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(54) Title: INSTRUMENT FOR CENTERING TOOLS WITHIN A WELLBORE

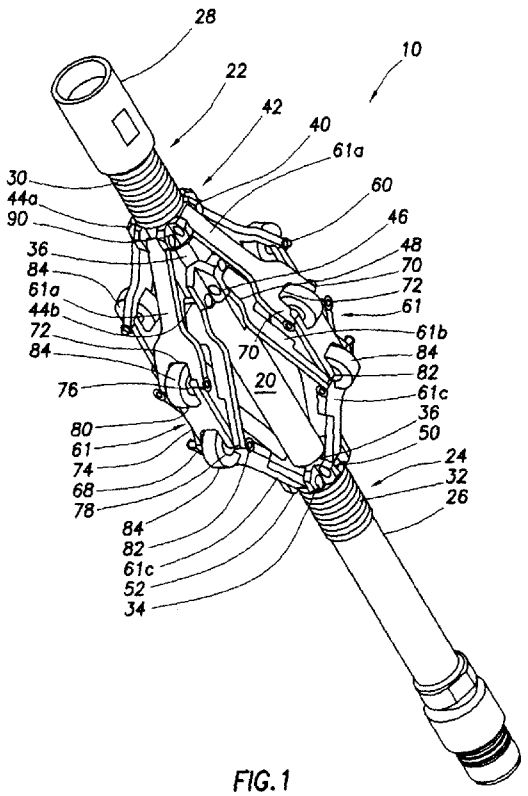

FIG. 1

(57) Abstract: A downhole controller for aligning downhole tools including a body extending between an upstream portion and a downstream portion, wherein a longitudinal axis of the body is coincident with the longitudinal axis of a borehole. First and second springs are disposed proximate the upstream and downstream portions, respectively. A first bulkhead is disposed around the upstream portion and a second bulkhead is disposed around the downstream portion. The first bulkhead having a first plurality of ribs extending outwardly therefrom to define an upper recess spaced from a middle recess and the second bulkhead having a second plurality of ribs extending outwardly therefrom to define a bottom recess. A linkage bar system is coupled to the upper, middle, and bottom recesses disposed around the body, wherein the linkage bar system includes first through third linkage bars, a roller support plate, and a roller.

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INSTRUMENT FOR CENTERING TOOLS WITHIN A WELLBORE

CROSS REFERENCE TO RELATED APPLICATION

BACKGROUND OF THE INVENTION

This disclosure relates generally to an instrument for centering wellbore tools and other tools that may be disposed in a wellbore or a cylindrical tubular member.

Certain centralizer devices for centering downhole tools during operations are known. Some wellbore tools, such as borehole televiewing equipment, require precise centering of the tool within the wellbore to provide accurate readings while such tools transverse the wellbore in the longitudinal direction. In this regard, there is a need for a centralizer tool that is capable of substantially centering a tool or tubular member with respect to a longitudinal axis of wellbores having various diameters while the tool or tubular member is stationary or the tool or tubular member is transversing the longitudinal axis without adversely affecting the accuracy or consistency of measurements recorded by such tool. There is also a need for a centralizer tool that is capable of being adapted to operate properly in borehole casings that include discontinuities or interrupts of varying lengths.

SUMMARY OF THE INVENTION

A downhole controller for aligning downhole tools includes a body extending between an upstream portion and a downstream portion. First and second springs disposed proximate the upstream and downstream portions, respectively. A first collar bulkhead disposed around the upstream portion and a second collar bulkhead disposed is around the downstream portion. The first collar bulkhead has a first plurality of ribs extending outwardly therefrom to define an upper recess spaced from a middle recess and the second collar bulkhead has a second plurality of ribs extending outwardly therefrom to define a bottom recess. A linkage bar system includes first through third linkage bars, a roller support plate, and a roller, wherein each of the first through third linkage bars extend between first and second ends. The first end of the first linkage bar is

coupled to the upper recess and the second end of the first linkage bar is coupled to an upper end of the roller support plate. The first end of the second linkage bar is coupled to the middle recess and the second end of the second linkage bar is coupled to a lower end of the roller support plate. The first end of the third linkage bar is coupled to the bottom recess and the second end of the third linkage bar is coupled to the lower end of the roller support plate, wherein the linkage bar system is adapted to compress of at least one of the first and second springs when the roller is obstructed by an interval in a borehole.

A downhole controller for aligning downhole tools includes a body extending between an upstream portion and a downstream portion. First and second springs disposed proximate the upstream and downstream portions, respectively. A first collar bulkhead is disposed around the upstream portion and a second collar bulkhead is disposed around the downstream portion. The first collar having a first plurality of ribs extending outwardly therefrom to define an upper recess spaced from a middle recess and the second collar having a second plurality of ribs extending outwardly therefrom to define a bottom recess. A radially extendable linkage bar system disposed around the body, wherein the linkage bar system includes first through third linkage bars, a roller support plate, and a roller. A coupling that is adapted to be coupled to the body, wherein the linkage bar system is adapted to compress of at least one of the first and second springs when the roller is obstructed by an interval in a borehole.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 shows an isometric view of one embodiment of centroller of the present disclosure;

FIG. 2 illustrates a partially exploded view of the centroller of FIG. 1; and

FIG. 3 shows the centroller of FIG. 2 transversing a section of a well casing having an interrupt therein.

DETAILED DESCRIPTION

In one embodiment of centroller 10, illustrated in FIG. 1 body 20 extends between upstream and downstream portions 22, 24. In certain embodiments, body 20 is tubular. However, those of ordinary skill in the art will recognize that body 20 may be of any desired shape or length. Where desired, extension pipes and or couplings 26, 28 may be attached to body 20 as known to those of skill in the art to convey structure such as tools into a borehole. Upper and lower compression springs 30, 32 are disposed around upstream and downstream portions 22, 24, respectively. Collar bulkheads 34, 36 may be slidably disposed around upstream and downstream portions 22, 24. As will be discussed in greater detail below, the spring rate and compression length of one or both compression springs 30, 32 may be adjusted based on considerations such as the weight and orientation of centroller 10. It is contemplated that centroller 10 may be oriented in a borehole with either upstream or downstream portion 22, 24 lowered into the borehole first.

Ribs 40 extend outwardly from top end 42 of collar bulkhead 34 to define four upper recesses 44a that are approximately equidistantly spaced around collar bulkhead 34. Similarly, ribs 46 extend outwardly from bottom end 48 of collar bulkhead 34 to define four lower recesses 44b that are approximately equidistantly spaced. In addition, ribs 50 extend outwardly from collar bulkhead 36 to define four recesses 52 that are approximately equidistantly spaced around collar bulkheads 36. Holes 60 are provided on ribs 40, 46, and 50. In one embodiment of the present disclosure, each recess 52 defined by ribs 40, 46, and 50 is adapted to anchor bar linkage assembly 61 that will be described hereinafter with reference to the figures.

With continuing reference to FIGS. 1 and 2, in certain embodiments of the present invention, bar linkage assembly 61 includes first through third linkage bars 61a, 61b, 61c, a roller support plate 62, and two molded roller 64a, 64b. Each of linkage bars 61a-61c extends from a first end 66 to a second end 68. The second end 68 is characterized by two fingers 70 that define a clevis 72 therebetween. Roller support plate 74 also extends from upper end 76 to lower end 78 wherein each end 76, 78 defines U-shaped slot 80 that is complementary to clevis 72 that are defined by the second end 68 of each linkage bars 61a, 61b, 61c.

Second end 68 of first linkage bar 61a is coupled to upper end 76 of roller support plate 74 by first pivot pin 82 and second end 68 of second linkage bar 61b is coupled to lower end 78 of second roller support plate 74b by second pivot pin. Further, second end 68 of third linkage

bar 68c is coupled to lower end 78 of roller support plate 74 at the same point as second linkage bar 68b is coupled to lower end 78 of roller support plate 74 by pivot pin 82 which extend through holes 60 of ribs 40, 46, 50 . Pivot pin 82 also function as axles for first and second molded rollers 84 that are disposed within the complementary U-shaped slots 80 formed between upper and lower ends of roller support plate 74 and clevis 72 of first through third linkage bars 61a-61c. One of ordinary skill in the art will recognize that linkage bars 61a-61c are able to radially articulate around pivot pins 82 when a load is applied to or removed from the linkage bar assembly 61 thus increasing or reducing the radial diameter of centroller 10 depending on the amount of load applied to the springs 30, 32.

First end 66a of first linkage bar 61a is disposed within upper recess 44a collar bulkhead 34 and hingedly coupled thereto by pivot pin 90. Those of ordinary skill in the art will recognize that any other type of screw or other suitable part may be used to achieve the hinged connection between linkage bar and other parts of the present disclosure. Similarly, first end of second linkage bar 61b is disposed within and hingedly coupled to lower recess 44b of collar bulkhead 34. In the same fashion, first end of third linkage bar 61c is disposed within and hingedly coupled to recesses 52 that is defined by ribs 50 on collar bulkhead 36.

In one embodiment, similar configurations of first through third linkage bars as described above are disposed in each of the four recesses 44a, 44b, 52 such that four linkage bar assemblies 61 form linkage bar system 91. As will be apparent to those of skill in the art, varying borehole conditions may require different designs of the linkage bar assembly 61. Therefore, in another embodiment fewer than four linkage bar assemblies may be utilized to form linkage bar system 91. In yet another embodiment more than four linkage bars may be utilized. Centroller 10 is designed to be relatively easy to reconfigure because the pivot pin that forms the hinge connection between first through third linkage bars, collar bulkheads, and roller support may be easily removed and installed with the use of simple hand tools. Consequently, one or more linkage bars may be added or removed depending on the needs of any particular project for which centroller 10 is required.

In use, centroller 10 is easily controlled by varying the strength of upper and lower compression springs 30, 32. Typically, the weight and/or orientation of a tool to be centralized is known or readily ascertainable. Therefore, a user can readily adjust the strength of either or both of springs 30, 32 to obtain precise load-force/moment characteristics. By so doing, a user is able

to orient the tool into a specific axial alignment even in situations where well deviation occurs or where there are well interrupts.

With reference now to FIGS. 2 and 3, a user can force at least one of springs 30, 32 into compression notwithstanding the loading orientation (i.e., the direction in which the centroller 10 is loaded). Centroller 10 is capable of compressing linkage bar system 91 positively in either a downhole or up-hole direction.

As shown in FIG. 3 tool 92 is attached to centroller 10 to centralize attached tool 92 within a borehole that includes interrupt 94 on borehole wall 96. A user aligns attached tool 92 with a longitudinal axis of centroller 10 by adjusting the spring rate of either or both compression springs 30, 32 knowing the weight of tool 92. Adjustment of the spring rate of either or both compression springs 30, 32 also causes the radial diameter of linkage bar system 91 decrease accordingly because the collar bulkheads 34, 36 are not fixedly attached to body 20. Specifically, in a situation where centroller 10 is being used to convey tool 92 in a downhole direction and one or more rollers 84 encounter an interval 94 in a borehole, compression spring 32 will be forced into spring compression until the threshold tension of centroller 10 is reached. Once the threshold tension is exceeded, one or more of pivot pin 82 will be sheared by the forces experienced by centroller 10, thereby causing linkage bar system 61 to break at one or more points. Once the linkage bar system 61 breaks, the centroller 10 is no longer able to generate a radial force to keep rollers 84 on 96 of the borehole. Further, any roller 84 that may have been obstructed by interval 94 becomes free, thereby enabling a user to retrieve centroller 10 and/or any attached tool 92.

Similarly, if one or more rollers 84 were obstructed by interval 94 while traveling in the upward direction, compression spring 30 will be forced into spring compression until the threshold tension is exceeded and one or more pivot pins 82 is sheared. Thereby allowing centroller 10 and/or tool 92 attached thereto to be retrieved from the borehole. Those of ordinary skill in the art will recognize that the above described double compression design of centroller 10 practically eliminates the probability of one of the rollers of centroller 10 getting stuck in interrupt 94 and/or losing centroller 10 and/or tool 92 in the borehole.

The threshold tension at which pivot pins 82 shear may be selected as desired by the designer of the centroller 10 by choosing pivot pins of varying materials, sizes and/or strengths to couple the linkage bars 61a, 61b, 61c to the roller support plates 74. The length of roller

support plates 74 can also be varied to suit different boreholes. Specifically, roller support plates 74 can be designed to be longer or shorter depending on casing interrupt geometry of any given borehole. In this manner, a user can ensure that at least one roller 84 is always in contact with wall 94 even where another roller 84 is passing through an interrupt.

The construction and operation of centroller 10 would be apparent to those of ordinary skill in the art in view of the foregoing description. Centroller 10 may be constructed from conventional engineering materials used in the relevant fields and following known fabrication principles. Those of ordinary skill in the art will recognize substitutions and modifications that may be made to the above description without departing from the scope of this disclosure.

I/WE CLAIM:

1. A downhole controller for aligning downhole tools:

a body extending between an upstream portion and a downstream portion;

first and second springs disposed proximate the upstream and downstream portions, respectively;

a first bulkhead disposed around the upstream portion and a second bulkhead disposed around the downstream portion;

the first bulkhead having a first plurality of ribs extending outwardly therefrom to define an upper recess spaced from a middle recess and the second bulkhead having a second plurality of ribs extending outwardly therefrom to define a bottom recess;

a linkage bar system including first through third linkage bars, a roller support plate, and a roller;

wherein each of the first through third linkage bars extend between first and second ends;

the first end of the first linkage bar is coupled to the upper recess and the second end of the first linkage bar is coupled to an upper end of the roller support plate;

the first end of the second linkage bar is coupled to the middle recess and the second end of the second linkage bar is coupled to a lower end of the roller support plate; and

the first end of the third linkage bar is coupled to the bottom recess and the second end of the third linkage bar is coupled to the lower end of the roller support plate, wherein the linkage bar system is adapted to compress of at least one of the first and second springs when the roller is obstructed by an interval in a borehole.

2. The downhole controller of claim 1, further including an extension coupling for attaching a tool thereto.

3. The downhole controller of claim 1, wherein the length of the roller support plate can be varied.

4. The downhole controller of claim 1, wherein a coupling between one of the linkage bars and the first and second collar bulkheads or the roller support plate is adapted to fail when the linkage bar system is subjected to a force greater than a threshold force.

5. The downhole controller of claim 4, wherein the linkage bars and the first and second collar bulkheads or the roller support plate are coupled by a linkage pin.

6. The downhole controller of claim 5, wherein the threshold force is varied by a varying the composition or size of the linkage pin

7. A downhole controller for aligning downhole tools:

a body extending between an upstream portion and a downstream portion;

first and second springs disposed proximate the upstream and downstream portions, respectively;

a first bulkhead disposed around the upstream portion and a second bulkhead disposed around the downstream portion;

the first bulkhead having a first plurality of ribs extending outwardly therefrom to define an upper recess spaced from a middle recess and the second bulkhead having a second plurality of ribs extending outwardly therefrom to define a bottom recess;

a radially extendable linkage bar system disposed around the body, wherein the linkage bar system includes first through third linkage bars, a roller support plate, and a roller; and

a coupling that is adapted to be coupled to the body, wherein the linkage bar system is adapted to compress of at least one of the first and second springs when the roller is obstructed by an interval in a borehole.

8. The downhole controller of claim 7, wherein the length of the roller support plate is variable.

9.. The downhole controller of claim 8, wherein a coupling between one of the linkage bars and the first and second collar bulkheads or the roller support plate is adapted to fail when the linkage bar system is subjected to a force greater than a threshold force.

10. The downhole controller of claim 8, wherein the linkage bars and the first and second collar bulkheads or the roller support plate are coupled by a linkage pin.

11. The downhole controller of claim 10, wherein the threshold force is varied by a varying the composition or size of the linkage pin.

12. A downhole controller for aligning downhole tools:

a body extending between an upstream portion and a downstream portion, wherein a longitudinal axis of the body is coincident with the longitudinal axis of a borehole;

first and second springs disposed proximate the upstream and downstream portions, respectively;

a first bulkhead disposed around the upstream portion and a second bulkhead disposed around the downstream portion;

the first bulkhead having a first plurality of ribs extending outwardly therefrom to define an upper recess spaced from a middle recess and the second bulkhead having a second plurality of ribs extending outwardly therefrom to define a bottom recess;

a linkage bar system disposed around the body, wherein the linkage bar system includes first through third linkage bars, a roller support plate, and a roller; and

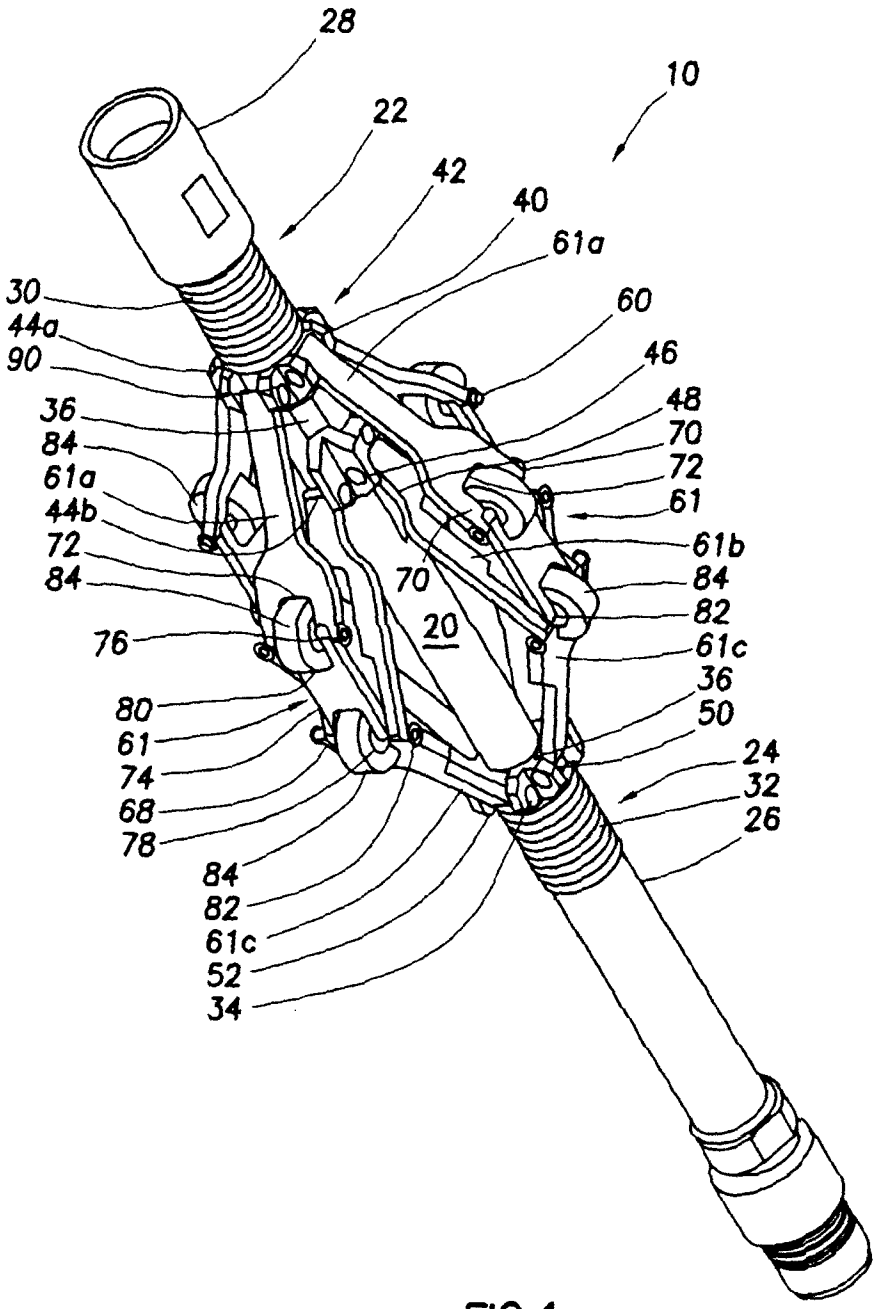
a coupling coupled to the body and adapted to suspend a tool from the body;

wherein the linkage bar system is adapted to compress of at least one of the first and second springs when the roller is obstructed by an interval in a borehole.

13. The downhole controller claim 12, wherein the length of the roller support plate can be varied.

14. The downhole controller claim 12, wherein the linkage bar system is coupled to the body by pivot pins.

15. The downhole controller claim 12, wherein the linkage bar system can be disassembled by the use of handtools.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84
82
76
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34

FIG. 1

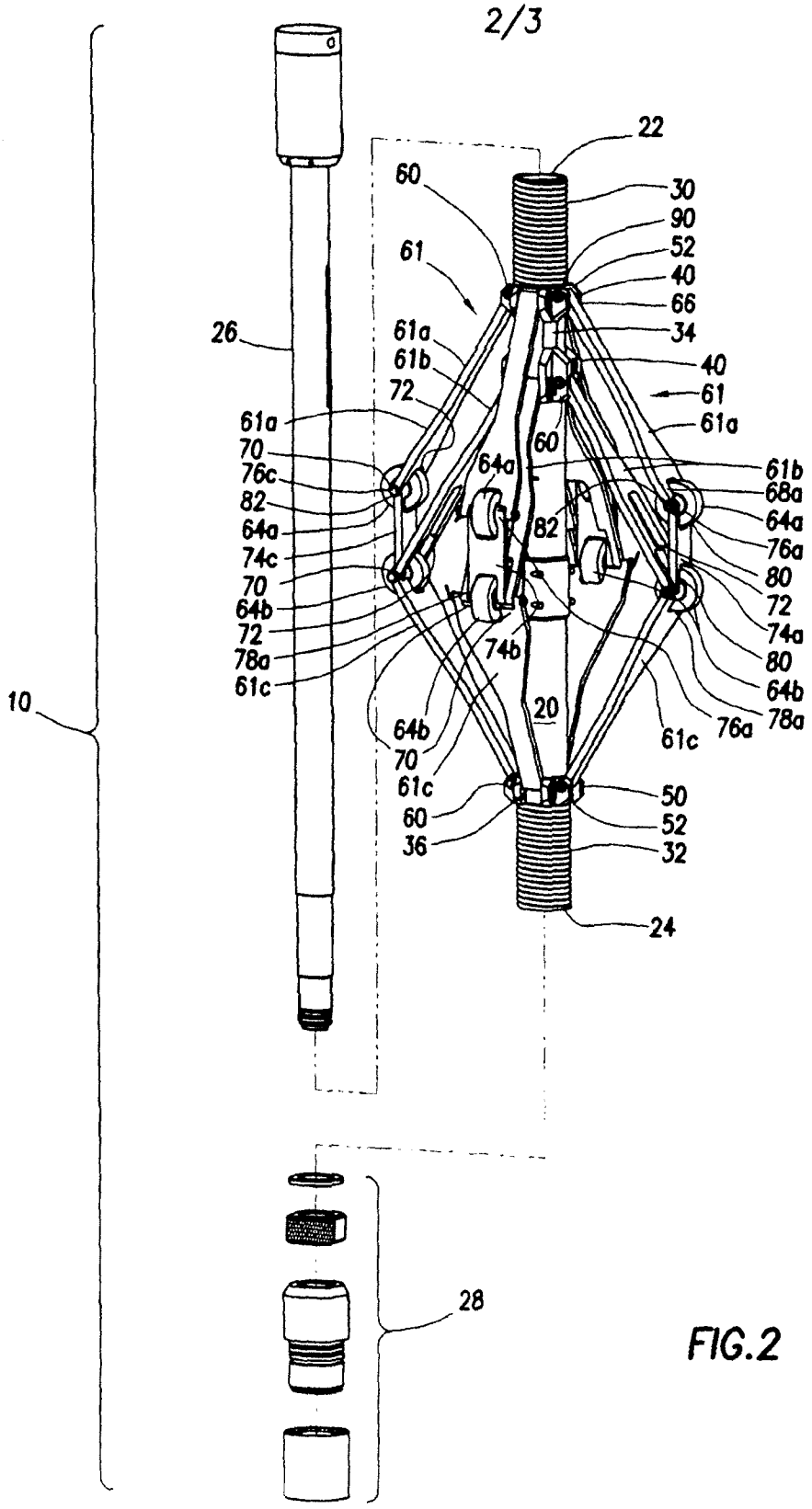
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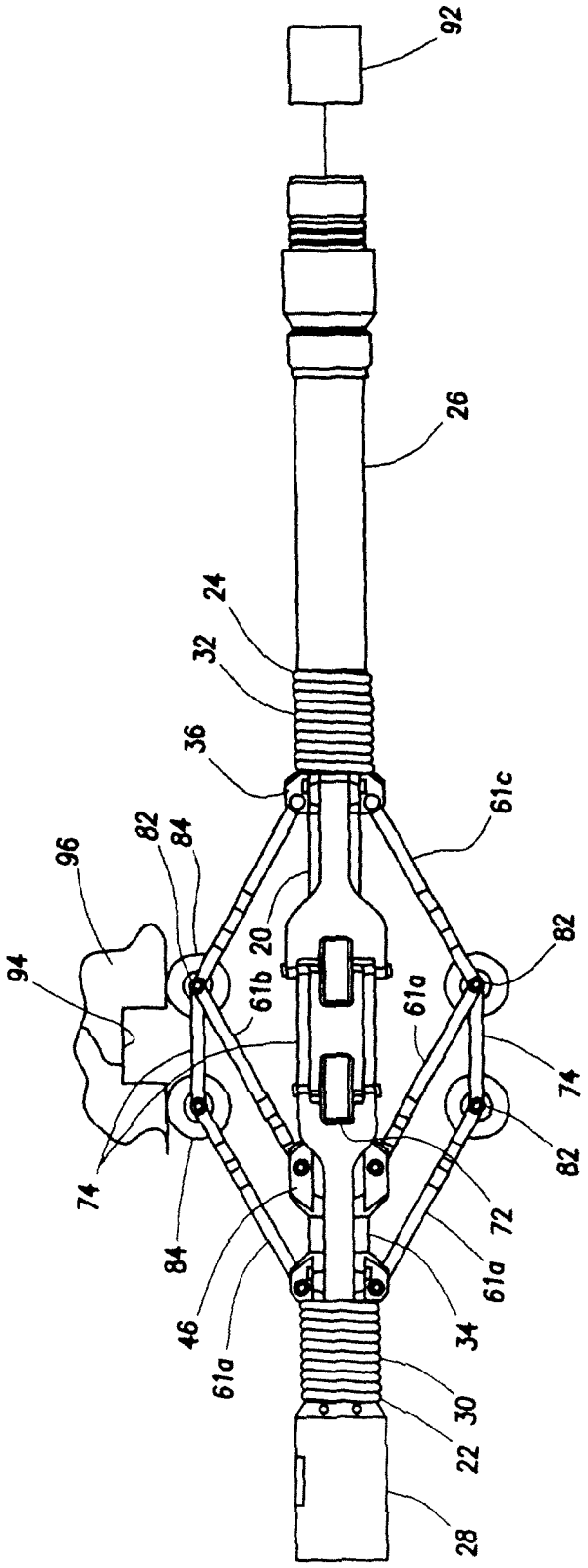
FIG.2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61a
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FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/024991

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E21B 17/00 (2012.01)
USPC - 166/241.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - E21B 17/00, 23/00, 47/09 (2012.01)
USPC - 166/241.1, 241.6, 241.7, 255.1, 255.2; 175/61, 73, 76, 325.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,557,327 A (KINLEY et al) 10 December 1985 (10.12.1985) entire document	1-15
Y	US 4,811,792 A (LEMBCKE et al) 14 March 1989 (14.03.1989) entire document	1-15
Y	US 2005/0279498 A1 (NAKAJIMA et al) 22 December 2005 (22.12.2005) entire document	4-6, 9, 11
A	US 2003/0173076 A1 (SHEIRETOV et al) 18 September 2003 (18.09.2003) entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☐

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 May 2012	21 MAY 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774