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(54) Title: APPARATUS FOR HANDLING TUBULAR MEMBERS

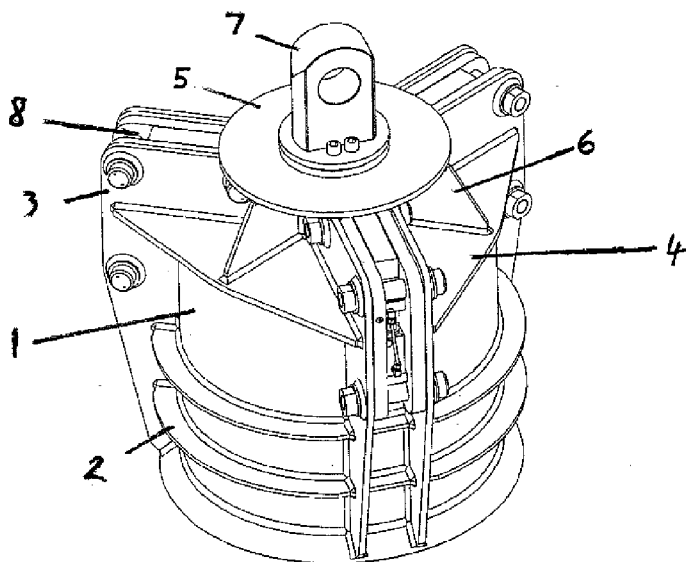


FIG 1

(57) Abstract: Apparatus for handling tubular members is provided with at least two gripping heads 8 arranged to grip a free end of the wall of a tubular member at respective spaced apart locations. The gripping heads each have a pair of rollers 19 and means 1 1, 14, 16, and 17 for urging the rollers towards each other to grip a free end of a wall of the tubular member. The means for urging the rollers together may include springs 16 arranged to urge a support 17 supporting the rollers relative to a profiled slot 1 1. The gripping heads 8 may be mounted on a support, such as a sleeve, arranged to be fitted over an end of a tubular member to be handled.



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APPARATUS FOR HANDLING TUBULAR MEMBERS**Technical Field of the Invention**

The present invention relates to apparatus for handling tubular members, particularly, although not exclusively, piles used in offshore anchoring systems.

5 Background to the Invention

There is a trend towards the use of larger tubular metal piles in offshore anchoring systems, especially for offshore wind turbine installations. As pile size increases the ratio of diameter to wall thickness usually also increases. This leads to greater flexibility of the pile and a consequent need for more careful handling if damage to the pile is to be avoided.

10 It is an object of embodiments of the present invention to provide improved apparatus for handling tubular members.

Summary of the Invention

According to the present invention there is provided apparatus for handling tubular members comprising at least two gripping heads, the gripping head comprising a pair of rollers
15 and means for urging the rollers towards each other in order to grip a free end of a wall of the tubular member, the at least two gripping heads being arranged to grip the wall of the tubular member at respective spaced apart positions.

Use of rollers to grip the wall of a tubular member reduces the risk of damaging the wall as compared to solid gripping elements. Gripping the free end of the wall at multiple spaced apart
20 positions evens out load applied to the tubular member when it is handled by the apparatus.

The axially extending surface of one each pair of rollers may be convex, and the axially extending surface of the other roller of each pair may be concave. Preferably, the degree of curvature of the rollers matches or substantially matches that of the wall of a tubular member to be handled.

25 The rollers of each pair may each be rotatably mounted in a support. At least one roller of each pair may contact a profiled surface arranged so that relative movement between the

support and the profiled surface causes the pair of rollers to be moved towards each other. The support may comprise two opposed recesses and a respective roller may be disposed in each recess. The recesses may be formed in respective jaws of a support. Two recesses may be provided in each jaw, allowing for rollers to be accommodated.

- 5 There may be sufficient clearance between the rollers and the recesses to enable the rollers to move towards and away from each other. Nevertheless, the openings to the recesses should be smaller than the diameter of the rollers so that the rollers are retained within the recesses.

- Each roller may contact a respective profiled surface. The profiled surfaces may be
10 provided by the edges of a slot formed in a plate. The edges of the slot may taper.

The apparatus may be arranged so that in use the support is moved relative to both the wall of a tubular member to be gripped and the profiled surface. In this way, the rollers may be driven across the surface of the wall of the tubular member as the rollers are urged together. Movement of the rollers across the surface may be accommodated by rotation of the rollers.

- 15 The means for urging the rollers of each pair together may comprise a resilient means such as one or more springs, such as gas springs. Where a resilient means is provided then an actuator or actuators are preferably also provided operative to work against the resilient means in order to release the rollers.

- Alternative embodiments are, of course, possible and other means may be used to
20 provide force to urge the pairs of rollers together. For example, an actuator could be used. To urge the rollers towards each other the means for urging may act to urge a support on which the or each roller is mounted relative to a profiled surface against which the or each roller bears.

- The apparatus may comprise at least three gripping heads. The gripping heads may all be mounted on a support, enabling them to simultaneously grip respective spaced apart locations
25 of a free end of the wall of a tubular member to be handled. For handling a tubular member of generally circular cross-section the gripping heads are preferably arranged so as to grip respective evenly spaced apart locations on the wall of the tubular member. The gripping heads

may be all be disposed in substantially the same plane. In one embodiment three gripping heads are provided, and are positioned to grip positions located on the circumference of the wall of a tubular member disposed at an angle of approximately 120° to each other.

5 The support may comprise a sleeve arranged to be placed over an end of a tubular member to be handled.

The tubular member may then be handled by moving the support, for example lifting the support using a crane or hoist.

10 Providing multiple spaced apart gripping heads helps to evenly distribute forces involved in moving, particularly upending, large tubular members such as piles. This reduces the risk of the tubular member being damaged through handling.

Detailed Description of the Invention

In order that the invention may be more clearly understood an embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

- 15 Figure 1 is a perspective view of apparatus according to the invention;
- Figure 2 is a perspective view of the apparatus of figure 1 mounted on a pile;
- Figure 3 is a plan view of the apparatus of figure 1;
- Figure 4 is a side view of the apparatus of figure 1 mounted on a pile having
20 a substantially cylindrical wall;
- Figure 5 is a cross-sectional view taken along the line A-A of figure 4;
- Figure 6 is a perspective view of a gripping head of the apparatus of figure
 1;
- Figure 7 is a plan view of the gripping head of figure 6;
- 25 Figure 8 is a cross-sectional view taken along the line A-A of figure 7; and

Figure 9 is a side view of the gripping head of figure 6.

In the following the terms upper, lower, top bottom and like terms are used to refer to the apparatus in the orientation in which it is illustrated, but should be taken as otherwise limiting. It will be appreciated that the apparatus may be used in a variety of different orientations.

5 The illustrated apparatus is constructed from appropriate steel or other metals or alloys.

Referring to the drawings apparatus for handling tubular members, such as piles, comprises a cylindrical sleeve 1 for receiving the end of a substantially cylindrical tubular member to be handled. The internal diameter of the sleeve 1 is chosen to be approximately 1% larger than the outside diameter of a tubular member to be handled.

10 One end of the sleeve is open, the lower end as shown in the drawings. The opposite end of the sleeve is partially closed.

Towards the open end of the sleeve 1 three spaced apart annular ribs 2 extend around the circumference of the sleeve to provide additional strength.

Evenly spaced around the sleeve are three pairs of substantially parallel plates 3
15 extending in an axial direction, that is to say substantially at right angles to the annular ribs. The plates 3 extend over the axial length of the sleeve, with their width increasing towards the partially closed end of the sleeve, and radially across the partially closed end of the sleeve where they meet. The end of the sleeve 1 between the two plates 3 of each pair is open. The remainder of the end of the sleeve, between respective pairs of plates, is closed by generally triangular plates
20 4. A substantially circular plate 5 is fastened substantially centrally over the top of the pairs of plates 3, and additional strengthening plates 6 extend substantially perpendicularly from the triangular plates 4 to meet the circular plate 5. A lifting eye 7 is fastened to the circular plate 5 by which the apparatus and any tubular member to which it is mounted may be lifted by means of a hoist or crane.

25 A respective gripping head 8 is mounted between each of the three pairs of plates 3. The gripping head is secured to the plates by nuts and bolts 9, although other suitable fasteners could be used.

Each gripping head 8 comprises a pair of spaced apart plates 10. The plates are substantially identical and have a generally square outline shape with radiussed corners. An elongate slot 11 is formed generally mid way along the length of one side of each plate. The sides of the slot are straight and diverge from its open end for just under half the depth of the slot, at which point the sides curve and approach each other. At about half the depth of the slot the shape of the lower part of the slot is repeated with the sides of the slot becoming straight and diverging and then curving towards each other at the end of the slot.

The two plates 10 are each fastened to an elongate substantially cuboidal block 12 positioned at the edge of the plates opposite to the edge in which the slot 11 is formed. The plates 10 are also each fastened to two hydraulic piston and cylinder assemblies 13 one either side of the slot 11, and each having substantially flat sides facing the slot and substantially parallel with each other.

A moveable element 14 is also disposed between the plates. The moveable element comprises a plate of generally rectangular outline shape. It is sized so that its two longer sides fit snugly between the piston and cylinder assemblies 13 and can slide relative to the piston and cylinder assemblies towards and away from the open end of the slot 11 in the plates 8. Movement of the moveable element away from the open end of the slot is restricted by the block 12. Two slots 15 are formed in surface of the moveable element 14 facing the block 12 and a gas spring 16 is disposed in each slot. The gas springs urge the moveable element away from the block, towards the open end of the slot 11 in the plates. An arm 17 extends from each of the longer sides of the moveable element over the piston and cylinder assemblies 13. As the moveable element moves towards the open end of the slot 11 the arms 17 will contact the piston and cylinder assemblies 13 arresting further movement. When fluid is supplied under pressure to the piston and cylinder assemblies 13 these apply force to the arms 17 of the moveable element urging the element towards the block 12 against the action of the gas springs 16.

An elongate slot is formed in the edge of the moveable element opposite to the edge facing the block. The slot generally coincides with the slot formed in the plates and divides the moveable element into two jaws. Two pairs of opposed recesses 18 are formed in the sides of

the slot in the moveable element. Each recess is has the cross-sectional shape of the major part of a circle, with the opening into the recess being narrower than the diameter of the circle. A roller 19 is rotatably mounted in each recess. The two rollers 19 mounted in one jaw of the moveable element have a convex surface, being of greater diameter at their centres than edges. The two
5 rollers 19 mounted in the opposite jaw have a matching concave surface, being of smaller diameter at their centres than edges. The radius of curvature of the rollers along their lengths is chosen to match, or substantially match, that of the wall of a tubular member to be handled by the apparatus.

The surface of each roller extends out of the recess and there is some clearance
10 between the surface of the roller and the recess, but the roller is retained in the recess since the opening of the recess is smaller than the diameter of the roller. The roller extends axially, with a reduced diameter, beyond the thickness of the moveable element to about the outside surface of the plates 10, so that the surface of the roller extensions contact the inside surface of the slots 11 formed in the plates 10.

15 The apparatus is arranged so that at the limits of travel of the movable element 17 the rollers extensions move between the opposite ends of the straight tapering surfaces of the slots in the plates. It will be seen that as the moveable element 14 is moved away from the block 12 under action of the springs 16 the roller extensions will move from a wider to a narrower part of the slots 11 which will move the rollers in opposite jaws of the moveable element to move
20 together. This enables the rollers to grip the wall of a tubular member received into the jaws.

The apparatus is used to handle tubular members, and especially for the up ending of piles. In use hydraulic pressure is provided to the piston and cylinder assemblies of the three gripping heads in order to urge the moveable element of each head against the action of the springs 16 and into contact with the block 12. This moves the roller extensions to the widest part
25 of the slots 11 in the plates 10 and so allows the rollers to float freely in the clearance allowed between the rollers 19 and the recesses 18. The apparatus is then placed over the end of a tubular member 20 so that the free end of the wall of the tubular member is received into the slots 11 of the plates and moveable element of each gripping head. Hydraulic pressure is then

released. The moveable element 14 of each gripping head is then urged away from the block 12, in turn moving the roller extensions from a wider to a narrow region of the slots 11 in the plates 10, moving the rollers together and urging them into contact with opposite sides respectively of the wall of the tubular member. That is to say, one roller of each gripping head is urged into
5 contact with the outside of the wall of the tubular member and the other roller of each pair is urged into contact with the inside of the wall of the tubular member. Owing to movement of the moveable element the rollers will move over the surface of the wall of the tubular member as they are brought together. This movement will be accommodated by the rollers rotating within the recesses avoiding tearing of the wall of the tubular member.

10 When the gripping heads are gripping the tubular member the tubular member can be handled by lifting the apparatus by way of the lifting eye 7 or elsewhere. Gripping the tubular member at multiple points reduces stress on the tubular member during handling, and particularly during upending, as compared to conventional approaches where the tubular member is supported only at a single point. The sleeve of the apparatus may also serve to provide support
15 the tubular member during handling operations.

The above embodiment is described by way of example only. Many variations are possible without departing from the scope of the invention as defined in the appended claims.

CLAIMS

1. Apparatus for handling tubular members comprising at least two gripping heads, each gripping head comprising a pair of rollers and means for urging the rollers towards each other in order to grip a free end of a wall of the tubular member, the at least two gripping
5 heads being arranged to grip the wall of the tubular member at respective spaced apart positions.
2. Apparatus as claimed in claim 1 wherein the axially extending surface of one of each pair of rollers is convex, and axially extending surface of the other roller of each pair of rollers is concave.
- 10 3. Apparatus as claimed in either claim 1 or claim 2 wherein the rollers forming each pair are each rotatably mounted in a support and at least one roller contacts a profiled surface arranged so that relative movement between the support and the profiled surface causes the pair of rollers to be moved towards each other.
4. Apparatus as claimed in claim 3 wherein the support comprises two opposed recesses
15 and a respective roller is disposed in each recess.
5. Apparatus as claimed in claim 4 wherein there is sufficient clearance between the rollers and the recesses to enable the rollers to move towards and away from each other.
6. Apparatus as claimed in either claim 4 or 5 wherein each roller contacts a respective profiled surface, the profiled surfaces being provided by edges of a slot formed in a plate.
- 20 7. Apparatus as claimed in claim 6 wherein the edges of the slot taper.
8. Apparatus as claimed in any of claims 3 to 7 wherein the apparatus is arranged so that in use the support is moved relative to both the wall of a tubular member to be gripped and the profiled surface.
9. Apparatus as claimed in any preceding claim wherein the means for urging the rollers of
25 each pair together comprises a resilient means.

10. Apparatus as claimed in claim 9 when dependent directly or indirectly on claim 3 wherein the resilient means is arranged to urge the support relative to the profiled surface.
11. Apparatus as claimed in either claim 9 or 10 comprising an actuator operative to act against the resilient means, thereby to enable the rollers to be moved apart and release grip on the wall of a tubular member.
12. Apparatus as claimed in any preceding claim having at least three gripping heads.
13. Apparatus as claimed in any preceding claim where the gripping heads are all mounted on a support.
14. Apparatus as claimed in claim 13 wherein the support comprises a sleeve arranged to be placed over an end of a tubular member to be handled.
15. Apparatus as claimed in any preceding claim wherein the gripping heads are arranged so that they can grip a free end of a substantially circular wall of a tubular member at locations which are substantially evenly spaced around the wall.

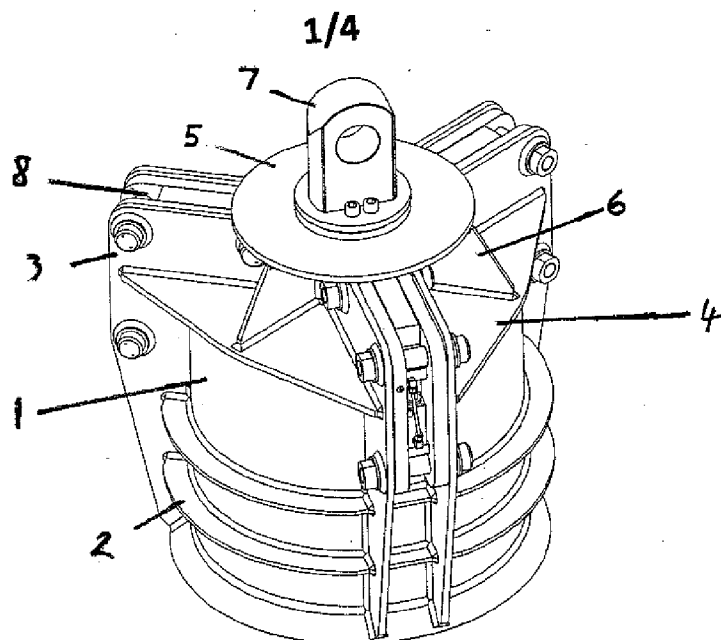


FIG 1

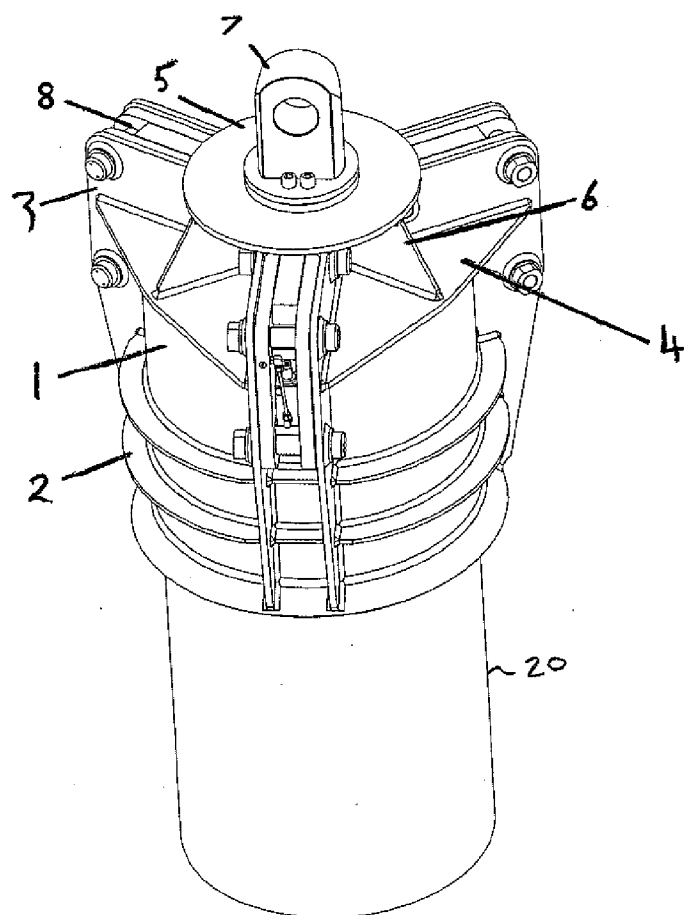


FIG 2

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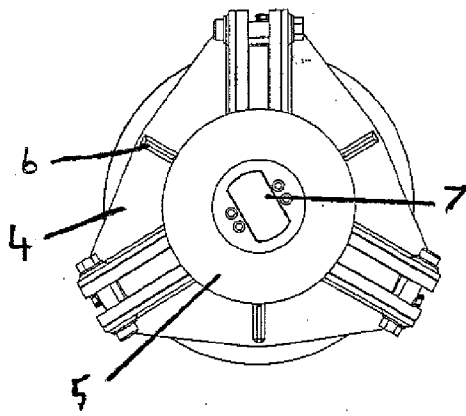


FIG 3

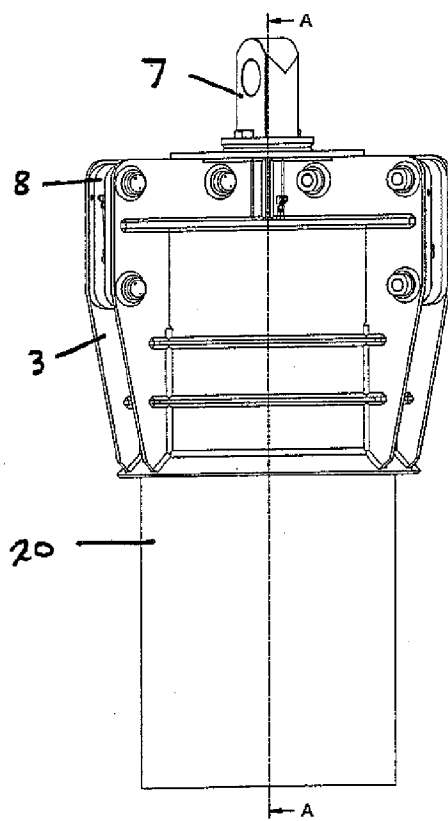


FIG 4

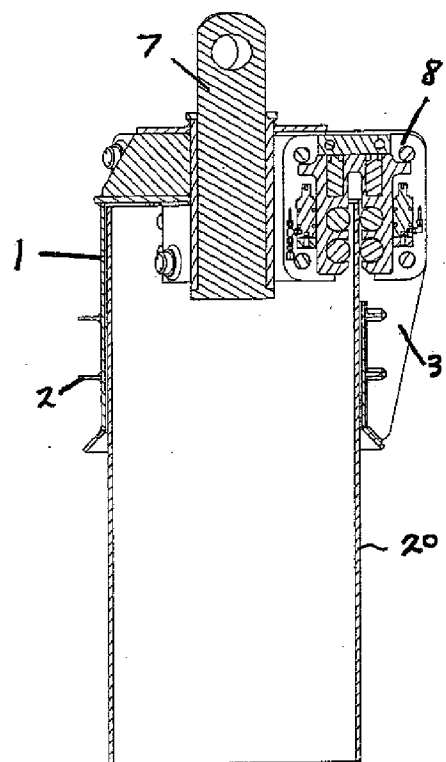


FIG 5

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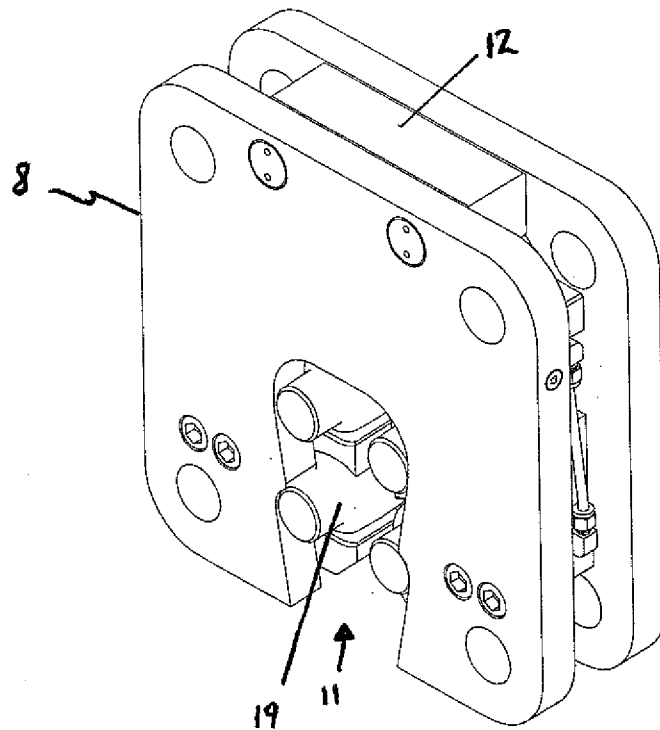


FIG 6

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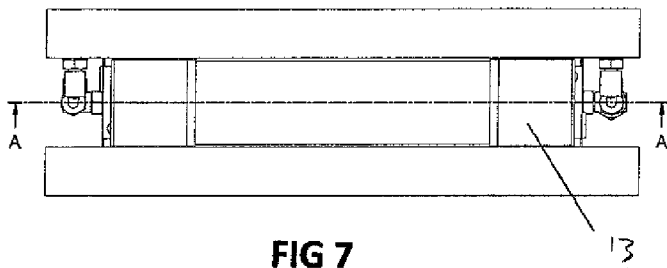


FIG 7

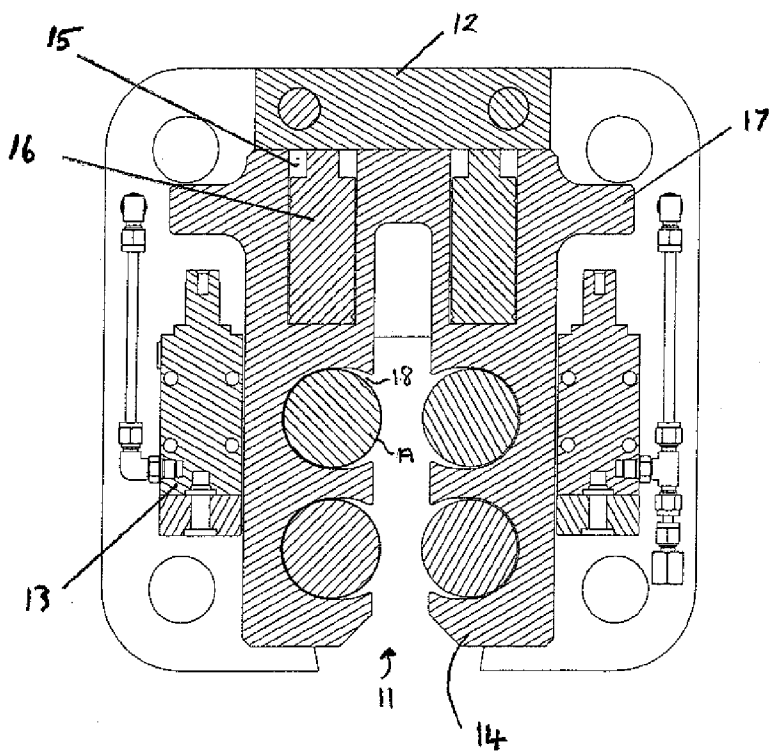


FIG 8

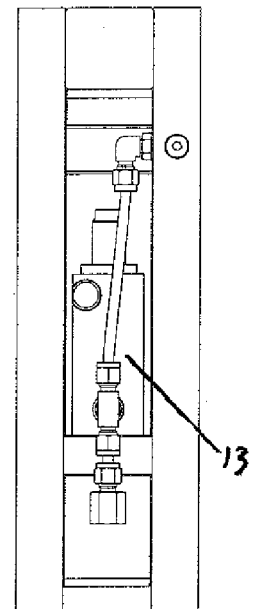


FIG 9