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(54) **Casing alignment tool.**

(57) An oil well casing alignment tool is disclosed wherein a casing section that has been elevated to an upright position, aligns the upright casing and locks it in a vertical position while permitting the casing to be axially rotated until it locks it into the sealing point of the previous casing section.

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CASING ALIGNMENT TOOL

The present invention pertains to production well completion to connecting well casings and their alignment to prevent thread and seal damage.

In particular, this invention relates to a casing alignment system comprising a head assembly having an open and a closed position, and roller assembly rotatably mounted on the head assembly for holding the casing.

In the completion of a well, such as an oil, water or gas well, it is standard practice to sink a casing once the well bore has been drilled. A casing is designed to preserve the integrity of the well bore. The casing is used as a conduit for well cementation and a pressurized container for production tubing.

A casing section is normally a seamless steel tube approximately 12.2 meters in length, anywhere from 11.4 to 50.8 cm in diameter and may have a wall thickness in excess of 2.5 cm. The casing section is normally threaded at each end with a collar screwed on to one end in preparation for placing in a well bore.

Referring to Figure 1, a well bore 4 is of a significantly larger diameter than the outer diameter of casing section 5 to allow easy placement down hole. A casing section 5 is placed in an upright position and lowered partially down hole, with a collared end 6 extending above the ground surface surrounding well bore 4. Casing section 5 is held in place by slips 7 secured to the surface to prevent casing section 5 from further descending well bore 4. A second casing section 5A is stood upright with its uncollared end approximately in line with collared end 6 of the previous, partially downhole section 5. Casing 5A is stood upright by a block arrangement 8 connected to a flexible cord 9 secured to casing 5A. A crewman (not shown) is located on a platform 10 on a drilling rig 11 30 to 40 feet above the ground. When the casing 5A is vertical, he throws a rope around collared end 6A of casing section 5A and attempts to line it up with collar 6 of casing section 5. Hydraulic tongs (not shown) are connected to casing section

5A and it is rotated along its center line to screw into the exposed collar 6 of the previous casing section 5. Casing section 5A is lowered into well bore 4 and held in place by slips 7 which had been loosened to permit lowering of casing 5A and tightened to hold casing section 5A. The procedure is repeated until casing sections the length of the well bore have been put in place.

Since the crewman is over 12 meters from the joint and must be significantly far from the center line he is attempting to coincide, misalignment problems can often occur. Misalignment of 2.5 cm at the position of the crewman can damage threads to the extent that it prevents a positive seal between casings. Misalignment of 10. cm will gall the threads and ruin the seal between casing joints while misalignment of 30 cm will result in crossthreading.

Previously, hydrocarbon production wells were relatively shallow and seal problems were of minimal concern since high pressure is not associated with shallow wells. Presently, casing sections must be able to withstand great pressure and a poor seal may wash out surrounding formations despite cementing the casings in place.

Furthermore, a casing section may weigh as much as 134 kg/m (90 pounds per foot). While the casing may be rated to hold 600 tonnes and the joint strength may be 80% or 480 tonnes, a joint made up having its threads damaged or galled will be significantly less. As a result, a joint may separate sending several thousand meters of casing downhole.

The present invention provides a method and apparatus for positive alignment of casing sections used to preserve the integrity of well bores. A spoke yoke type is fixed to a drilling rig. The spoke is aligned with the center line of the well bore below. A casing section is lifted vertically upright and brought near the yoke and lowered to touch the collar of the previous casing section. The yoke is closed, clamping the casing in position with rotatably mounted bearings positioned along the inner periphery of the yoke. The casing section may then be rotated to connect to the collar of the previous casing section.

Figure 1 is a view of a well site. Figure 2 is a plan view of a casing alignment tool assembly.

Figure 3 is a side view of the assembly of Figure 1.

Figure 4 is an enlarged view of a portion of Figure 1.

Figure 1 illustrates a plan view of a casing alignment tool assembly as having a frame 13 with base member 14 angled support members 16 and centerpice 18. A portion of center member 18 extends past the intersection of angled members 16 and contains a pivot point 20. Attached at pivot point 20 is casing alignment tool 22 having head assembly 24, roller arm assemblies 26 and rollers 28. Illustrated in phantom are pneumatic cylinders 30, air pressure flowlines 32 and 34 and piston connections 36.

In operation, base member 14 of mounting frame 13 may be attached to any structure in close proximity to a pre-drilled well bore, the only requirement being that the centerpoint defined by rollers 28 is capable of being aligned with the center of the well bore.

Referring now to Figure 2, a side view of the apparatus of Figure 1 is illustrated as having a pneumatic cylinder 40 attached to piston arm 42 which connects to curve member 44 of casing alignment tool 22. Pivot point 20 is illustrated as a plurality of adjustment holes A, B, C, D, E, and F. For illustrative purposes casing alignment tool 22 is illustrated as being pivotally mounted through adjustment hole F.

In operation, a device such as a block is lowered to the ground to attach to a casing section. To provide the clearances necessary for the block to be lowered, pneumatic cylinder 40 is activated to draw piston 42 within cylinder 40 thus drawing curved member 44 towards cross member 18. When pneumatic cylinder 40 draws piston member 42 within casing alignment tool 22 is elevated to provide clearances for a block to lift a casing section to an upright position.

Proper alingment may be selected by any method. For example, a plum line may be dropped from a centerpoint defined by rollers 28. However, the preferred embodiment positions casing alignment tool 22 after three or four sections of casing have been lowered to the bore hole. As indicated previously, casing sections may be put in place by the following method.

A casing section is raised to its vertical upright position by the use of a block and lowered into a bore hole to a point with an end of the casing section with a collar mounted thereon extending above the ground surface surrounding the bore hole. Slips may be used to hold the first section of casing in position while a second section is raised to vertical upright position and lowered to the collar of the first section. A crewman is located on a platform at the end of the second casing opposite the end and proximity of the collar of the first casing to align the center line of the second casing with the center line of the first casing. Hydraulic tongs may be attached to the uncollared end of the second casing to rotate the second casing and screw it into the collar of the first casing. The slips may then be opened and the combination of the first and the second casing lowered into the bore hole. The slips may then be closed to hold the collared end of the second casing in a position similar to that of the first casing to allow the addition of the third casing section. After several additional casings have been added, the last casing is left in its extended position from the bore hole. Casing alignment tool 22 may then be lowered and adjusted for proper centering on the well bore.

Although manual alignment of the casing sections does not provide the accurate alignment of the present invention, manual alignment is sufficient at these first few non-critical sections of the casing. In general, the cementation of a well bore will be the best at the bottom. Thus, sealing will not be a problem. Furthermore, the joints for the first few sections will not have to support the weight and will be supported by later joints. Since casing sections may weigh as much as 134 kg/m and each section is approximately 12.2 meters long, the fifth joint will only have to support about 9 tonnes. Casing of that size will be rated in the near proximity of 600 tonnes having a joint strength 80% of its support rating or 480 tonnes. Although misaligned joint greatly reduces the joint strength, the weight that the fifth joint will have to support is less than 2% of its rated joint strength.

Referring now to Figure 3 an enlarged plan view of casing alignment tool 22 is shown in greater detail. Roller arm 26 is

illustrated as having adjustment holes 60, 62, 64, 66 and 68. Thus, casing alignment tool 22 may be used for a variety of sizes of casing. In Figure 3, piston 36 is connected to roller arm 26 at hole 64, which is for a casing 22.86 cm in diameter. By connecting the end of piston 36 to hole 60, a casing 12.7 cm in diameter may be aligned. Similarly, hole 62 is for 17.78 cm diameter casing, hole 66 is for 27.3 cm diameter casing and hole 68 is for 33.97 cm diameter casing.

In operation, casing alignment tool 22 is lifted by pneumatic cylinder 40 to provide clearances for a block to be lowered to pick up a casing section. The preferred embodiment uses a pneumatic cylinder with a 9.525 cm bore and an 45.72 cm working stroke. Such a cylinder is marketed as a Miller Model A-848 (trademark). However, any similar device such as an equivalent pneumatic or hydraulic cylinder or a solenoid may be used to maintain casing alignment 22 in a standby position. Alternatively, casing alignment tool may be configured to withdraw to a standby position instead of being raised to a standby position.

Prior to lowering casing alignment tool 22 to its alignment position, roller arms 26 are opened through pneumatic cylinders 30. Pneumatic cylinders 30 are operated by providing fluid pressure through fluid lines 34 urging pistons 36 to a withdrawn position rotating roller arms 26 to an open position.

When a casing has been elevated to a vertical upright position, casing alignment tool 22 may be lowered by pneumatic cylinder 40 through extension of piston arm 42. When casing alignment tool 22 is in its alignment position a casing section may be pulled against inner rollers 28 mounted on the fixed portion of casing alignment tool. When the casing section is in near proximity of inner rollers 28 pneumatic cylinders 30 may be energized through fluid pressure exerted through fluid line 32. Pressure exerted through fluid line 32 extend piston arms 36 drawing roller arms 26 to a closed position which clamps a casing section in a center of an area defined by rollers 28. When a casing section has been clamped by rollers 28, hydraulic tongs or the like may be attached to the end of the casing section and rotate the

clamped casing section into the collared end of a previous casing section. Rollers 28 are rotatably mounted on the stationary portion of casing alignment tool 22 and the roller arms 26 of casing alignment tool 22. Since rollers 28 are rotatably mounted, a casing section may be rotated freely to screw it in to the collared section of a previous casing section providing a positive accurately aligned seal.

Roller arms 26 illustrates two possible positions for rollers 28. Position 70 may be used for rollers 28 or in casings having smaller outer diameter. Hole 72 may be used for casings of greater diameter.

Hydraulic cylinders 30 may be of any type with sufficient strength to provide a positive clamp on casing sections by rollers 28 when energized. Piston rods 36 are preferably made of stainless steel. Rollers 28 may be of any type, however, those with nylon rollers with floating shafts are preferred.

The present invention provides a method and apparatus for eliminating all the problems inherent in misalignment of casing sections in bore hole casing placement. Through the use of the present invention casing sections may be accurately aligned without a great deal of time and expense. Through the accurate alignment of the casing sections, a great amount of time and money is saved.

In the event of slant drilling, the casing alignment tool of the present invention may be easily adapted to an angled bore hole by repositioning of casing alignment tool 22 or support frame 12.

CLAIMS:

1. A casing alignment system comprising:
a head assembly having an open and a closed position, and
roller assembly rotatably mounted on the head assemoly for holding the casing.

2. The alignment system of claim 1 wherein the head assembly further comprises:
hydraulically operated arms defining open and closed positions.

3. The alignment system of claim 2 wherein the head assembly is mounted on a production well.

4. A casing alignment tool comprising:
a support for holding a casing in line with the center line of a preceding casing.

5. The tool according to claim 4 also including:
roller assembly rotatably mounted on the support for holding and clamping the casing in position with respect to the preceding casing.

6. A method for aligning casings in a well bore comprising the steps of:
positioning a clamping tool in an open position in line with the center line of the well bore;
elevating a casing section above the well bore in near proximity of the clamping tool; and
closing the clamping tool around the casing section.

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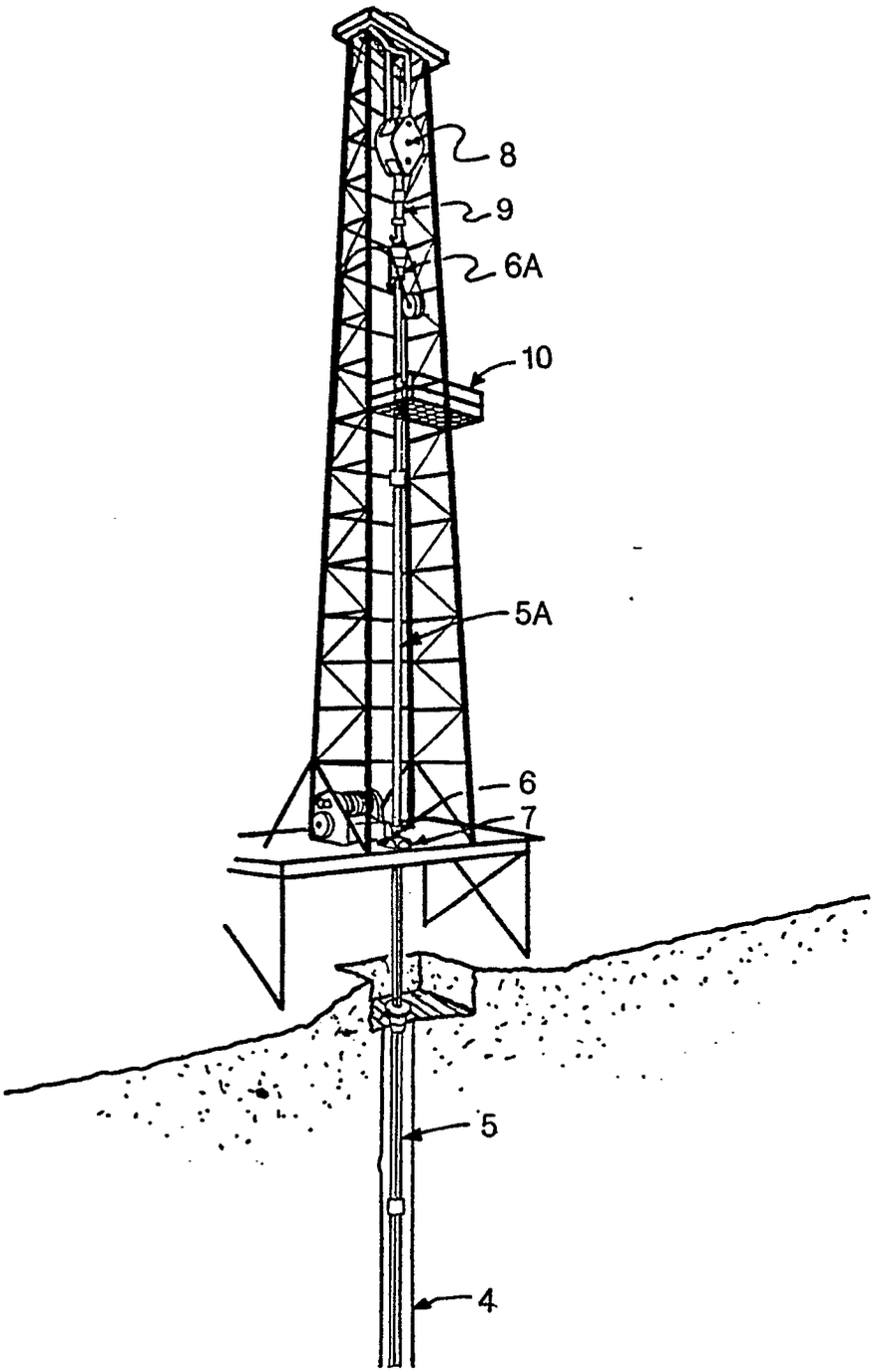

FIG. 1

FIG. 2

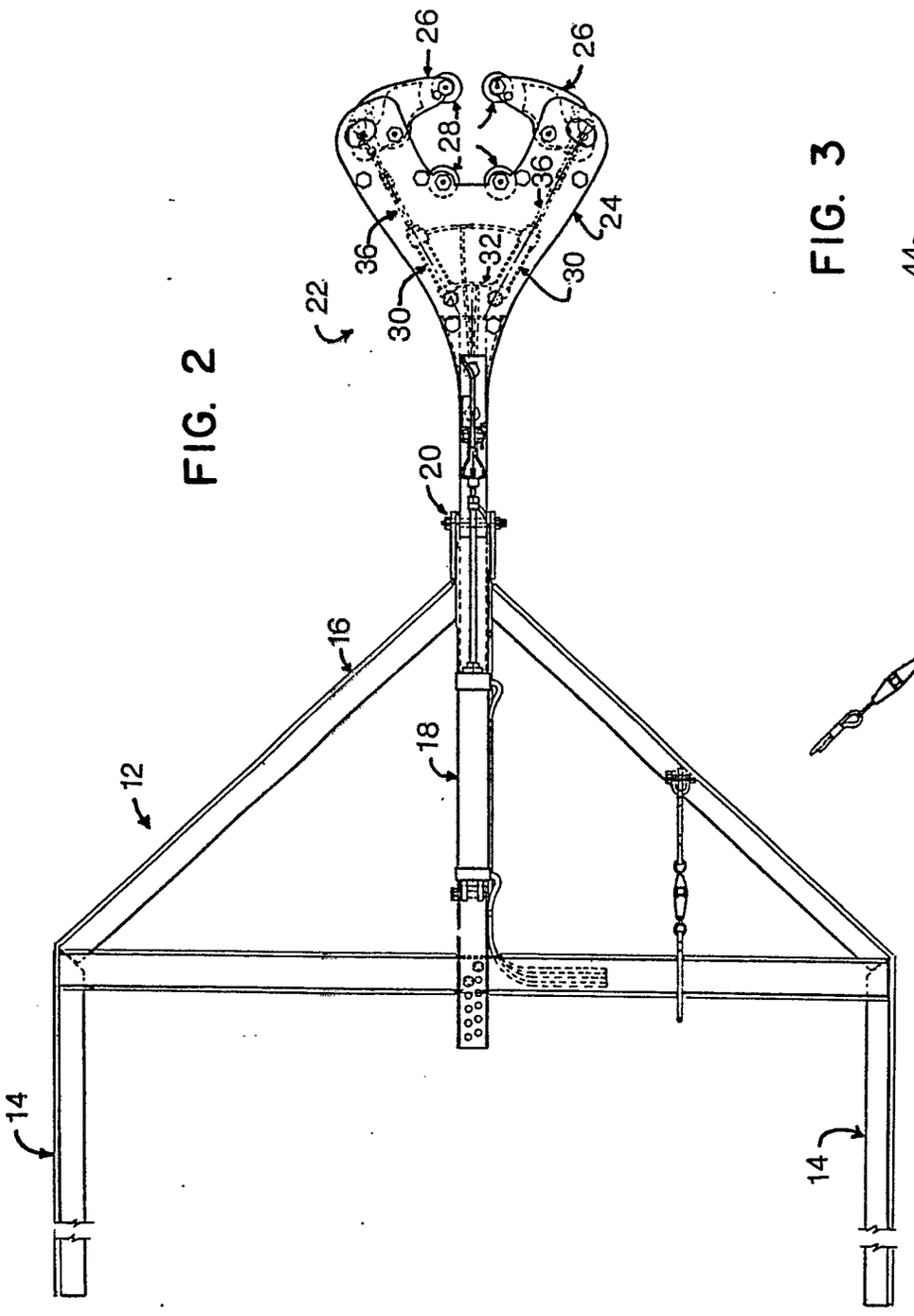
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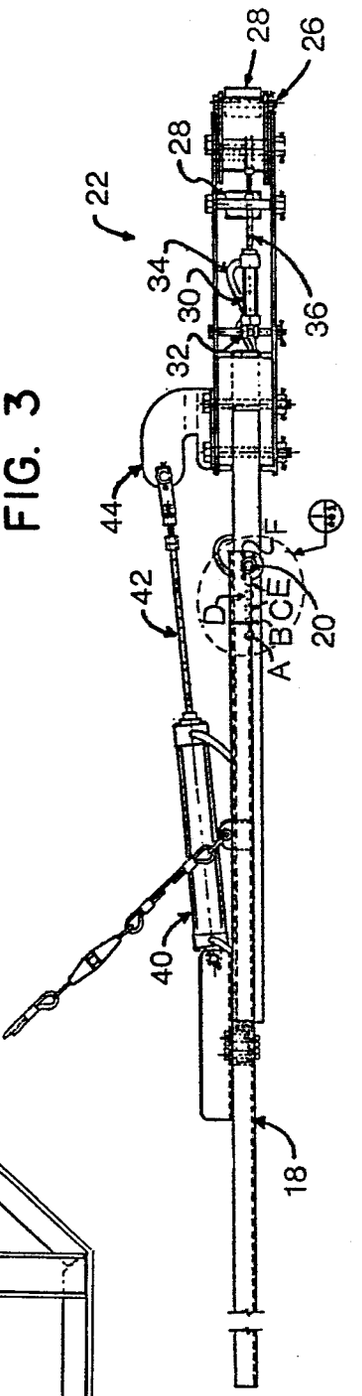
FIG. 3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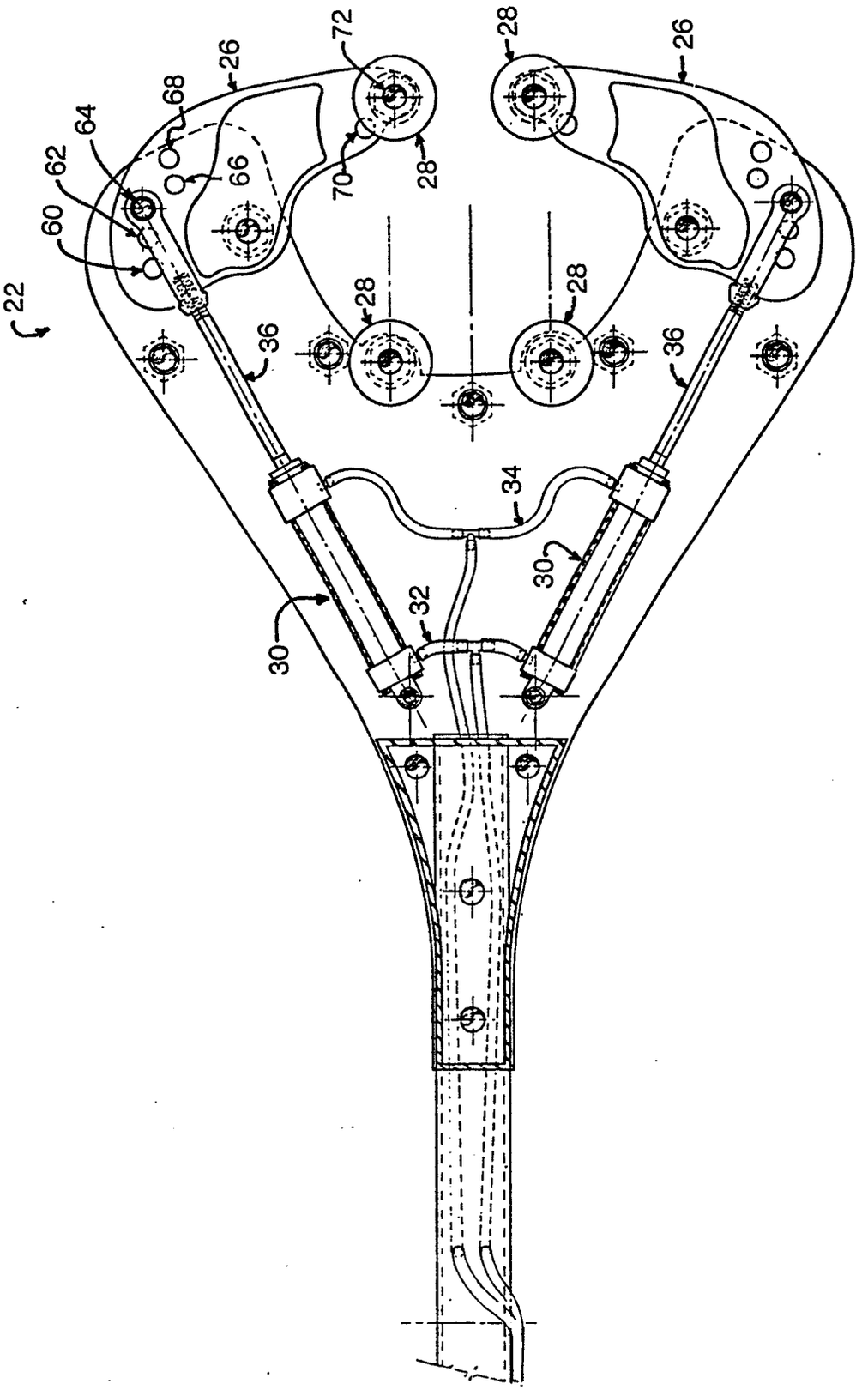

FIG. 4