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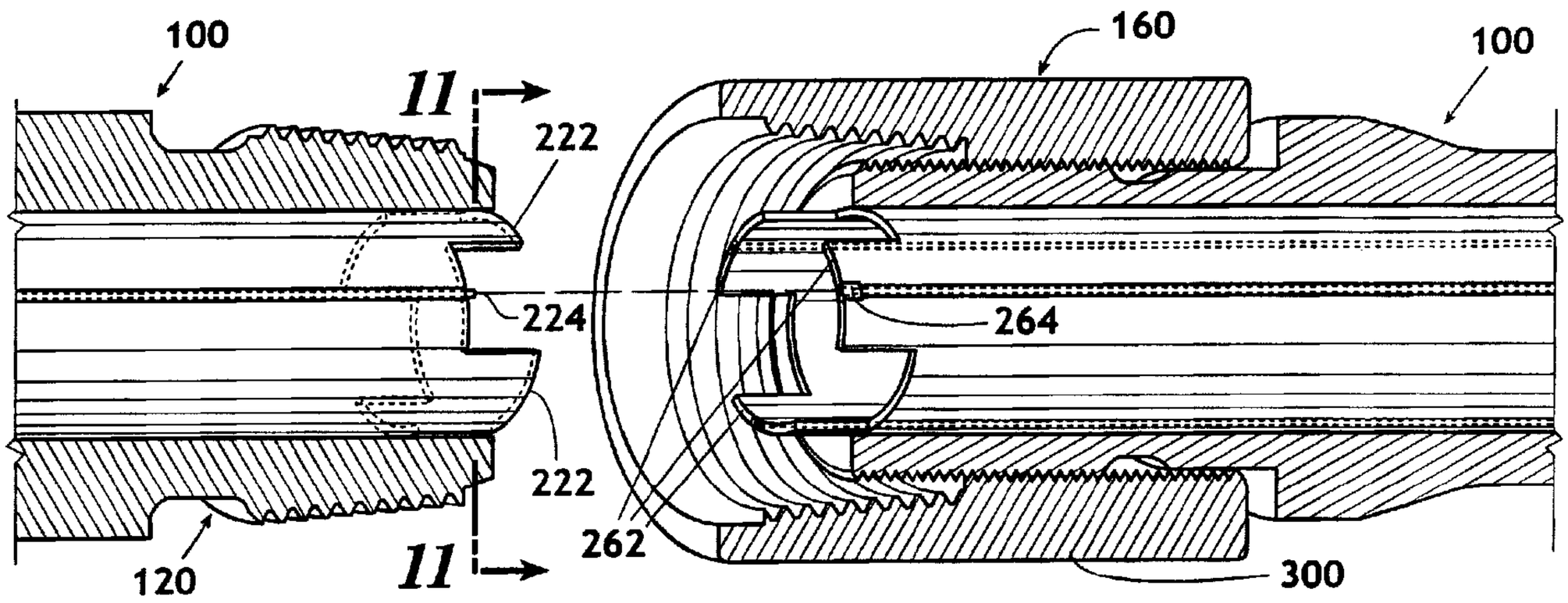

(57) Abrégé/Abstract:
The invention comprises a section of improved tubing with coupled end connectors and an insert containing at least one electrical wire. The insert has an outside diameter that is approximately equal to the inside diameter of the improved tubing. The insert also has projections at each end such that when two inserts are placed end to end, the projections will mate up. The insert has at least one groove cut into its side and running the length of the insert. The groove is for the placement of a wire for transmission of power to the well bore or for the placement of a wire for transmission of data from the well bore. The groove is installed down the length of the insert. The groove is deep enough so that when a wire is placed inside the groove, the wire does not project beyond the outside diameter of the insert. The insert may contain as many groove and wire combinations as are necessary for the particular application. The wire has an electrical connection at each end of the insert. When the inserts are placed end to end, the insert projections line up the electrical connectors and correct mating of the insert projections will result in correct mating of the electrical connectors. The inserts are the same length as the tubing and are installed inside the tubing such that the insert is flush with the first end of the tubing. The inserts are then welded to the tubing or secured to the tubing by some other method. A threaded coupler is then installed on the second end of the tubing to protect the exposed insert and electrical connector. The coupler will also be used to secure the improved tubing together. Individual pieces of improved tubing are connected together in a three step process. First the coupler is threaded onto the second end of the tubing. Next, the first end of one tubing member is positioned above the second end of another tubing member. Next, the insert projections are properly aligned so that they will mate together. Then, the two pieces of tubing are plugged together so that the electrical connections engage each other. Finally, the coupler is screwed onto the first end of the tubing so that the two pieces of tubing are secured together. The process may be repeated as necessary to create an elongated string of improved tubing.

ABSTRACT OF THE INVENTION

The invention comprises a section of improved tubing with coupled end connectors and an insert containing at least one electrical wire. The insert has an outside diameter that is approximately equal to the inside diameter of the improved tubing. The insert also has projections at each end such that when two inserts are placed end to end, the projections will mate up. The insert has at least one groove cut into its side and running the length of the insert. The groove is for the placement of a wire for transmission of power to the well bore or for the placement of a wire for transmission of data from the well bore. The groove is installed down the length of the insert. The groove is deep enough so that when a wire is placed inside the groove, the wire does not project beyond the outside diameter of the insert. The insert may contain as many groove and wire combinations as are necessary for the particular application. The wire has an electrical connection at each end of the insert. When the inserts are placed end to end, the insert projections line up the electrical connectors and correct mating of the insert projections will result in correct mating of the electrical connectors.

The inserts are the same length as the tubing and are installed inside the tubing such that the insert is flush with the first end of the tubing. The inserts are then welded to the tubing or secured to the tubing by some other method. A threaded coupler is then installed on the second end of the tubing to protect the exposed insert and electrical connector. The coupler will also be used to secure the improved tubing together.

Individual pieces of improved tubing are connected together in a three step process. First the coupler is threaded onto the second end of the tubing. Next, the first end of one tubing member is positioned above the second end of another tubing member. Next, the insert

projections are properly aligned so that they will mate together. Then, the two pieces of tubing are plugged together so that the electrical connections engage each other. Finally, the coupler is screwed onto the first end of the tubing so that the two pieces of tubing are secured together. The process may be repeated as necessary to create an elongated string of improved tubing.

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Attorney Docket No. 020105

IMPROVED TUBING CONTAINING ELECTRICAL WIRING INSERT

FIELD OF THE INVENTION

The present invention generally relates to tubing that is used to produce hydrocarbons in a subterranean environment and specifically to an improved tubing having an insert with electrical wiring.

BACKGROUND OF THE INVENTION

Basic artificial lift methods to produce oil and water from a well have improved and changed in recent years. Nearly all methods of artificial lift still employ the connection of a plurality of pipes to form a conduit within a well that has been drilled and cased to allow oil and water to be pumped from the bottom of the well to production tanks at the surface. The production string usually has a pumping device at its lower end that is positioned near the bottom of the well bore that has been prepared for production. Pumping mechanisms such as electrical submersible pumps (ESP) and progressive cavity pumps (PCP) provide the energy needed to bring fluids to the surface through a string of jointed tubing. These pumps normally require an electric motor in order to make them work. Although a multitude of improvements have been made to these pumps over the years, there has been little done to reposition the wires that provide power to the pump from the outside of the tubing to the inside of the tubing.

For various reasons, those who are skilled in the science of producing fluids from a well have sought out a reliable method of supplying power to the bottom of a well bore. The previously proposed solutions to this problem have been unreliable, expensive, and complicated to install and remove. For example, the currently preferred method of power transmission to the

bottom of the well bore is to secure a cable, that contains one or more wires by means of bands that secure the cable to the outside of the production string of tubing. The bands keep the wire adjacent to the tubing so that it does not snag on the production casing or on any objects which might be in the well bore. The bands also support the weight of the cable by securing the cable to the tubing. However, this method is problematic because it exposes the cable and bands to the corrosive elements of the well bore. Furthermore; installing (running) or removing (pulling) the tubing string creates opportunities to separate the cable from the tubing because inclined well bores (the most common type of well bores) increase the chance of the band to hanging up and failing at the gap where two joints of casing have been screwed together. Failure of one or more bands can prevent the removal of the pump or tubing because the annular space between the outside of the production tubing and the inside of the production casing is small and the cable, if not secured to the tubing, can wedge between the casing and the tubing causing the tubing to become stuck. Even if the cable does not break, the insulation on the wire inside the cable can be damaged which can create a short circuit in the electrical circuit, rendering the wire essentially useless. The tubing string then has to be pulled back up to the surface, and the short found and repaired, before the pump can be run back to bottom of the well bore. The problems created by banded external cables are costly and time consuming. Therefore, a need exists for an alternative method of power transmission from the surface to the bottom of the well bore that is both reliable and cost effective.

One solution to the above stated problem is to employ a plurality of tubing with multiple wires attached to the inside of the tubing instead of the outside of the drill pipe. While this solution alleviates the problem of snagging the wire, it does not solve the problem of exposing the wire to the harsh environment of the produced fluids that are contained within the production

tubing. Simply hanging the cable on the inside of the tubing is also problematic because there is no way to support the weight of the cable and the pressure requirements of the pump will be higher due to the added friction between the fluid that is being pumped and the rough exterior of the cable.

Another solution to the above stated problem is to concentrically position the wires on the exterior of a tube that is inserted and attached to the actual production tubing itself. This solution avoids the problems presented by simply attaching the wire to either the interior or the exterior of the tubing. An example of this technique can be found in U.S. Patent 4,683,944 (the '944 patent) entitled "Drill Pipes and Casings Utilizing Multi-Conduit Tubulars." The '944 patent discloses a drill pipe with electrical wires positioned inside conduits in the drill pipe wall. However, positioning the wire inside the drill pipe wall significantly decreases the overall pipe wall thickness. In order to overcome the decreased wall thickness, significantly thicker drill pipes will have to be used. Furthermore, the multiple conduits create weak points in the drill pipe in between the conduits. The high rotational stress which the drill pipe encounters in the drilling operations can cause stress fractures in the pipe wall between the multiple conduit tubulars. In an extreme case, high rotational stress can lead to an internal fracture in the drill pipe that disengages the interior wall of the drill pipe from the exterior wall of the drill pipe.

Furthermore, the manufacture of the multiple conduit drill pipe is a complicated process which is unlike the manufacturing process for conventional drill pipe. Conventional drill pipe is manufactured by attaching male and female pipe connections to opposite ends of a conventional piece of pipe. The two connections are usually welded to the pipe. Multiple conduit pipes must be either extruded with the multiple conduits in place, or the multiple conduits must be drilled or

cut out of a conventional drill pipe. In either case, the costs associated with manufacture of multiple conduit drill pipe are high.

Another problem encountered in the addition of wires to drill pipe, which is not unique to multiple conduits, is the problem associated with creating reliable, secure electrical connections. In conventional drill pipe the individual pipe segments screw together, creating a problem for connecting the wires during the screwing or unscrewing process. This problem can be overcome by using drill pipe that plugs together and that is secured with a threaded coupler. This type of connection is known in the art. The '944 patent discloses a similar type of coupling connection, but requires a planer conduit seal in between the individual pipe segments in order to assure the integrity of the conduit connection. The removable conduit seal is crucial to the method in the '944 patent because a permanently installed conduit seal would be susceptible to damage during manufacture, transportation, storage, and installation of the multiple conduit drill pipe during drilling operations. Installing these conduit seals during the drilling process is also a cumbersome and a time consuming process. Therefore, a need exists for a method of transmitting electrical power to the bottom of a well bore in which the electrical connections are adequately protected from damage and the process of connecting the individual pipe segments is relatively simple and fast.

The needs identified above exist for production tubing, drill pipe, casing, and/or for any cylindrical pipe used to produce hydrocarbons in a subterranean environment. Therefore, as used herein, the term "tubing" shall mean production tubing, drill pipe, casing, and/or any other cylindrical pipe that is used to produce hydrocarbons in a subterranean environment.

Since, the previous solutions to the power transmission problem are lacking, a need still exists for an apparatus and method of transmitting power to a well bore in which the wire is not

exposed to either the interior or the exterior of the tubing and is operable with any conventional tubing, including without limitation production, casing or drill pipe. Furthermore, a need exists for an apparatus and method for connecting the individual tubing segments together in which the electrical connections are well protected and the connection process is quick and easy.

SUMMARY OF THE INVENTION

The present invention, which meets the needs stated above, is an improved tubing which. overcomes the problems presented by earlier inventions involving tubing and electrical wiring combinations. The invention comprises a section of tubing with coupled end connectors and an insert containing at least one electrical wire. The insert has an outside diameter that is approximately equal to the inside diameter of the improved tubing. The insert also has projections at each end such that when two inserts are placed end to end, the projections will mate up. The insert has at least one groove cut into its side and running the length of the insert. The groove is for the placement of a wire for transmission of power to the well bore or for the placement of a wire for transmission of data from the well bore. The groove is installed down the length of the insert. The groove is deep enough so that when a wire is placed inside the groove, the wire does not project beyond the outside diameter of the insert. The insert may contain as many groove and wire combinations as are necessary for the particular application. The wire has an electrical connection at each end of the insert. When the inserts are placed end to end, the insert projections line up the electrical connectors and correct mating of the insert projections will result in correct mating of the electrical connectors.

The inserts are the same length as the tubing and are installed inside the tubing such that the insert is flush with the first end of the tubing. The inserts are then welded to the tubing or

secured to the tubing by some other method. A threaded coupler is then installed on the second end of the tubing to protect the exposed insert and electrical connector. The coupler will also be used to secure the improved tubing together.

Individual pieces of improved tubing are connected together in a three step process. First the coupler is threaded onto the second end of the tubing. Next, the first end of one tubing member is positioned above the second end of another tubing member. Next, the insert projections are properly aligned so that they will mate together. Then, the two pieces of tubing are plugged together so that the electrical connections engage each other. Finally, the coupler is screwed onto the first end of the tubing so that the two pieces of tubing are secured together. The process may be repeated as necessary to create an elongated string of improved tubing.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is an illustration of the improved tubing without the insert or the coupler.

Figure 2 is an illustration of the insert.

Figure 3 is an illustration of the insert installed in the improved tubing.

Figure 4A is a cross-sectional illustration of the two wire embodiment of the insert taken along line 4-4 in figure 2.

Figure 4B is a cross-sectional illustration of the three wire embodiment of the insert similar to the two wire embodiment in figure 4A.

Figure 5 is an exploded illustration of the connection between the first end of the improved drill pipe and the second end of the improved tubing.

Figure 6 is a cross-section of the two wire embodiment of the insert installed in the improved tubing taken along line 6-6 in figure 5.

Figure 7 is a cross-section of the two wire embodiment of the insert installed in the improved tubing taken along line 7-7 in figure 5.

Figure 8 is an illustration of the positioning and alignments steps for the two wire embodiment of the improved tubing.

Figure 9A is an illustration of the plugging step for the two wire embodiment of the improved tubing.

Figure 9B is an illustration of the securing step for the two wire embodiment of the improved tubing.

Figure 10 is an illustration of the positioning and alignment step for the three wire embodiment of the improved tubing. The dashed line indicates the alignment of the wire connectors in the three wire insert embodiment.

Figure 11 is a cross-sectional illustration of the three wire embodiment of the insert taken along line 11-11 in figure 10.

Figure 12 is an illustration of the plugging step for the three wire embodiment of the improved tubing.

Figure 13 is an illustration of the securing step for the three wire embodiment of the improved tubing.

Figure 14 is a cross-sectional illustration of the three wire embodiment of the insert taken along line 14-14 in figure 13.

Figure 15 is a detail view of the geometry between the insert, the wire, and the improved tubing around the area indicated by circle 15 in figure 14.

Figure 16 is an illustration of a submerged pump in a production situation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As used herein, the term "improved tubing" means tubing that is adapted to receive a coupler and that has an insert. Figure 1 is an illustration of improved tubing **100** without insert **200** (see Fig. 2) or coupler **300** (see Fig. 5). Improved tubing **100** is comprised of three sections: first end **120**, midsection **140**, and second end **160**. First end **120** comprises coarse threads **122**, first end weld joint **124**, and wrench grip **126**. Midsection **140** comprises pipe **142**, pipe first end **144**, and pipe second end **146**. Second end **160** comprises fine threads **162**, second end weld joint **164**, and coupler stop flange **166**. First end **120** and second end **160** may be like those found in U.S. Patent 5,950,744 (the '744 patent) entitled "Method and Apparatus for Aligning Pipe and Tubing." Typically, first end **120** and second end **160** are manufactured by either casting or forging and pipe **142** is manufactured by some other method (i.e. electric resistance welding or extrusion). The manufacture of improved tubing **100** involves the threading of first end **120** and second end **160** to pipe **142**. While the preferred method of manufacturing first end **120** and second end **160** is threading the two ends of improved tubing **100**, those skilled in the art will be aware of other methods of manufacturing first end **120** and second end **160**. Regardless of the method of manufacture, the inside diameter of first end **120**, midsection **140**, and second end **160** are substantially the same so that when insert **200** engages improved tubing **100**, the outside surface area of insert **200** contacts the inside surface area of improved tubing **100**.

Figure 2 is an illustration of insert **200**. Insert **200** is comprised of insert first end **220**, insert midsection **240**, and insert second end **260**. Insert first end **220** comprises insert first end projection **222** and insert first end electrical connection **224**. Insert midsection **240** comprises insert body **242** and insert groove **244**. Insert second end **260** comprises insert second end

projection **262** and insert second end electrical connection **264**. The depressions in insert second end **260** in between insert second end projections **262** match up with the insert first end projections **222**. Likewise, the depressions in insert first end **220** in between insert first end projections **222** match up with the insert second end projections **262**. Thus, when two inserts **200** are coaxially aligned with insert first end **220** facing insert second end **260**, insert first end **220** will mate up with insert second end **260**. Insert **200** also contains insert groove **244** which is a groove cut down the long axis of insert **200**. Insert groove **244** is sufficiently large to accommodate at least one wire **246**. Wire **246** is electrically coupled to insert first end electrical connection **224** and insert second end electrical connection **264** and is used as a medium to transfer electricity from the surface to the bottom of the well bore. Insert first end electrical connection **224** and insert first end electrical connection **264** are single plug connectors similar to the K-25 series electrical connectors produced by Kemlon Products and Development Co. of Pearland, Texas. The K-25 series of single plug electrical connections are able to withstand temperatures up to 500 ^{o}F and pressures up to 25,000 psi.

Figure 4A is a cross-section of the two wire embodiment of insert **200** taken along line 4-4 in figure 2. Inset **200** may contain only one wire **246** or may contain a plurality of wires **246**. For simplicity of illustration of the invention, figures 1 through 9B (excluding 4B) depict the invention with only two wires. In alternative embodiments, wire **246** can be a fiber optic in which case the two electrical connections on insert **200** would be optical connections and the fiber optic would be optically coupled to the optical connections. In another alternative embodiment, the invention could employ a mixture of fiber optics and electrical wires. In the preferred embodiment the invention incorporates three wires such that the three wires each carry the appropriate load of a three phase, 440-volt electrical system, as illustrated in figures 4B and

10 through 15. However, the number and type of wires is not meant to be a limitation on the invention as those skilled in the art will be aware of how best to configure the invention with fiber optics, electrical wiring, or other connections within insert groove **244** of improved drill pipe **100**.

Figure 3 is an illustration of improved tubing **100** with insert **200** installed. Insert **200** is sized lengthwise so that when insert **200** is inserted into improved tubing **100**, insert first end projection **222** is flush with first end **120** and insert second end projection **262** is the only portion of insert **200** that is projecting beyond second end **160**. As seen in figure 6, insert **200** is circumferentially sized such that the outer diameter of insert **200** is sufficiently equal to the inside diameter of improved tubing **100**. Insert groove **244** is sufficiently deep in insert body **242** so that wire **246** does not extend beyond the outer diameter of insert **200**, yet is not deep enough to affect the structural integrity of insert **200**. Insert **200** is coaxially positioned inside improved tubing **100** and secured in place. In the preferred embodiment, insert **200** is the same material as improved tubing **100** and is secured in place by welding. However, insert **200** can be made of any material suitable for drilling operations including various metal alloys, fiberglass, plastic PVC, polymer, or any other material as determined by those of skill in the art. Likewise, insert **200** can be secured in place by welding, glue, heat shrinking, expanding, set screws, or any other method as determined by those skilled in the art. Heat shrinking is defined as a process in which the outer pipe is heated so that the outer pipe expands, the insert is positioned inside the pipe, and the pipe is allowed to cool so that it contracts and secures the insert in place. Expanding is a process in which a tool (expander), having a slightly larger outside diameter than the inside diameter of the insert, is pulled forcibly through the insert causing the outside surface of the insert to expand and grip the inside of the improved tubing. Set screws is a process in

which the improved tubing and insert are tapped and threaded and a screw is inserted through the improved tubing and insert to secure the insert in place relative to the pipe.

Figure 5 is an exploded illustration of the connection between two separate pieces of improved tubing **100** with insert **200** installed and coupler **300** positioned for installation on first end **120** and drill pipe second end **160**. Coupler **300** is annular in shape and contains coupler fine threads **302** and coupler coarse threads **304**. Coupler fine threads **302** are configured for screwing engagement with drill pipe fine threads **162**. Coupler coarse threads **304** are configured for screwing engagement with drill pipe coarse threads **122**. The pitch of drill pipe coarse threads **122** and drill pipe fine threads **162** are different pitch so that coupler **300** can only mate up with improved tubing **100** in one orientation. Similarly, when coupler fine threads **302** and coupler coarse threads **304** engage pipe coarse threads **122** and drill pipe fine threads **162**, the coarse threads and the fine threads do not interfere with the threading process of each other. As seen in figure 7, coupler stop flange **166** has a larger cross-sectional area than fine threads **162** and acts as a stop for coupler **300** so that coupler **300** does not go past second end **160**. The outside diameter of coupler **300** is sufficiently similar to pipe wrench grip **126** so that when the user is attaching the individual pieces of improved drill pipe **100** together, a pipe wrench will fit onto both pipe wrench grip **126** and coupler **300** without undue adjustment of the pipe wrench. Coarse threads **122** and coupler coarse threads **304** are tapered so that they may be completely engaged with a minimal amount of rotations after first end **120** and second end **160** have been plugged together. Coupler **300** is also sufficiently long so that when coupler **300** is completely screwed onto second end **160** and abuts coupler stop flange **166**, coupler **300** extends past insert second end projection **262**. It is important that coupler **300** extend past insert second end projection **262** because improved tubing **100** will typically be stored, transported, and handled

with coupler **300** installed on second end **160** and coupler **300** will protect insert second end **260** and specifically insert second end electrical connection **264** from damage.

Figure 8 is an illustration of coupler **300** installed on second end **160** just prior to connection of two pieces of improved tubing **100**. Figure 8 is representative of how improved tubing **100** will be stored, transported, and handled. In figure 8, coupler **300** extends past insert second end projection **262** and insert second end electrical connection **264**.

Figures 8, 9A, and 9B illustrate the process of attaching two sections of improved tubing **100** together. In attaching the two sections of improved tubing **100** together, as far as the scope of this invention is concerned, it does not matter whether the second end **160** of one section of improved tubing **100** is above the first end **120** of the other section of improved tubing **100** or vice-versa. The improved tubing **100** may also be connected in the horizontal. However, the preferred embodiment and industry standard is to place the second end **160** above the first end **120**. The attachment process comprises four steps: positioning, aligning, plugging, and securing.

First, in the positioning step the two sections of improved tubing **100** are positioned over one another with a second end **160** of one improved tubing **100** facing the first end **120** of the other improved tubing **100**. As seen in figure 8, the aligning step consists of rotating one or both sections of improved tubing **100** such that the insert second end projection **262** in one section of improved tubing 100 will properly mate with the insert first end projection **222** in the other section of improved tubing **100**.

When the two sections of improved tubing **100** are properly aligned, the two sections of improved tubing **100** may be plugged together. Figure 9A is an illustration of the plugging step in which two sections of improved tubing **100** are plugged together. In the plugging step, the second end **160** of one section of improved tubing **100** is lowered onto the first end **120** of the

other section of improved tubing **100** until the two sections of improved tubing **100** contact each other and/or the two inserts **200** fully mate with each other. To properly mate, insert second end projections **262** will fill the depression between insert first end projections **222** and insert first end projections **222** will fill the depression between insert second end projections **262**. When insert first end projection **222** and insert second end projection **262** properly mate, insert first end electrical connection **224** and insert second end electrical connection **264** will electrically couple and provide an electrical connection which will tolerate the harsh environment of the well bore. After the two improved tubing **100** are plugged together, they are secured by screwing coupler **300** onto first end **120**.

Figure 9B is an illustration of two sections of improved tubing **100** secured together by coupler **300**. Coupler **300** is secured to first end **120** by pipe wrenches (not shown) which grip coupler **300** and pipe wrench grip **126** and torque coupler **300** until coupler **300** is firmly screwed onto drill pipe first end **120**. The two sections of improved tubings **100** may then be used in the production process.

Figures 10 through 14 illustrate a three wire embodiment. The manufacture of the three wire improved drill pipe is similar to the manufacture of the two wire improved tubing. Likewise, the assembly of a plurality of three wire improved tubing is similar to the assembly of a plurality of two wire improved tubing. Figure 10 is an illustration of the alignment step for a three wire embodiment of the insert in which coupler **300** is installed on second end **160**. The dashed line in figure 10 indicates the alignment of insert first end electrical connection **224** and insert second end electrical connection **264**. When the two electrical connectors are properly aligned, insert first end projection **222** and insert second end projection **262** are also properly aligned. Figure 11 is a cross-sectional illustration of the three wire embodiment of insert **200**

and improved tubing **100** taken along line 11-11 in figure 10. Figure 12 is an illustration of the plugging step for the three wire embodiment of insert **200** taken along line 11-11 in figure 10. Figure 13 is an illustration of the securing step of two pieces of improved tubing **100** with the three wire embodiment of insert **200** and the coupler disengaged from the first end of the tubing.

Figure 14 is a cross-section of the three wire embodiment of the insert taken along line 14-14 in figure 13. Insert **200** in the three wire embodiment is similar to insert **200** in the two wire embodiment in that the inside diameter of pipe **142** is substantially the same as the outside diameter of inset body **242**. Figure 15 is a detail view of the geometry between insert **200**, wire **246**, and improved tubing **100** around the area indicated by circle 15 in figure 14. Figure 15 illustrates the point that insert groove **244** is cut into insert body **242** so that wire **246** does not project above the outer surface of insert body **242**.

Figure 16 is an illustration of a submerged pump in a production situation. Figure 16 shows multiple pieces of improved tubing **100** with the inserts installed (not shown). Power comes from an external source **402** and is stepped down in transformer **404**, is routed through vent box **406**, and goes to wellhead **408**. Power is transmitted down tubing pump **412** and or motor **414**. Well bore **418** is typically cased with casing **416**.

With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

What is claimed is:

1. An apparatus for providing a tubing with transmission capability comprising:

an improved tubing having a first end and a second end and having an inside and an outside;

a cylindrical insert engaged with the inside of the improved tub ing and having a first end and a second end;

at least one groove disposed lengthwise in said cylindrical insert;

at least one wire positioned within said groove; and

at least one projection on the first end of said cylindrical insert and at least one depression on the second end of said cylindrical insert,

wherein said at least one projection on a first improved tubing mates with said at least one depression on a second improved tubing for coupling the at least one wire between each first and second improved tubing when a plurality of said improved tubing having cylindrical inserts are aligned along a common axis.

2. The apparatus of claim 1 wherein the at least one groove is formed in the outside of said insert.

3. The apparatus of claim 1 further comprising a pair of connectors coupled to the at least one wire, one connector at the first end of said cylindrical insert and one connector at the second end of said cylindrical insert.

4. The apparatus of claim 3 wherein said connectors are coupled when said projection mates up with said depression.

5. The apparatus of claim 4 wherein said connectors are electrical connectors, said coupling is an electrical coupling and said wire is an electrical wire.

6. The apparatus of claim 5 wherein said connectors are optical connectors, said coupling is an optical coupling and said wire is a fiber optic.

7. The apparatus of claim 1 further comprising a coupler rotatably engaged to the second end of said first improved tubing and rotatably engaged to the first end of said second improved tubing for securing the connection between the first and second improved tubing.

8. The apparatus of claim 7 further comprising a coupler stop flange disposed at the second end of said improved tubing so that the coupler extends beyond the cylindrical insert's second end.

9. The apparatus of claim 7 wherein the coupler is rotatably engaged with the second end of the first improved tubing using fine threads, further comprising coarse threads for engaging the first end of the second improved tubing.

10. The apparatus of claim 9 wherein said coarse threads are tapered threads.

11. The apparatus as described in any one of claims 1 to 10 wherein the tubing is used in a well bore for producing fluids from a subterranean environment.

12. A method for attaching a first improved tubing to a second improved tubing, each improved tubing having a coaxial cylindrical insert, a longitudinal groove formed in an outside of said insert and at least one wire positioned within said groove, the method comprising:

positioning said first improved tubing coaxially with said second improved tubing;

aligning at least one projection extending from a first end of said cylindrical insert on said second improved tubing with at least one depression on a second end of said cylindrical insert of said first improved tubing;

coupling a first end of the at least one wire in the second improved tubing with a second end of the at least one wire in the first improved tubing; and

securing said first improved tubing to said second improved tubing.

13. The method of claim 12 wherein said second improved tubing is vertically above said first improved tubing.

14. The method of claim 12 further comprising electrically connecting the first end of the at least one wire in the first improved tubing with the second end of the at least one wire in the second improved tubing.

15. The method of claim 12 further comprising optically connecting the first end of the at least one wire in the first improved tubing with the second end of the at least one wire in the second tubing.

16. The method of claim 12 further comprising securing said first improved tubing to said second improved tubing with a rotatably engaged coupler.

17. A method of manufacturing an improved tubing comprising:

cutting at least one groove in an outside of a cylindrical insert;

embedding at least one wire in the at least one groove in said cylindrical insert;

forming at least one projection on a first end of said cylindrical insert and forming at least one depression on a second end of said cylindrical insert; and

installing said cylindrical insert coaxially in said improved tubing.

18. The method of claim 17 further comprising securing a first and a second improved tubing with a rotatably engaged coupler wherein the at least one projection on the first end of said first cylindrical insert mates with the at least one depression on the second end of said second cylindrical insert.

19. The method of claim 17 further comprising securing said cylindrical insert in said improved tubing.

20. The method of claim 19 wherein said cylindrical insert is secured in said improved tubing using mechanical fasteners.

21. The method of claim 19 wherein said cylindrical insert is secured in said improved tubing using adhesives.

22. The method of claim 17 further comprising attaching a connector to each of a first end and a second end of the wire.

23. The method of claim 22 wherein the wire is an electrical wire and further comprising electrically connecting the at least one wire with an electrical connector.

24. The method of claim 22 wherein the wire is an optical wire further comprising optically connecting the at least one wire with an optical connector.

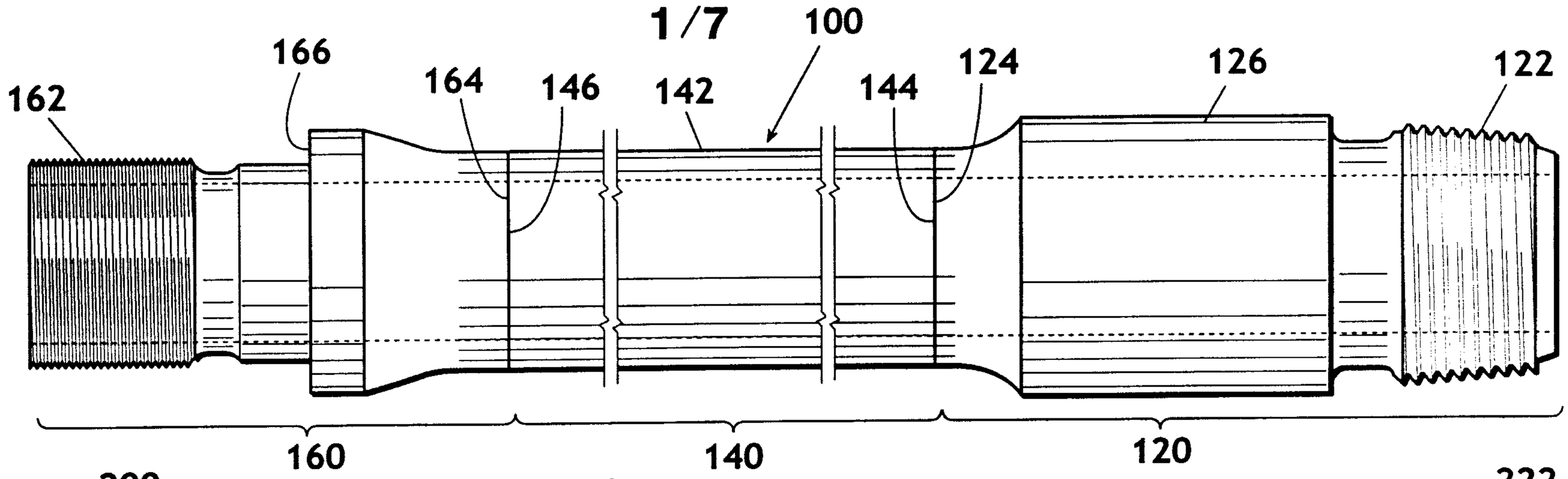


Fig. 1

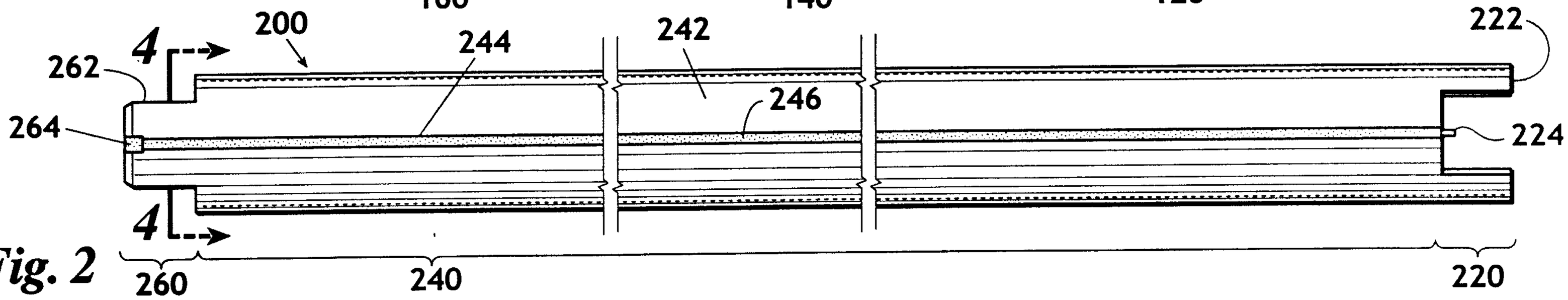


Fig. 2

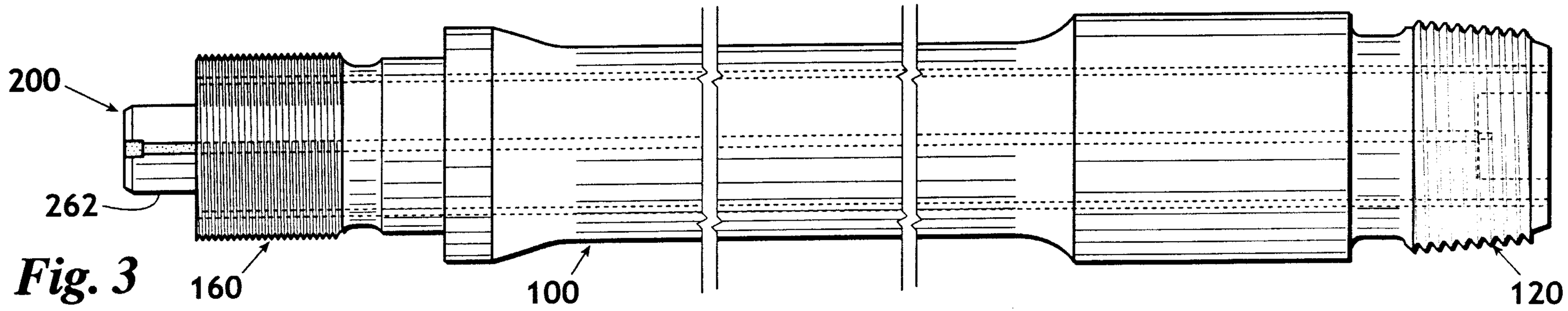


Fig. 3

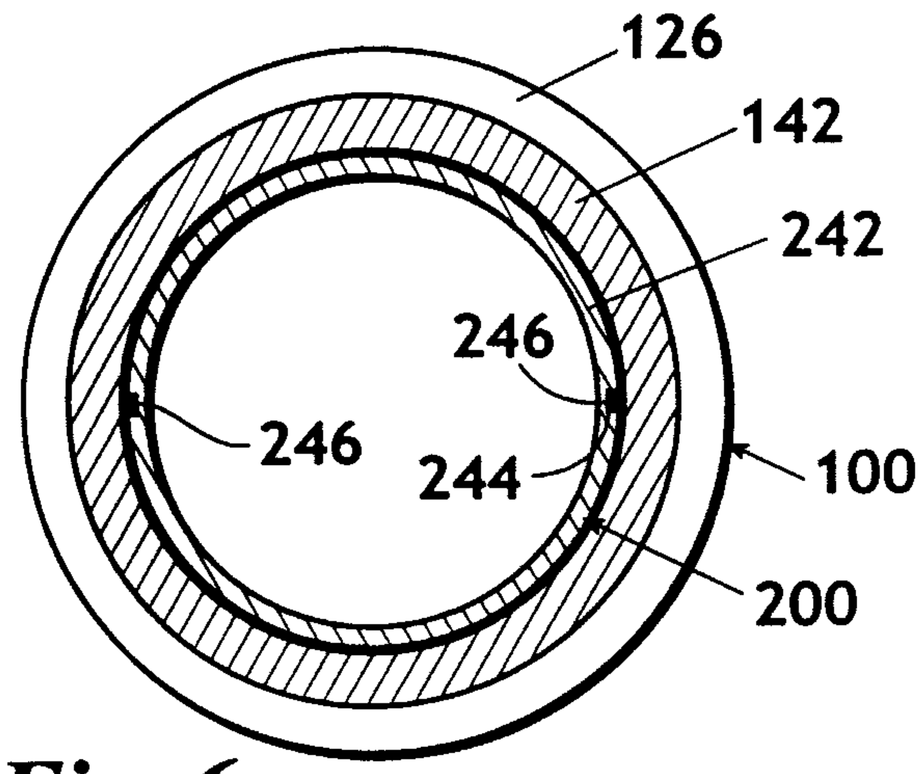
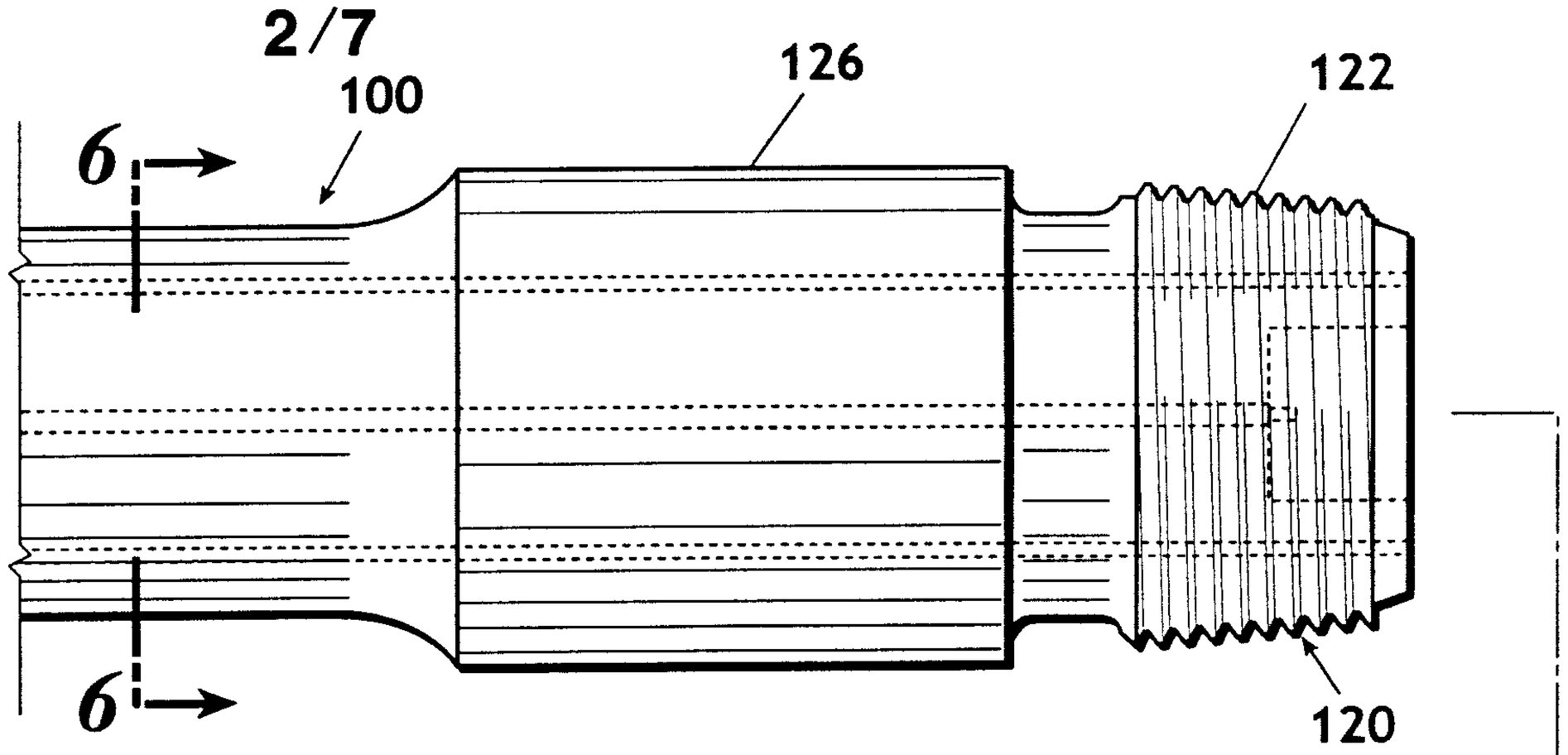


Fig. 6



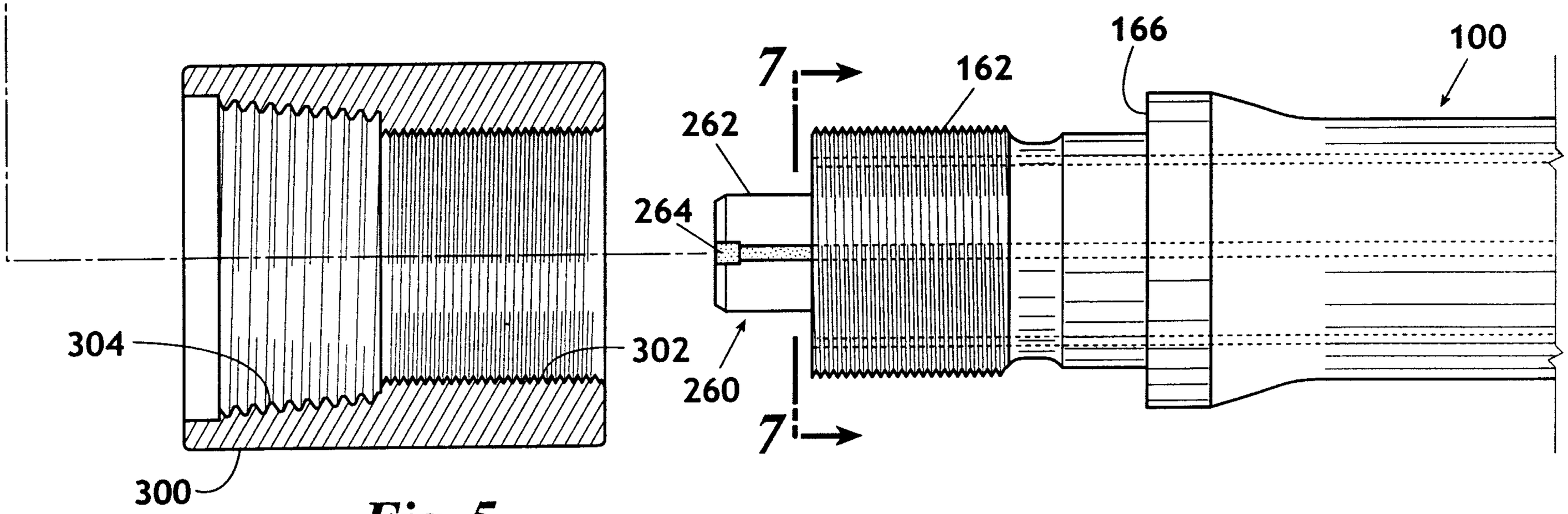


Fig. 5

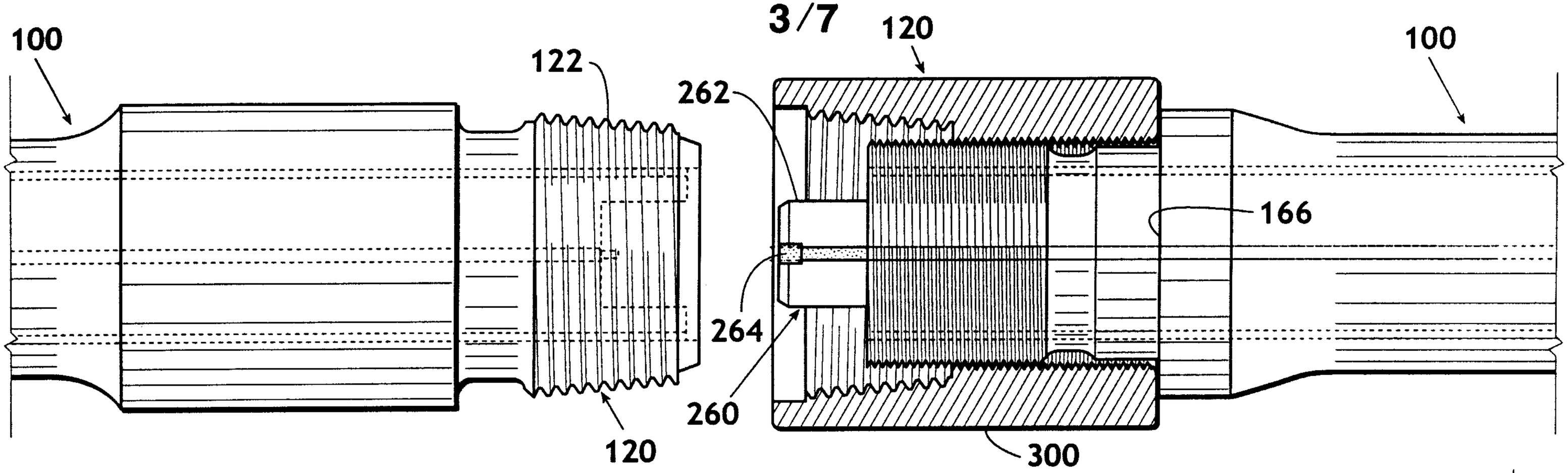


Fig. 8

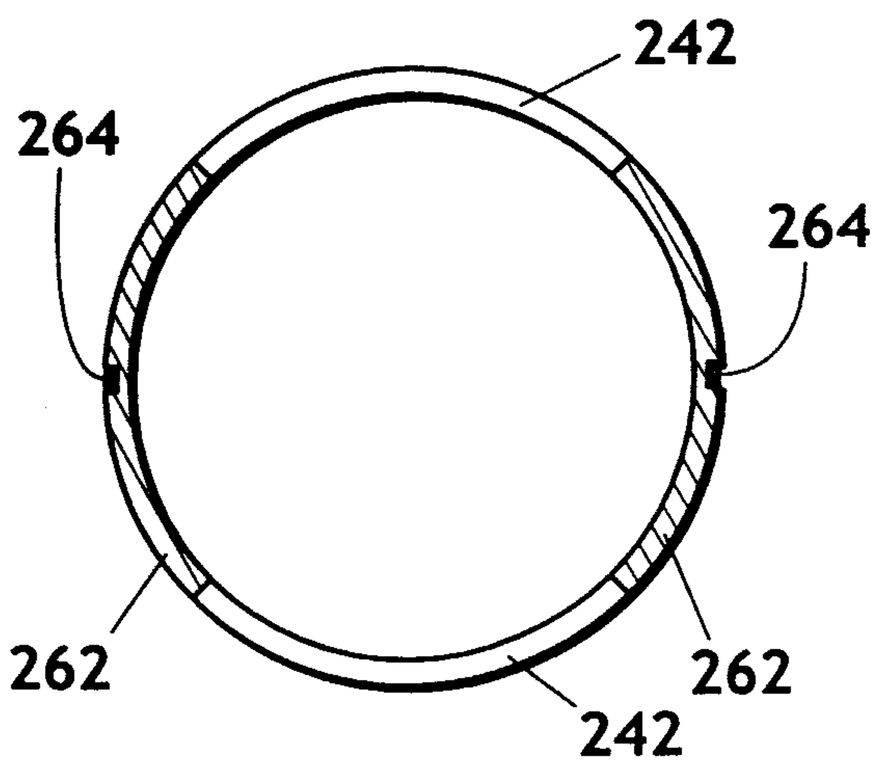


Fig. 4A

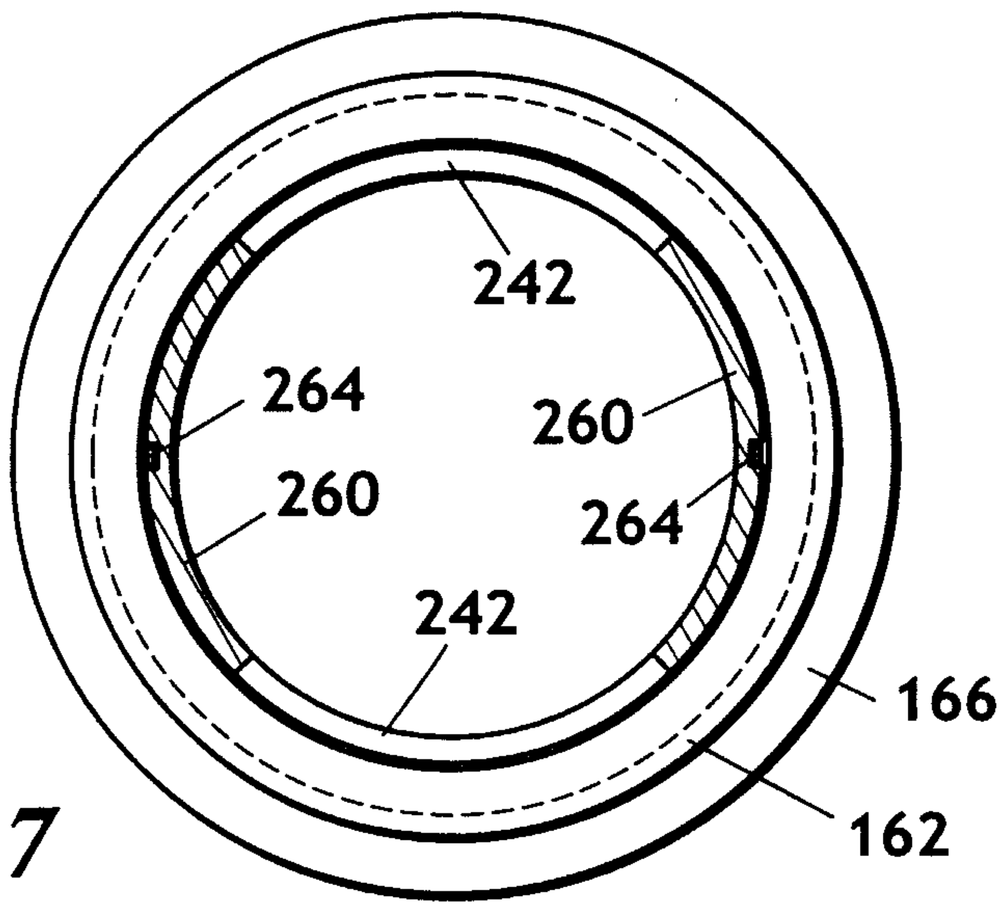


Fig. 7

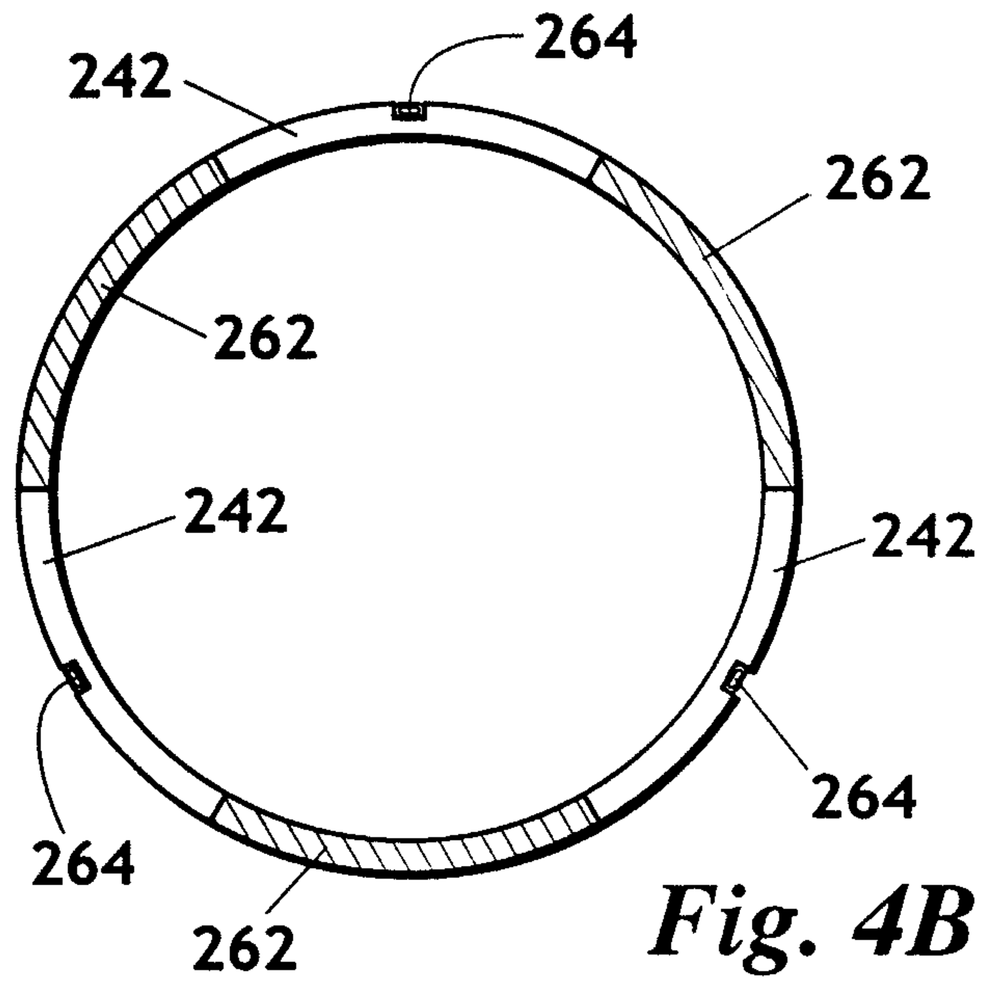


Fig. 4B

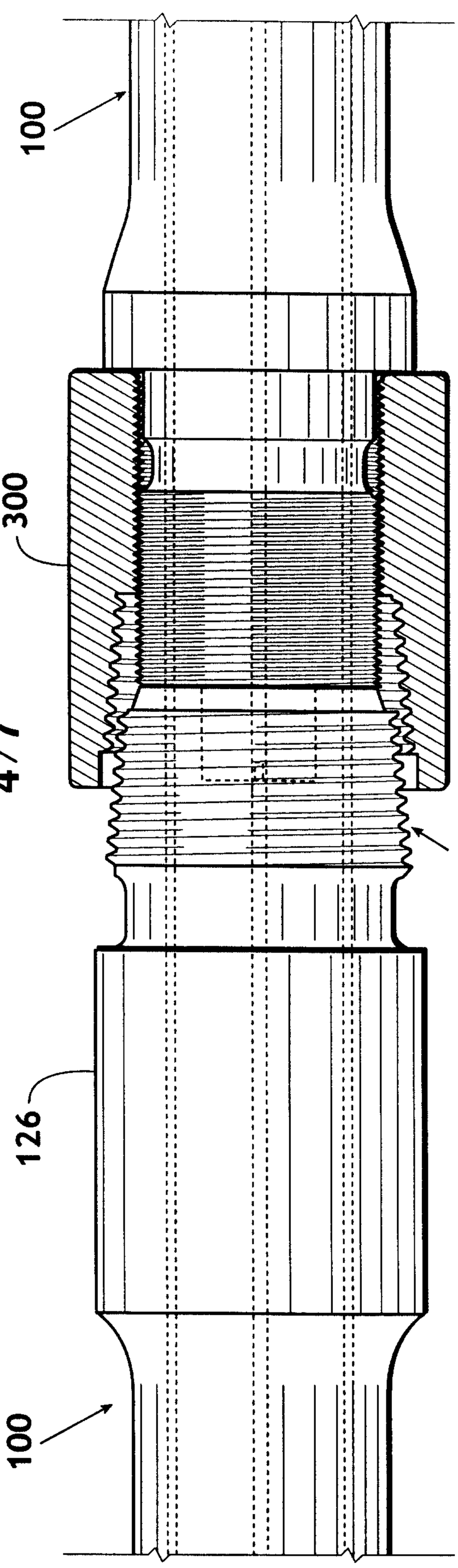


Fig. 9A

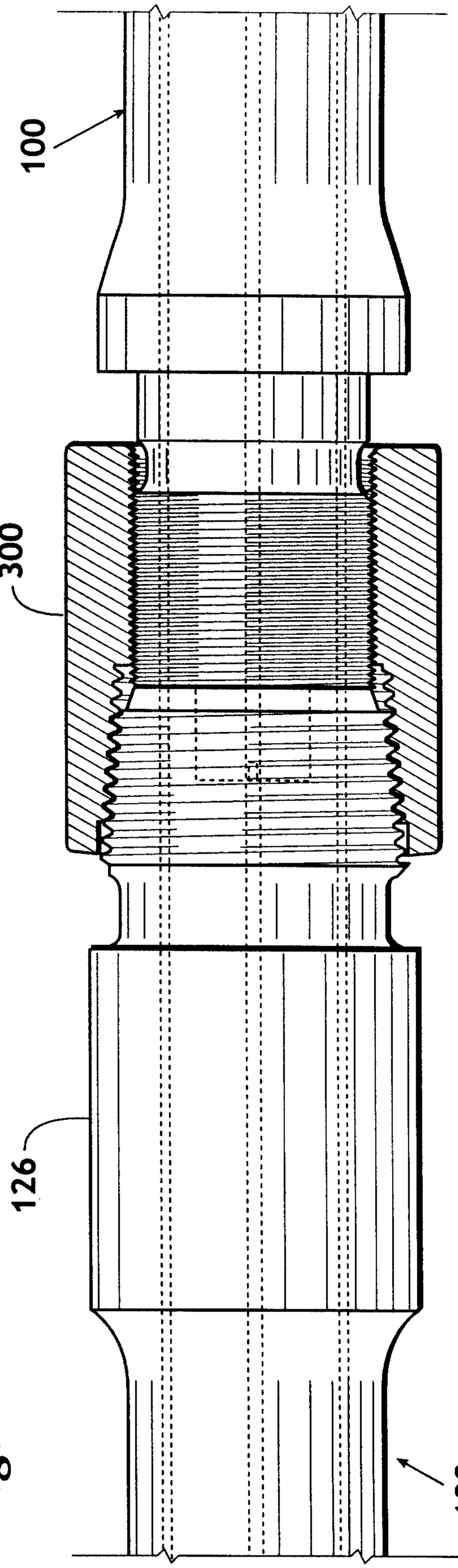


Fig. 9B

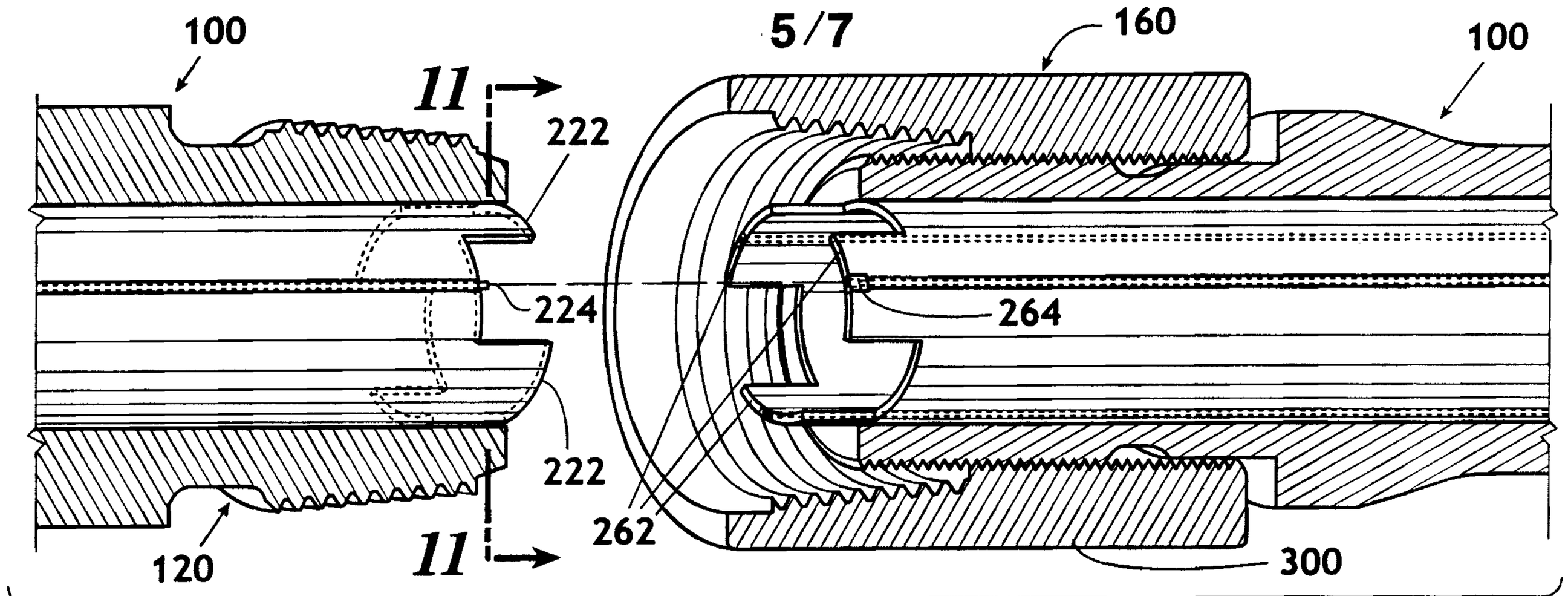


Fig. 10

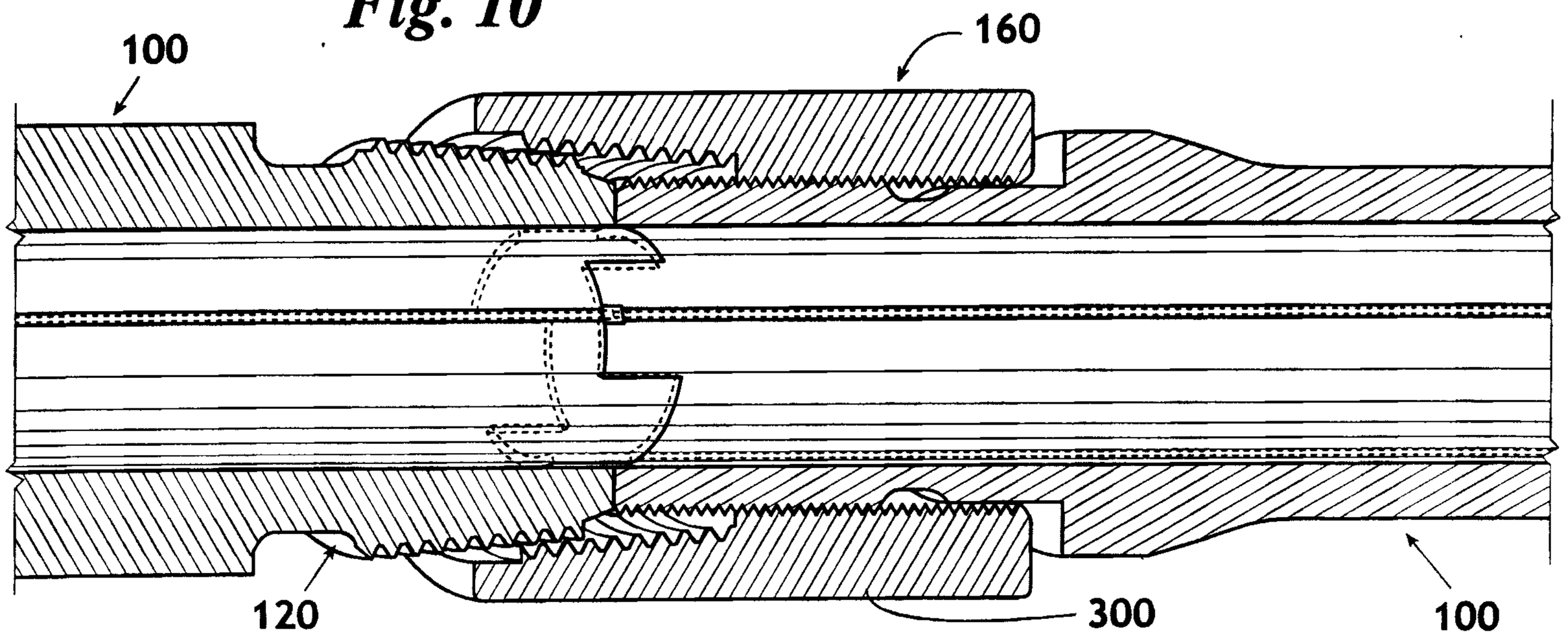


Fig. 12

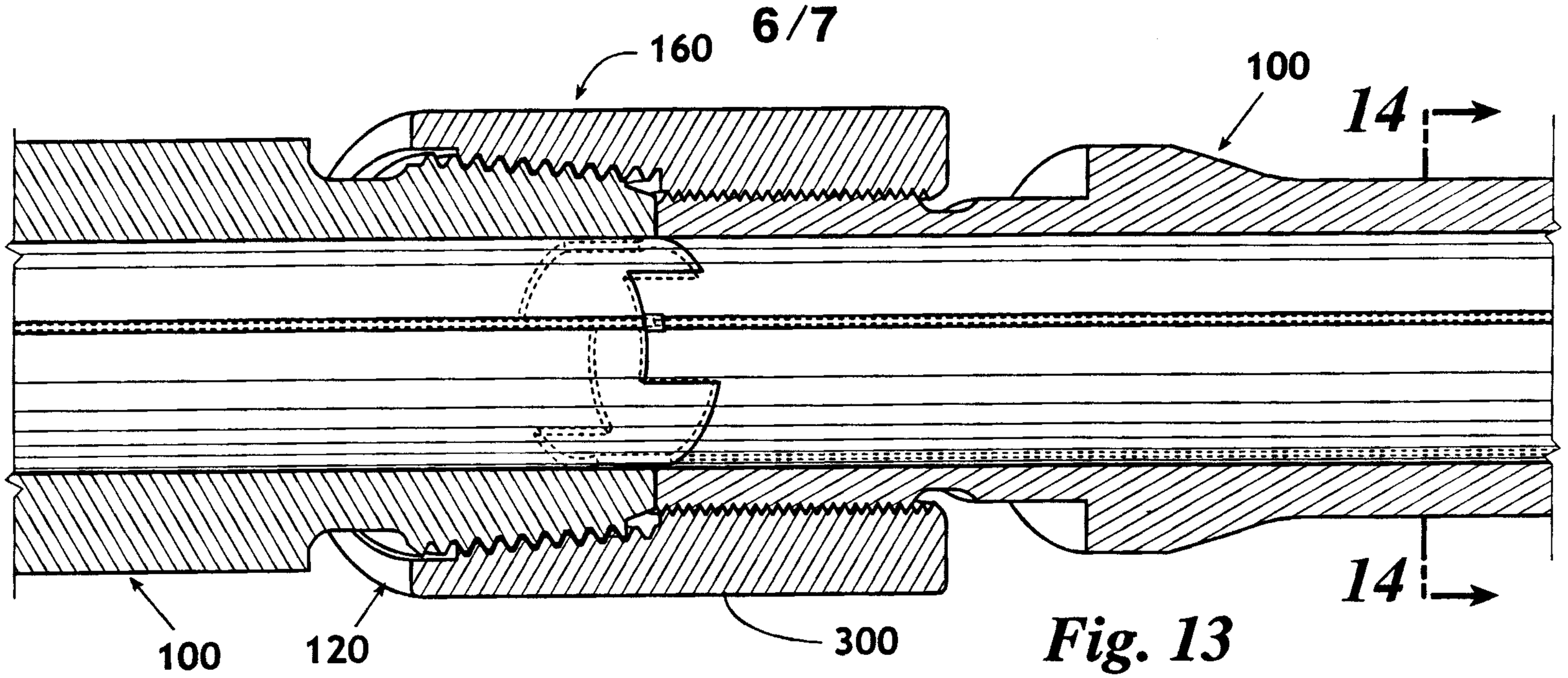


Fig. 13

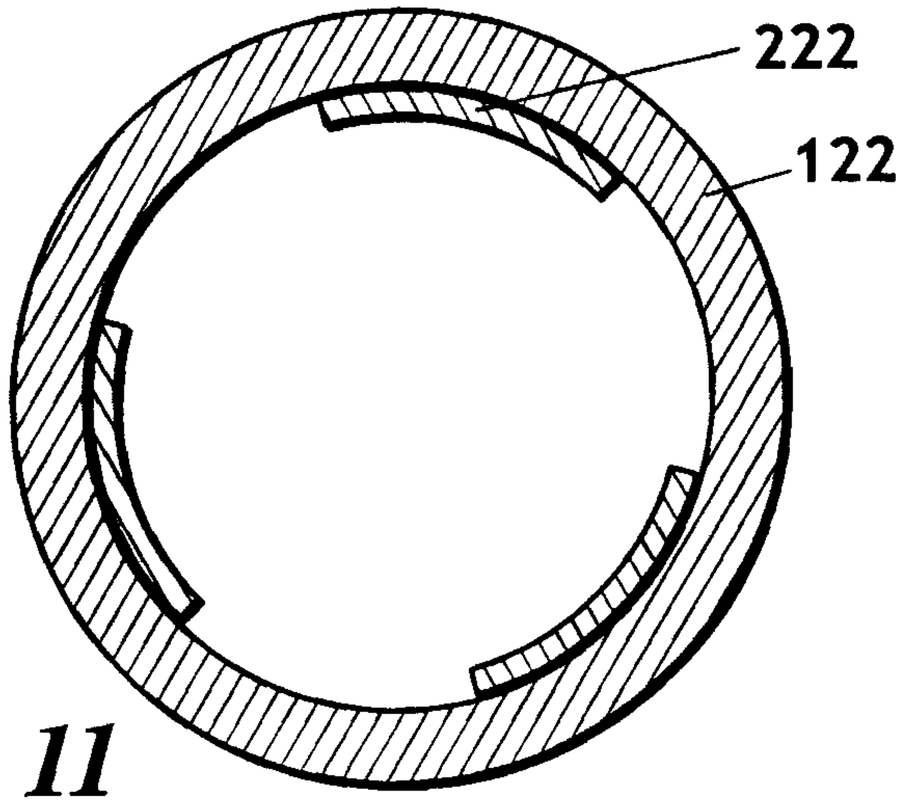


Fig. 11

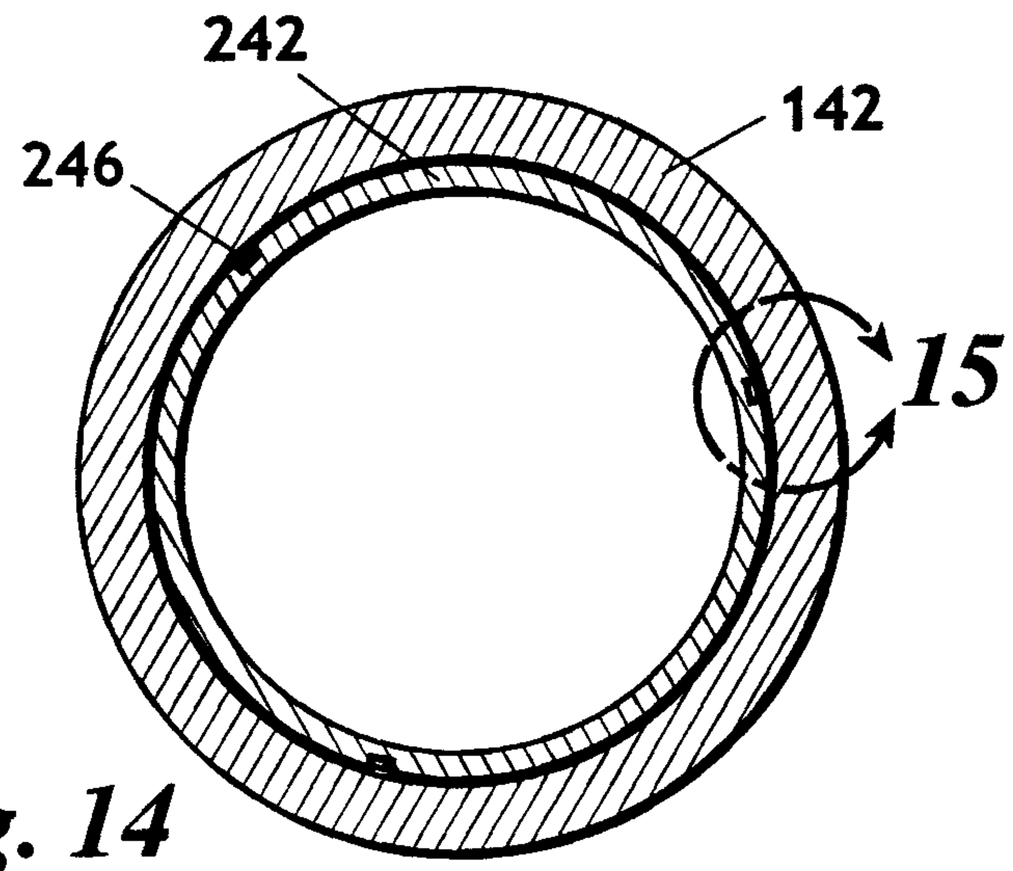


Fig. 14

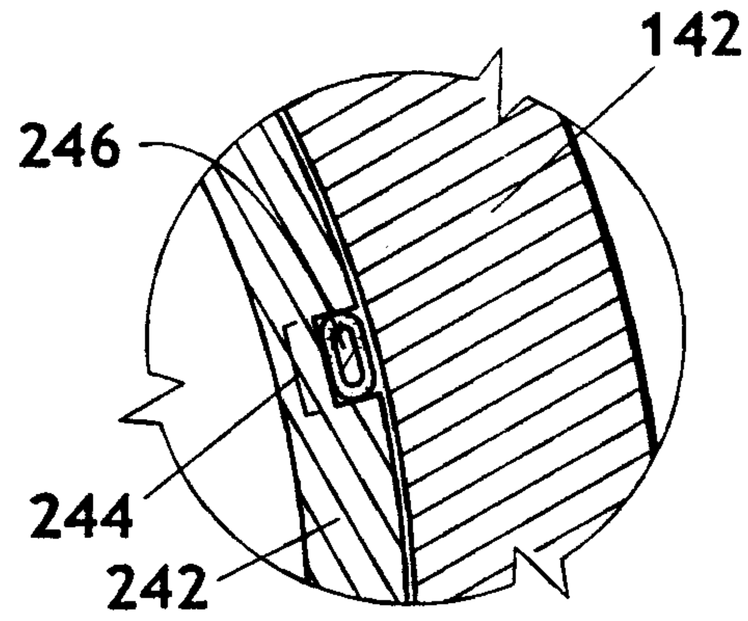


Fig. 15

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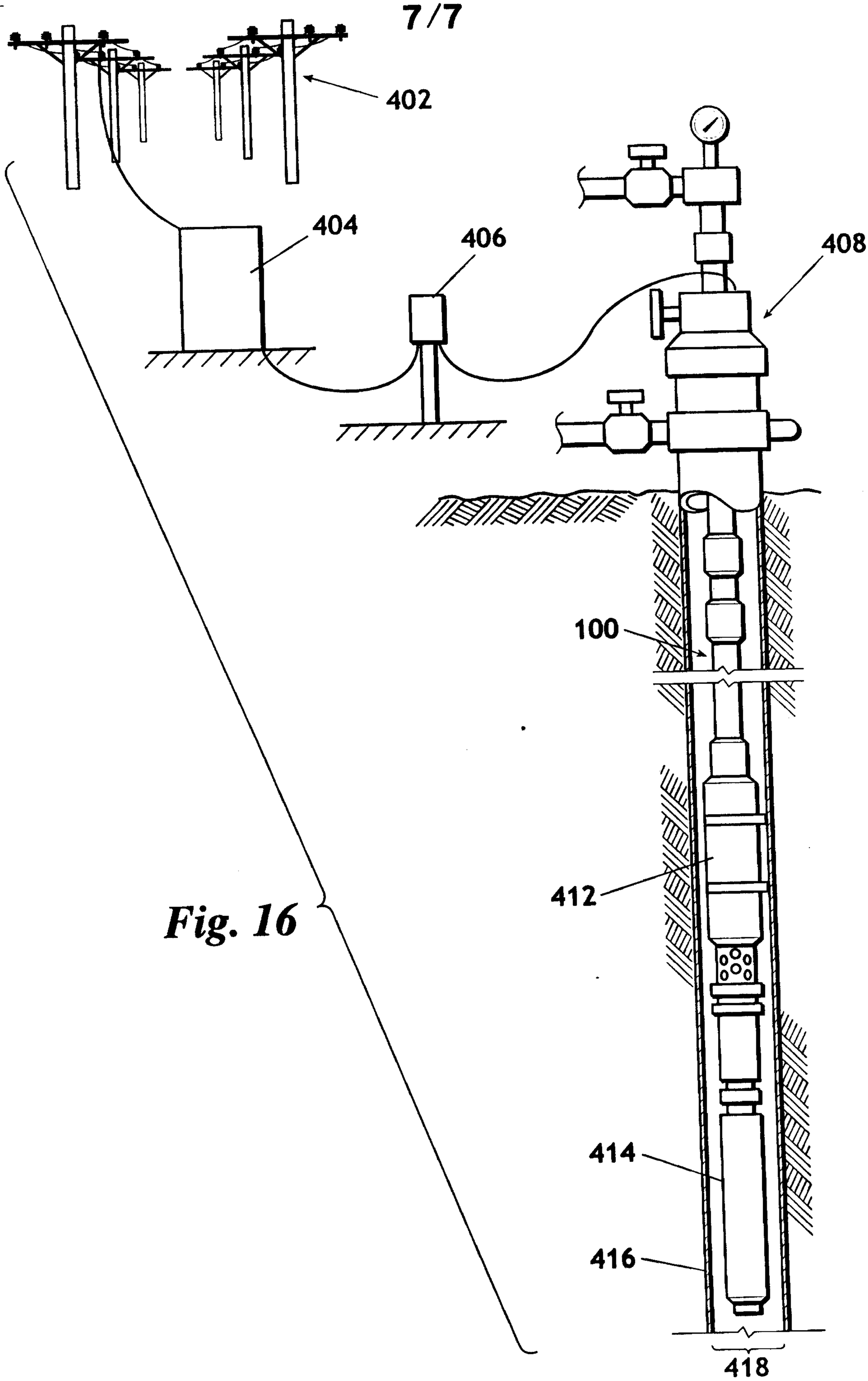
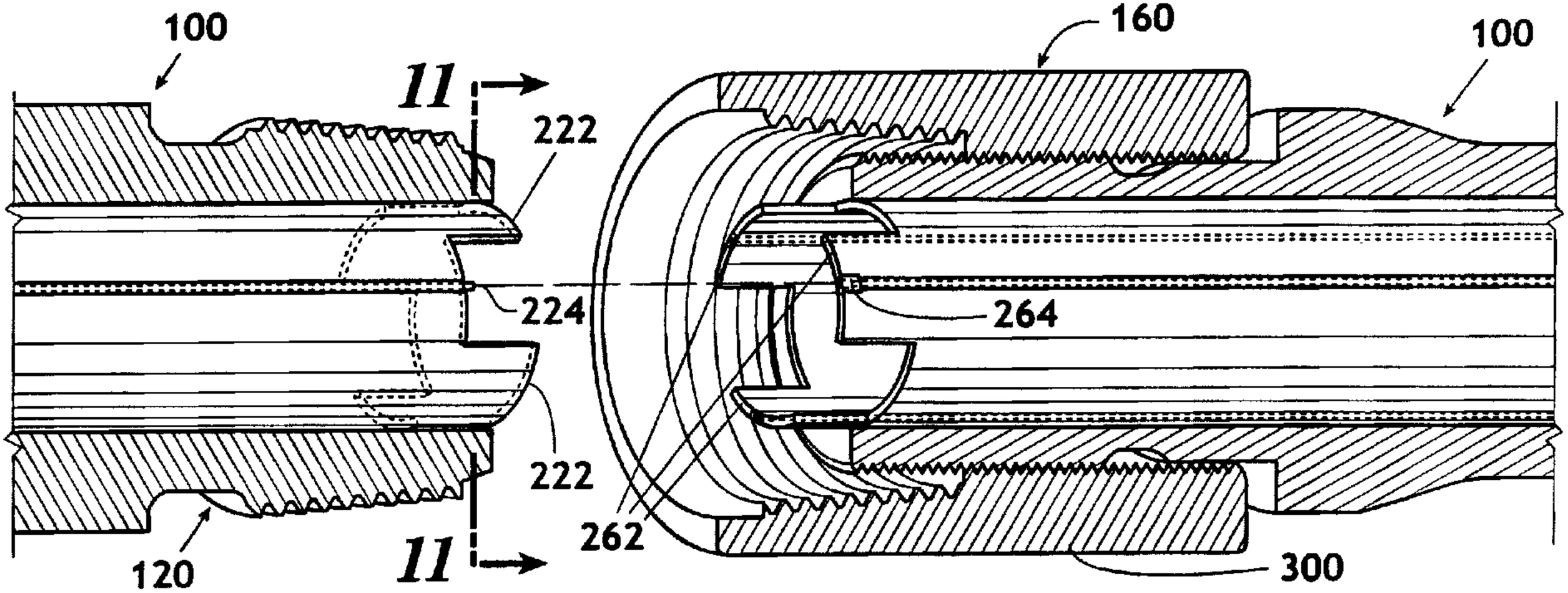


Fig. 16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