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(54) Downhole tool

(57) A method of locating a tubing string in a bore, the method comprising the steps: providing a device defining a restriction-engaging member; locating the device on the lower end of a tubing string; and then running the tubing string into the bore until the member engages a restriction in the bore and the device and the tubing is prevented from advancing further by the restriction. The member is then re-configured to permit further advancement of the device and tubing relative to the restriction and the device and tubing moved a predetermined distance relative to the restriction to position the tubing at a desired location in the bore.

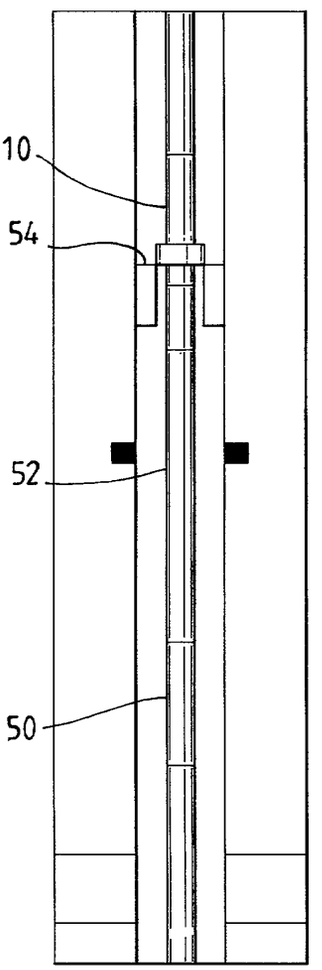

Fig. 4

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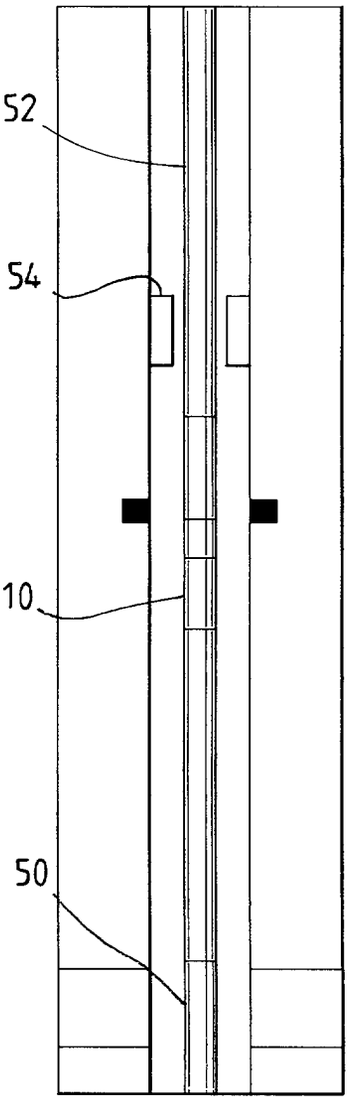

Fig. 5

Description

FIELD OF THE INVENTION

[0001] This invention relates to a downhole tool, and in particular to a tool for facilitating location of items in a borehole. The invention also relates to a system incorporating such a tool, and a method of using the tool.

BACKGROUND OF THE INVENTION

[0002] In downhole operations in the oil and gas exploration and production industry, tubing, in the form of a completion, test string or casing string, is run into a bore and suspended or otherwise fixed therein. The lower end of the tubing string will often engage seals provided in, for example, a packer or liner top, and thus must be positioned with some accuracy. The operator will be aware of the general location or depth of the packer, and thus will make up and run in the tubing string, formed from appropriate tubing sections, until the lower end of the string engages the packer seals. The operator is thus able to identify the location of the packer relative to the length of tubing that has been run into the bore. The tubing string is then partially retrieved to allow incorporation of landing devices and the like at appropriate points in the string. The landing string is then run back into the bore such that the lower end of the tubing lands out on the packer and the landing devices engage appropriate profiles, seals and the like at the upper end of the bore.

[0003] This method of locating tubing can be time-consuming and also has the disadvantage that the movement of the lower end of the tubing into and out of the packer seals may result in seal damage and subsequent seal failure.

[0004] Non-physical means may also be employed to locate, for example, a completion or drill stem test (DST) tubing string in a well. Firstly, a radioactive (gamma ray or GR) tag may be set in the bore-lining casing and a further tag set in the tubing string. The location of the tag in the casing will have been determined previously by logging runs of sensors on electric line during the process of logging or casing and cementing the well, and thus provides a datum. Once the tubing string has been run in, with the tubing tag, a further log is run which then places the tag on the tubing at a distance from the tag on the casing. The tubing may then be raised or lowered to achieve the desired relative spacing between the tags, and thus the desired location of the tubing in the casing. However, this method is relatively complex and confusion can result.

[0005] It is among the objectives of embodiments of the present invention to provide an alternative method and apparatus for locating tubing strings downhole.

SUMMARY OF THE INVENTION

[0006] According to one aspect of the present invention there is provided a method of locating a tubing string in a bore having a restriction therein, the method comprising the steps:

providing a device defining a restriction-engaging member;

locating the device on the lower end of a tubing string;

running the tubing string into the bore until the member engages a restriction in the bore and the device and the tubing is prevented from advancing further by the restriction;

re-configuring the member to permit further advancement of the device and tubing relative to the restriction; and

moving the device and tubing a predetermined distance relative to the restriction to position the tubing at a desired location in the bore.

[0007] Preferably, the member defines an upset, that is a radial extension from the device body.

[0008] Preferably, the member is re-configured such that the member may be radially retracted. Alternatively, the member may be positively retracted.

[0009] Preferably, the member is re-configured by application of a predetermined force thereto. Conveniently, application of a predetermined weight will re-configure the member. Such weight may, for example, overcome a biassing force or release a coupling, such as a shear member.

[0010] Preferably, the method comprises the further step of maintaining the member in the retracted configuration. This may be achieved by restraining the member in the retracted configuration, or by providing a member which is normally retracted or tends to adopt a retracted configuration, and when unrestrained adopts a retracted configuration. In one embodiment the member may be in the form of a snap-ring movable from a larger diameter portion of the device body to a smaller diameter portion of the device body. In another embodiment, the member may be in the form of one or more keys, fingers or segments similarly movable between larger and smaller diameter body portions, or between supported and unsupported configurations.

[0011] The invention also relates to apparatus for use in locating a tubing in a bore with reference to an existing bore restriction, the apparatus comprising: a device adapted for mounting on the lower end portion of a tubing string to be run into a bore, the device comprising a radially extending member adapted to engage a bore restriction and adapted to be selectively retracted to permit passage of the device beyond the restriction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] These and other aspects of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of a tool for use in a method of locating an object in a bore in accordance with embodiments of the present invention;

Figures 2 and 3 are schematic sectional illustrations of steps of a method in accordance with an embodiment of the present invention, utilising the tool of Figure 1;

Figures 4 and 5 are schematic sectional illustrations of steps of a method in accordance with a further embodiment of the present invention, utilising the tool of Figure 1;

Figure 6 is a sectional view of a further tool for use in a method in accordance with embodiments of the invention;

Figure 7 is a sectional view of a device for use in a method in accordance with embodiments of the present invention, the device being shown in a running configuration; and

Figure 8 is a sectional view of the device of Figure 7 shown in an operated configuration.

DETAILED DESCRIPTION OF THE DRAWINGS

[0013] Figure 1 of the drawings illustrates a device in the form of a space-out tool 10 which may be used to locate an object, typically a tubing string, but alternatively a valve, packer, plug, or the like, in existing tubing, such as bore-lining casing.

[0014] The use and operation of the tool 10 will be described herein with reference to an operation to locate a completion string in bore-lining casing 30 provided with a stab-through packer 32, as illustrated in Figures 2 and 3 of the drawings. In this example, a bore 34 has been lined with casing 30. The packer 32, defining a seal bore 38, is then run into the casing 30 on wireline and set in the lower end of the casing 30. The packer includes a mule shoe 40 below the seal bore 38, which mule shoe 40 includes a bore restriction 42. A completion tubing string 44 is then made up and run into the bore 34, the tool 10 being incorporated in the lower end of the string 44. As will be described, the tool 10 allows the tubing 44 to be located with accuracy relative to the packer 32, and subsequently allows accurate location of other items forming part of the string relative to the packer 32.

[0015] The tool 10 comprises a generally cylindrical body 12 having threaded upper and lower male end portions 14, 15, to allow the body 12 to be threaded and pinned to corresponding female end portions 16, 17 of completion tubing 18, 19. Mounted on the tool body 12, adjacent and abutting the lower tubing 19, are upset members or keys 20 which, as illustrated in the initial configuration, extend radially beyond the tubing outer surface. A sleeve 22 abuts the upper end of the upset members 20, the sleeve 22 being biassed downwards by a compression spring 24 but being initially fixed to the tool body 12 by shear pins 25.

[0016] The completion string 44 including the tool 10 is run into the bore restriction at the lower end of the mule shoe 40, the tool 10 being located in the string one or two tubing joints below the seal assembly 46 which will subsequently engage the packer seal bore 38. Once the upset members 20 have engaged the bore restriction 42, as illustrated in Figure 2, the space-out of the completion tubing 44 may be carried out; the depth of the packer 32 has now been established, and the string 44 may be partially retrieved to allow incorporate landing devices and the like at appropriate points in the string. On running back into the bore, the upset members 20 again engage the restriction 42, allowing space out to be checked. If sufficient weight is then applied to the string the pins 25 will shear, allowing the sleeve 22 and upset members 20 to move upwards relative to the body 12. The upset members 20 thus travel up the body 12 until they pass over an annular body profile 26; the members 20 retract into the profile 26, allowing the sleeve 22, urged by the spring 24, to move downwards over the members 20 and lock the members 20 in the retracted configuration. The tool 10 may then pass through the restriction 42 unhindered, and the seals 46 on the tubing may land out in the packer 32.

[0017] Figures 4 and 5 of the drawings illustrate the tool 10 being utilised to locate a device 50, which may be a perforating gun, pump, valve or some other tool or device, mounted on a tubing string 52 relative to a restriction 54 that occurs at a liner top, but could equally occur at a casing size change. The tool 10 is incorporated in the string 52, a predetermined distance, for example one or two tubing joints above the device 50, and is run into the bore. As with the first described embodiment, the tool 10 lands out on the bore restriction 54, as illustrated in Figure 4, and confirms the string space out. Figure 5 illustrates the situation after sufficient weight has been applied to the string to shear the pins 25, and the upset members 20 have retracted into the profile 26, such that the tool 10 has been able to pass through the restriction 54, and the device 50 positioned at the desired location.

[0018] Figure 6 shows an alternative form of space-out tool 110 which may be utilised in a similar manner to the tool 10 described above.

[0019] The tool 110 comprises a body 112 adapted to form part of the lower end of a completion string and carries an upset member in the form of a snap-ring 120 mounted on a shoulder 121 defined on the body 112. The snap-ring 120 is held on the shoulder 121 by a sleeve 122 releasably fixed to the body 112 by shear pins 125.

[0020] In a similar manner to the first described tool 10, the snap-ring 120 will engage a bore restriction, al-

lowing the location of the restriction, and any associated tool or device, to be determined with accuracy with reference to surface. Further, by application of sufficient weight to the tool 110, the pins 125 may be sheared, allowing the snap-ring to move off the shoulder 121, and assume a smaller diameter configuration, such that the tool 110 may then pass through the restriction.

[0021] Reference is now made to Figures 7 and 8 of the drawings, which are sectional views of a preferred tool 150, in Figure 7 the tool being shown in a running configuration, and in Figure 8 the tool 150 being shown in an operated configuration.

[0022] The tool 150 comprises a one-piece tubular body 152 having male threaded ends 154, 155 for coupling the body 152 to adjacent upper and lower tubing sections 156, 157 provided with corresponding female threads. Appropriate seals 158 are provided between the body ends 154, 155 and the tubing sections 156, 157, which are restrained against relative rotation by pins 160.

[0023] The body 152 carries a restriction-engaging member defined by sixteen fingers 162 which are initially restrained from axial movement relative to the body 152 by a lower sleeve 164 releasably fixed to the body 152 by shear pins 166, and also by an upper sleeve 168 biassed towards the fingers 162 by a compression spring 170 which acts between the sleeve 168 and the body 152.

[0024] The tool 150 is utilised in a similar manner to the tools 10, 110 described above, being run into a bore until the fingers 162 engage an appropriately-sized restriction, thus providing a definitive land out with a set down of up to 10,000 lbs. The fingers 162 are retracted by applying additional weight to the string sufficient to shear the screws 166, and with this example the shear-out weight may be set up to 45,000 lbs.

[0025] On shearing the pins 166, the fingers 162 are moved upwardly over the body 152 for a limited distance (in this example two inches), and then drop into an annular body recess 172. The fingers 162 are retained against the body 152 in the retracted configuration, within the recess 172 by the upper and lower retaining sleeves 168, 164. As noted above, the upper sleeve 168 is biassed towards the fingers 162 by the spring 170. In a somewhat similar manner, the lower sleeve 164 is biassed towards the fingers 162 by a spring 174, the shear pins 166 initially restraining the spring 174 in a pre-compressed configuration.

[0026] The string on which the tool 150 is mounted may be pulled back out after the initial landing out of the fingers 162 to allow location of appropriate landing devices on the string, or the landing string may be run without pulling back the tubing string, the latter method being appropriate for deepwater wells.

[0027] It will be apparent to those of skill in the art that the above-described tools provide a simple but effective means for locating items, particularly tubing strings including completion, test strings or casing strings, in a bore relative to a restriction.

[0028] It will further be apparent to those of skill in the art that these embodiments are merely exemplary of the present invention and that various modifications and improvements may be made thereto without departing from the scope of the present invention.

Claims

1. A method of locating a tubing string in a bore having a restriction therein, the method comprising the steps:

   (a) providing a device defining a restriction-engaging member;
   (b) running the tubing string into the bore until the member engages a restriction in the bore and the device and tubing are prevented from advancing further by the restriction;
   (c) re-configuring the member to permit further advancement of the device and tubing relative to the restriction; and
   (d) moving the device a predetermined distance relative to the restriction to position the tubing at a desired location in the bore.

2. The method of claim 1, comprising re-configuring the member by radially retracting the member.

3. The method of claim 1, comprising re-configuring the member by positively retracting the member.

4. The method of any of the preceding claims, comprising re-configuring the member by application of a predetermined force thereto.

5. The method of claim 4, comprising re-configuring the member by application of a predetermined downward weight thereto.

6. The method of claim 4 or 5, comprising releasing a shear coupling.

7. The method of any of the preceding claims, further comprising the step of maintaining the member in a retracted configuration.

8. The method of claim 7, comprising restraining the member in the retracted configuration.

9. The method of any of the preceding claims, wherein following step (b), landing devices are incorporated in the tubing string and, carrying out step (d) lands out the string.

10. The method of claim 9, further comprising pulling the tubing string back out prior to incorporating the

landing devices in the tubing string.

11. The method of claim 9, wherein the landing devices are incorporated in the tubing string without pulling back the tubing string.

12. Apparatus for use in locating a tubing string in a bore with reference to an existing bore restriction, the apparatus comprising: a device adapted to be run into a bore on a lower end of a tubing string, the device comprising a radially extending member adapted to land out on a bore restriction and adapted to be selectively retracted to permit passage of the device and the associated tubing string beyond the restriction.

13. The apparatus of claim 12, wherein the member is adapted to be retracted by application of a predetermined weight thereto.

14. The apparatus of claim 13, wherein the member is initially retained in a restriction-engaging position by a releasable coupling.

15. The apparatus of claim 14, wherein the coupling is in the form of a shear member.

16. The apparatus of any of claims 12 to 15, further comprising means for maintaining the member in a retracted configuration.

17. The apparatus of claim 16, wherein said means for maintaining the member in the retracted configuration comprises spring biassed sleeves located above and below the member.

18. The apparatus of any of claims 12 to 17, wherein the member comprises a plurality of fingers.

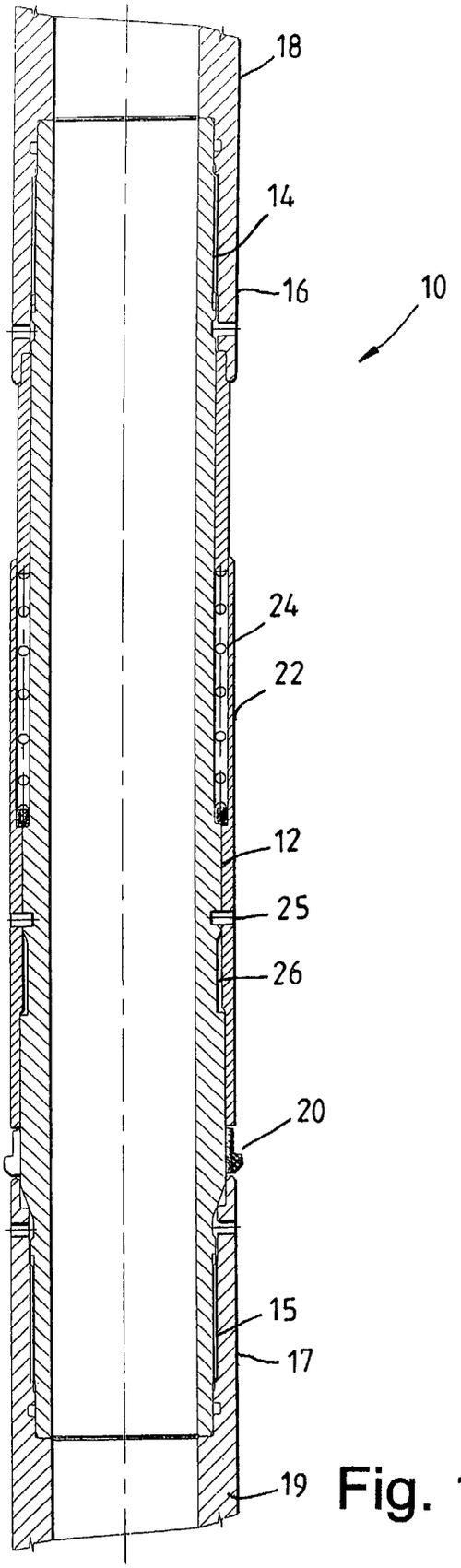

Fig. 1

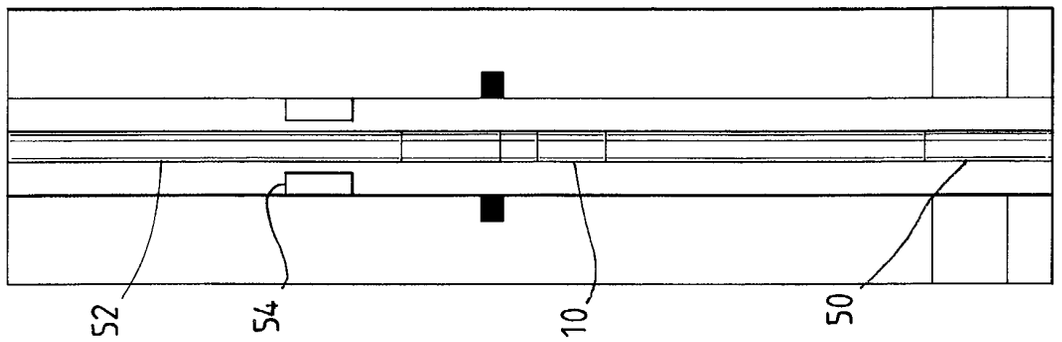

Fig. 5

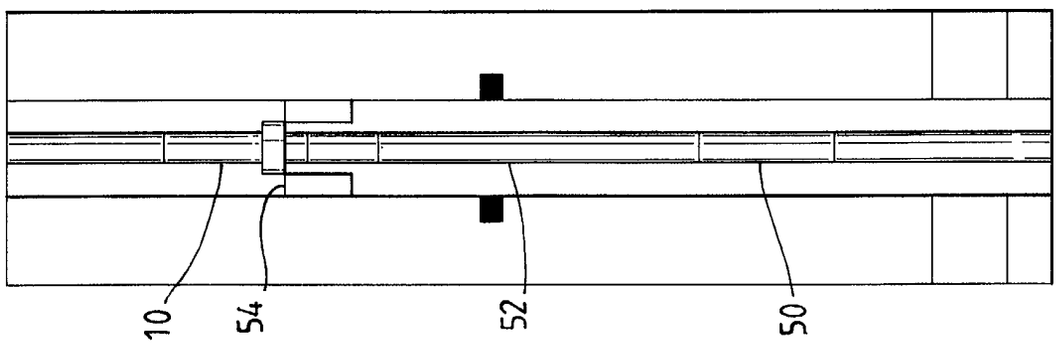

Fig. 4

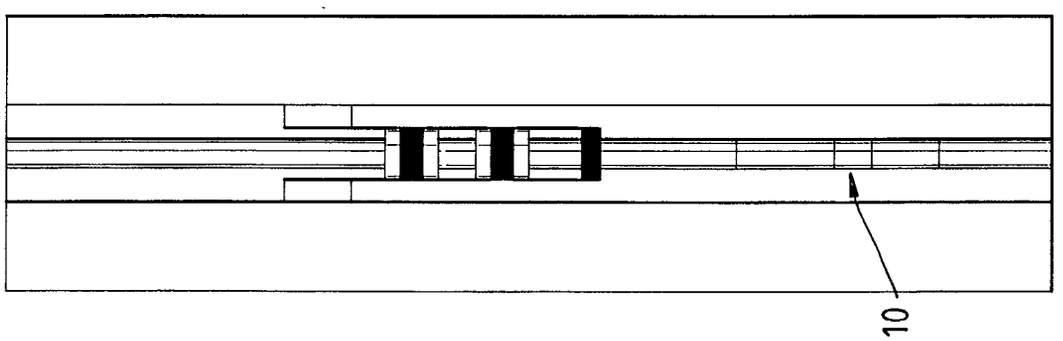

Fig. 3

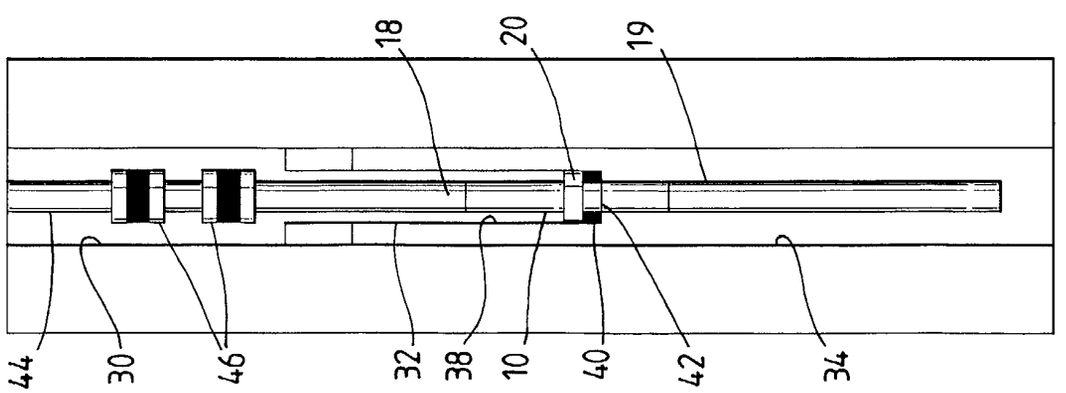

Fig. 2

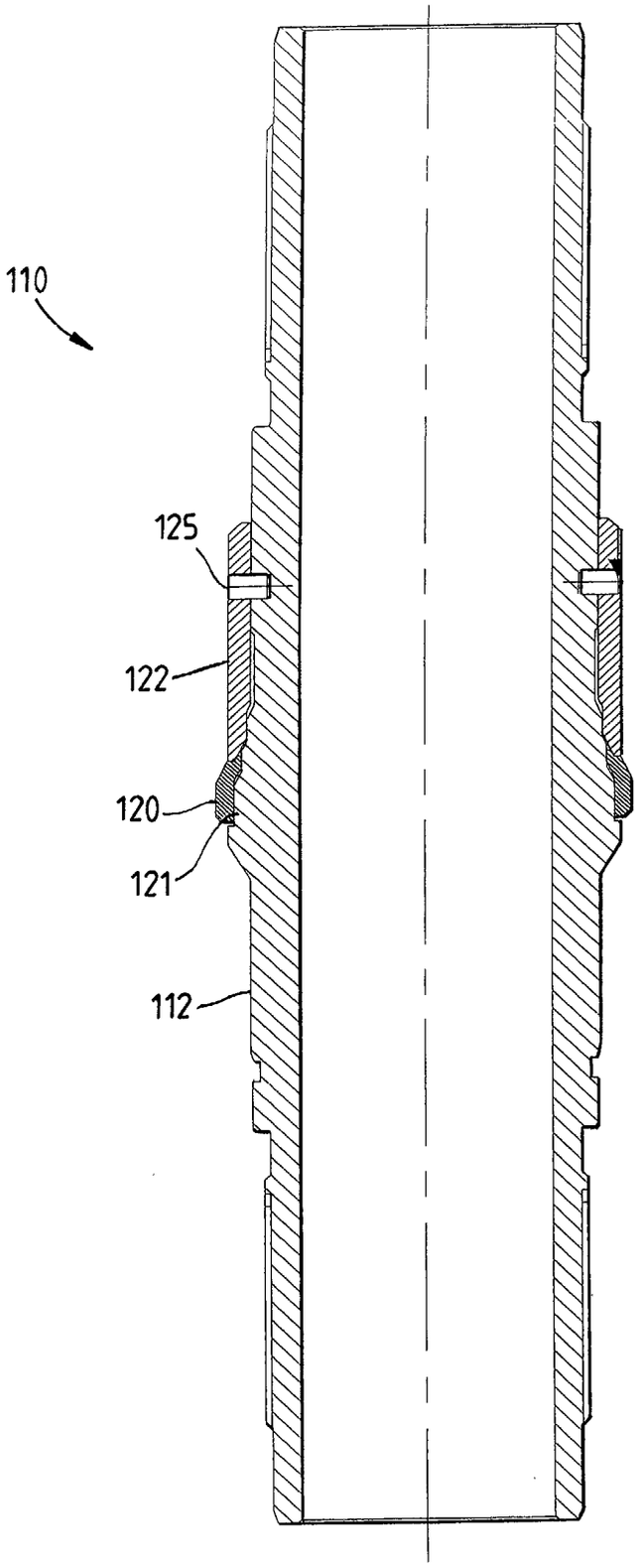

Fig. 6

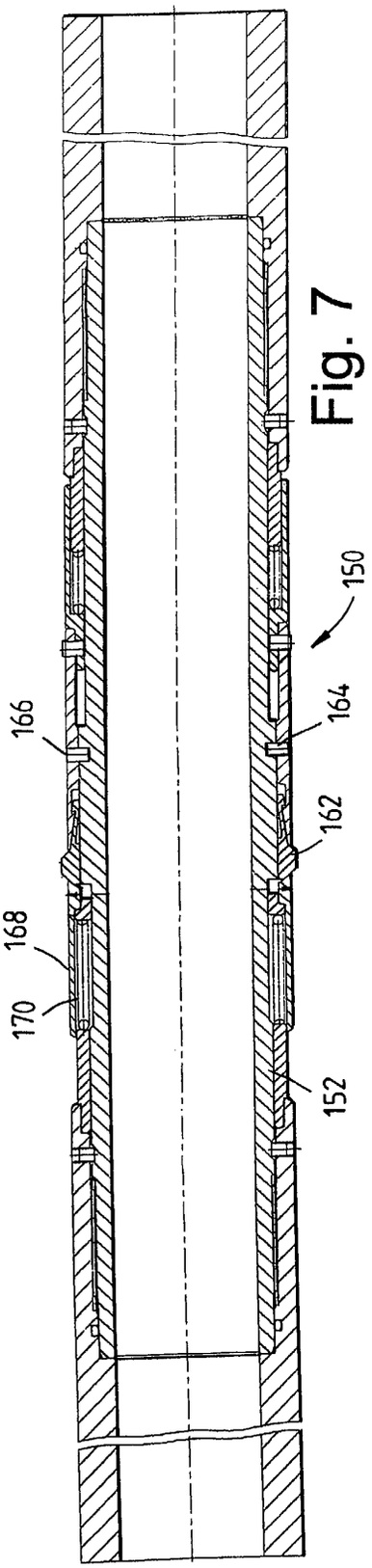
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Fig. 7

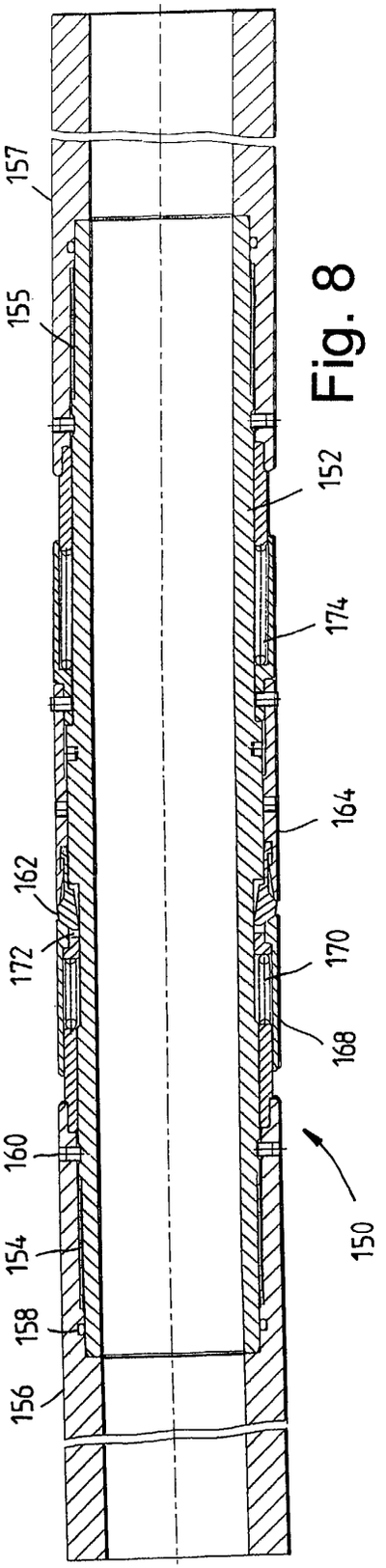
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Fig. 8