrangement between the supporting element and the release ring;

FIG. **6** is an outside view of the invention with the indicator sleeve;

FIG. **7** is a skeletal view of one of the arrangements of a releasing system under the indicator sleeve with the support member in the collapsed (set) position. In this position, the indicator sleeve is raised;

FIG. **8** is a skeletal view of one of the arrangements of a releasing system under the indicator sleeve with the support member in the open (released) position. In this position, the indicator sleeve is lowered;

FIG. **9** is an isometric view of the invention with a segmented support member.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the details of the above-described drawings, the assembly shown in FIG. **1**. The device has at its upper end a Top Sub **1** that is threadedly connected to the Top Drive (not shown) at A. The Top Sub **1** is threadedly connected and sealed at **20** to a Housing **2**. Housing **2** is threadedly connected to the Lower Entry Housing **3**. Together housings **2** and **3** comprise an outer housing. Inserted between and held in place by the Top Sub **1** and the Housing **2** is an Inner Protective Sleeve **5** that with the top sub **1** acts as a mandrel, this sleeve is sealed with the Housing **2** at its upper end by a seal **21**. The single piece expandable Supporting Element also referred to as a gripping assembly **4** is shown in the normal relaxed and collapsed position and is protected from external damage by the Lower Entry Housing **3** and from internal damage by the Lower Entry Housing **3** and Inner Protective Sleeve **5**. As will be seen the Inner Protective Sleeve **5** is a key element that protects the Supporting Element **4** and provides the means of expanding the Supporting Element **4** to allow removal of the Tubular **15**. The Supporting Element **4** is attached to the releasing system through the Releasing Rings **6** and **7** with a "T" slot arrangement shown in FIG. **4**. The Releasing Ring **7** is attached to Releasing Rods **8**. Releasing Rods **8** are arranged in axially drilled holes through Housing **2**.

Releasing Ring **7** is attached to Releasing Ring **6** by a set of Balls **30** in mating grooves in Releasing Rings **6** and **7**. This attachment allows relative rotation of the Supporting Element **4** and Releasing Ring **6** (through the "T" slot arrangement between Releasing Ring **6** and Supporting Element **4**) shown more clearly in FIG. **5**. Allowing the rotation of the Supporting Element **4** is important to prevent wear and damage at internal surface **40** to extending lower end fingers which can constitute element **4** as the Tubular **15** may be rotating while the Upset U portion is being inserted or removed as can be more clearly seen in FIG. **2**. The Supporting Element **4** is supported on its lower end at surfaces **70** and **90** by Entry Housing **3** at surfaces **60** and **80** respectively. These mating surfaces provide a key role in supporting the Support Member at a ideal diameter for complete supporting the Shoulder **35** of the Tubular **15** as can be clearly seen in FIG. **2** (or the shoulder of a collar in a threaded and coupled connection as seen in oil field tubulars such as casing)

To seal on a tubular a Seal Sub **9**, which constitutes a sealing member is biased to the lower position by Spring **11**, there is a Seal **26** to seal in the bore of Inner Protective Sleeve **5**. Seal Sub **9** has another Seal **27** for sealing inside a tubular. Seal Sub **9** is prevented from moving down by shoulder at **28** on the interior of Inner Protective Sleeve **5**.

One of the releasing assembly is shown at the external upper end of Housing **2** and is formed by Piston **13**, Sleeve **12** and Cap **14**. Seals are shown at **22**, **23**, **24**, and **25**. Piston **13** is attached to Rods **8** at B such that movement of the Piston **13** will move Rods **8**. When pressure is applied to chamber R, Piston **13** and Rods **8** move upward causing Release Rings **6** and **7**, which form a part of the releasing assembly, to pull the Supporting Element **4** upwards. This upward movement will cause the Supporting Element **4** to expand to its released position. This expansion occurs when the Supporting Element **4** at surface **19** contacts the end of Inner Protective Sleeve **5** at surface **18** and the Piston **13** raises the Supporting Element **4** to its most upward and released position. This releasing means is not attached to Housing **2** to allow it to rotate about Housing **2** should it be desirable to rotate the invention by the top drive. Chambers R and S can be attached to any pressure means available.

It is important to understand that the Supporting Element **4** can be biased to the lowest and latched position by the weight of all components Piston **13**, Rods **8** Releasing Rings **6** and **7**, Balls **30** and Supporting Element **4**. Should additional bias be required pressure can be applied to Chamber S of "One Releasing Means".

Surfaces **60** and **80** at the interior of the Lower Entry Housing **3** will cause the Support Element **40** to move to a position ideal for supporting a tubular at surface **19**.

Those skilled in the art will realize that Surface **19** of the Supporting Element **4** can be at any angle such that Surface **19** mates exactly with the surface located below the upset of the tubular. Those skilled in the art will also realize that the angle between Surfaces **70** and **19** should be positive (angle θ) such that the Supporting Element **4** can not be released when it is supporting a tubular.

Those skilled in the art will realize that the Supporting Element **4** and Lower Entry Housing **3** can be constructed as shown in FIG. **4** to allow the Supporting Element **4** to grip on the exterior of a tubular below the upset portion should there be one.

Those skilled in the art will appreciate that the Supporting Element **4** can be made of several elements rather that the single piece illustrated in these Figures. Later in this discussion there will be mention of an Indicator Sleeve. The Indicator Sleeve could be attached to the Piston **13** and made such that it would be over the exterior of the Housing **2** so that one could determine the operational position of the Supporting Element **4**, in other words "Set" (collapsed) or "Released" (expanded).

In FIG. **2** the device is shown with a Tubular **15** being inserted into the invention. The upper end of the Tubular **15** initially pushes on the lower internal Surface **100** of the Supporting Element **4**. This forces Supporting Element **4** upward and surface **19** into contact at surface **19** with the Inner Protective Sleeve **6** at surface **18**, continued upward movement of the Tubular **15** causes the Supporting Element **4** to continue its upwards and expanding travel until the Supporting Element **4** expands sufficiently to allow the Upset Portion U of the Tubular **15** to pass through, this is the released position of the Supporting Element **4**.

Tubular **15** will contact Seal Sub **9** at shoulder **28** forcing it upward against Spring **11**. In addition Seal **27** will be in sealing contact with the upper end of Tubular **15** such that fluid can pass through the interior to and from the Tubular **15** and Top Drive (not shown). There exists a differential area between Inner Protective Sleeve **5** and the Tubular Sealing shoulder **28** that causes Seal Sub **9** to remain in contact with Tubular **15** when any pressure exist in the interior of the invention.

In FIG. **3** the device is shown in the set position with the Tubular **15** being supported at surface **35** by the Supporting Member **4** at surface **19**. Supporting Member **4** is supported

at its lower end at surfaces **70** and **90** resting against surfaces **60** and **80** of the Lower Entry Housing **3**.

In this position the entire string of tubular can be manipulated by lifting or lowering, fluid can be pumped into or allowed to flow out of the tubular and when sufficient weight is being supported by the top drive the tubular can be rotated. This is a simple device that is robust, light and less expensive than other devices.

To release the device, the tubular would be supported by the slips at the rig floor, the top drive would be lowered until there is space between surface **35** of the Tubular **15** and surface **19** of the Supporting Element **4**. This provides room for the Supporting Element **4** to be retracted. Pressure is then applied to chamber R which lifts Piston **13**, Rods **8** Releasing Rings **6** and **7** and the Supporting Element **4**. Supporting Element **4** is moved radially by the contact with surface **18** of the Inner Protective Sleeve **6** and surface **19** of the Supporting Element **4**. In the released position the Supporting Element **4** is completely out of the path of the tubular and protected by the Inner Protective Sleeve **6**.

FIG. **4** is another configuration of the invention shown in FIG. **1** except the supporting Surface **80** of the Lower Entry Housing **3** is eliminated thus allowing the Supporting Element **4** to move radially inwards until the gripping teeth on the interior contact the body of the Tubular **15** below the upset portion at Surface U. Those familiar with the art will realize that in this configuration pressure can be applied to Chamber S causing Support Member to contact the tubular Body at **50** with sufficient force to allow significant torque to be applied to the Tubular **15** as well as manipulation of the Tubular **15** into or out of the well bore.

FIGS. **5** and **5**A are views of the Supporting Element **4** and the "T" slot arrangement between the Supporting Element **4** and the Release Ring **6**. The Lower Entry Housing **3** is not shown for clarity.

FIGS. **6**, **7** and **8** are illustrations of a mechanical releasing system with a Sleeve **200** at the upper end and extending downward and over the Housing **2**. At the upper end of the Housing is a Plate **300** with Pivots **201** forming a linkage. A pin (not shown) forms the Pivot **201** and supports a Release Member **302**. Release Member **302** contacts the top of a groove in the Rod **8**. The Indicator Sleeve **200** rests on the top of the Releasing Member **302**.

With the invention attached to a Top Drive at A any method of applying a force to the Indicator Sleeve **200** which would cause it to move down would operate the Releasing Member **302** such that the Rod **8** moves up and releases the Supporting Element **4**. There can be a Hydraulic or Pneumatic Cylinder attached to the Top Drive that could be actuated to supply the releasing force.

The arrangement shown in FIGS. **7**, **8** and **9** could be applied to the invention in any of the Figures to provide a method of knowing if the invention is in the Set or Released Position. FIG. **9** is a view of the Supporting Element **4** in the Released or expanded position as separate segments. The Lower Entry Housing **3** is not shown for clarity.

We claim:

1. An assembly for moving at least one tubular between a location outside a borehole and the borehole, comprising:

a mandrel comprising an upper end adapted for connection to a device that provides axial or rotational movement and fluid delivery to a passage through said mandrel, said mandrel further comprising an open lower end;

an outer housing surrounding said mandrel comprising a lower end entry opening for the tubular;

a gripping assembly within said outer housing having a first position interfering with said passage for mechanical engagement with the tubular on insertion into said lower end entry opening for tandem movement toward a second position radially displaced clear of said passage by the tubular passing said lower end entry opening, said gripping assembly selectively movable toward said first position relative to and against the passing tubular to grip the tubular for support from said outer housing;

a release assembly on said outer housing for selectively moving said gripping assembly to said second position to permit removal of the tubular;

said gripping assembly rotatably mounted to turn with the tubular when in contact therewith and relative to said outer housing as said tubular is advanced into said lower end entry opening.

2. The assembly of claim **1**, wherein:

said release assembly selectively actuated adjacent an upper end of said outer housing by said device to move said gripping assembly from said first to said second positions when the tubular is independently supported.

3. The assembly of claim **2**, wherein:

a linkage is actuated by the device to axially move said gripping assembly until said gripping assembly engages said mandrel for radial displacement to said second position.

4. The assembly of claim **1**, wherein:

said outer housing further comprising an externally visible position indicator for said gripping assembly.

5. The assembly of claim **4**, wherein;

said position indicator moving in tandem with said release assembly.

6. The assembly of claim **1**, wherein:

said passage further comprising a sealing member to engage the tubular when the tubular is advanced through said lower end entry opening and into said passage.

7. The assembly of claim **6**, wherein:

said sealing member engages internally to the tubular.

8. The assembly of claim **7**, wherein:

said sealing member is biased toward the tubular.

9. The assembly of claim **6**, wherein:

said sealing member engages a top of the tubular with a smaller seal than an upper seal on said sealing member disposed in said passage such that pressure in a flowpath through said sealing member coming from said passage holds said sealing member to the top of the tubular with a net force.

10. The assembly of claim **9**, wherein:

said outer housing further comprising an externally visible position indicator for said gripping assembly.

11. The assembly of claim **10**, wherein:

said position indicator moving in tandem with said release assembly.

12. The assembly of claim **1**, wherein:

said gripping assembly comprising a plurality of elongated fingers disposed along a tapered surface within said outer assembly;

said elongated fingers engaging said mandrel when axially shifted by said release assembly when said fingers move from said first to said second position of said gripping assembly.

13. The assembly of claim **12**, wherein:

said tapered surface guiding said fingers toward the tubular for a grip of a tapered surface defining an upset on the tubular.

14. The assembly of claim 13, wherein:

said fingers retaining the tubular by a wedging action resulting from relative axial movement of said fingers with respect to said tapered surface.

15. The assembly of claim 13, wherein:

said fingers engaging a radial surface on said outer housing after travelling along said tapered surface for retaining the upset or coupling on the tubular.

16. The assembly of claim 1, wherein:

said release assembly comprises a double acting hydraulic piston.

17. An assembly for moving at least one tubular between a location outside a borehole and the borehole, comprising:

a mandrel comprising an upper end adapted for connection to a device that provides axial or rotational movement and fluid delivery to a passage through said mandrel, said mandrel further comprising an open lower end;

an outer housing surrounding said mandrel comprising a lower end entry opening for the tubular;

a gripping assembly within said outer housing having a first position interfering with said passage for mechanical engagement with the tubular on insertion into said lower end entry opening for tandem movement toward a second position radially displaced clear of said passage by the tubular passing said lower end entry opening, said gripping assembly selectively movable toward said first position relative to and against the passing tubular to grip the tubular for support from said outer housing;

a release assembly on relatively movable components of said outer housing for selectively mechanically moving said gripping assembly toward said second position to permit removal of the tubular;

said release assembly selectively actuated adjacent an upper end of said outer housing by said device to move said gripping assembly from said first to said second positions when the tubular is independently supported.

18. The assembly of claim 17, wherein:

a linkage is actuated by the device to axially move said gripping assembly until said gripping assembly engages said mandrel for radial displacement to said second position.

19. An assembly for moving at least one tubular between a location outside a borehole and the borehole, comprising:

a mandrel comprising an upper end adapted for connection to a device that provides axial or rotational movement and fluid delivery to a passage through said mandrel, said mandrel further comprising an open lower end;

an outer housing surrounding said mandrel comprising a lower end entry opening for the tubular;

a gripping assembly within said outer housing having a first position interfering with said passage for mechanical engagement with the tubular on insertion into said lower end entry opening for tandem movement toward a second position radially displaced clear of said passage by the tubular passing said lower end entry opening, said gripping assembly selectively movable toward said first position relative to and against the passing tubular to grip the tubular for support from said outer housing;

a release assembly on said outer housing for selectively moving said gripping assembly to said second position to permit removal of the tubular;

said passage further comprising a sealing member biased to move axially into selective engagement with the tubular for subsequent tandem movement when the tubular is advanced through said lower end entry opening and into said passage.

20. The assembly of claim 19, wherein:

said sealing member engages internally to the tubular.

21. The assembly of claim 19, wherein:

said sealing member engages a top of the tubular with a smaller seal than an upper seal on said sealing member disposed in said passage such that pressure in a flowpath through said sealing member coming from said passage holds said sealing member to the top of the tubular with a net force.

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