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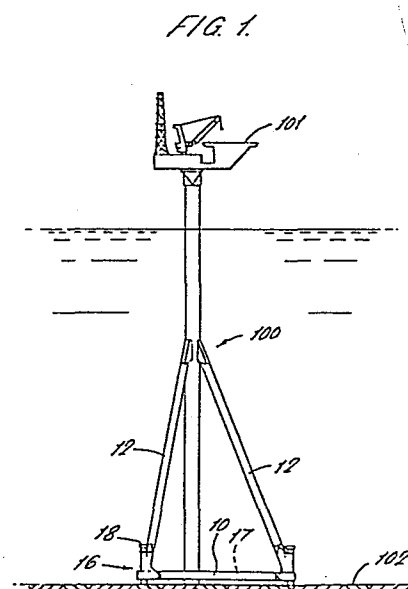
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54 Tower structure.

57 The configuration of a joint at a foot of a tower structure (100), for example, which is for supporting an offshore platform (101), forming the connection between each round tubular supports leg (12) of the structure and an apex (16) of a base frame which comprises round tubular members (10 and 17) and which is anchored to the sea bed (102) by means of piles driven through sleeves (18) incorporated into the joint.



TOWER STRUCTURE

This invention relates to a tower structure and more particularly to the configuration of a joint at a foot
5 of a tower structure.

According to the invention there is provided a tower structure having at least two tubular elements having longitudinal axes which meet at a foot for the structure, each tubular element being connected to at
10 least two flat metal plates, said plates being symmetrically spaced one on each side of the longitudinal axis of their associated tubular element, plate means for providing a gradual transition between the flat plates and their associated
15 tubular element to form a continuous surface between each flat plate and its associated tubular element, the joint between the at least two tubular elements being effected by joining together their associated flat plates, and sleeve means for receiving one or more piles
20 therethrough whereby to anchor the foot, the sleeve means being rigidly attached directly or indirectly to

the said flat plates with the axis of the sleeve means in a plane parallel to or coincident with the plane of the axes of the tubular elements.

By way of example an embodiment of the invention,
5 and a modification thereof, will now be described with reference to the accompanying drawings, in which:

Figure 1 shows an offshore tower structure,

Figure 2 is a detail of the joint at a foot of the structure,

10 Figure 3 is a sectional view of the foot in a vertical plane,

Figure 4 is a sectional view of the foot along the lines CC,

15 Figure 5 is a sectional view of the foot along the lines DD,

Figure 6 is a view of an alternative arrangement of the joint at a foot of the structure, and

Figure 7 is a sectional view of the foot along the lines EE.

20 A joint configuration in accordance with the invention forms a connection in a tower structure between at least two round tubular metal elements having longitudinal axes which meet at a foot for the structure. In an embodiment of the invention, which is shown in
25 Figure 1 of the drawings, the tower structure 100 is

for supporting an offshore platform 101 and is of the kind described in our copending British Application No. 8307639 which is anchored to the sea bed by means of piles. The joint at the foot of this
5 tower structure 100 occurs at the junction of each of three support legs 12 with an apex 16 of a triangulated base frame comprising tubular frame members 10 and bracing struts 17. The joint at each foot of the structure in this embodiment includes
10 a tubular metal sleeve member 18 through which there can be driven a pile for anchoring the structure on the sea bed 102. The configuration of the joint between the support legs 12 and the central column 11 is the subject of our copending British Application
15 No. 8212699.

The configuration of the joint at each foot forms an all-welded connection between the five tubular metal elements 10, 12, 17 and 18. The joint comprises a pair of flat metal plates 20 of

generally triangular shape (see Figures 3, 4 and 5),
having one corner 21 preferably rounded and the other two
corners 22 pointed. The plates 20 lie parallel to
each other and to the longitudinal axes of both frame
5 members 10 and at a distance apart approximately equal to the
diameter of frame members 10. Further metal plates
24 and 25 are arranged to lie at right angles to
plates 20 with the outer plate 24 extending around and
being welded to the outer peripheral edges of plates 20.
10 Plates 24 and 25 also terminate in pointed ends 26 and
these, together with pointed ends 22 of plates 20, are
arranged to form an abutment for the end of each frame
member 10 which has been cut off square to form an
edge 23. Further, curved triangular-shaped metal plates 30
15 are welded in position to complete the attachment of
each frame member 10 with plates 20, 24 and 25, one
edge 31 of each curved triangular-shaped plate 30 having been
shaped to conform to the contour of end edge 23 of each
frame member 10. Four such curved triangular-shaped plates 30
20 are needed for each frame member 10, and the result is
a gradual transition over a continuous surface from
the circular cross-section of frame member 10 to the
rectangular cross-section of the wedge-shaped structure
which is defined by plates 20, 24 and 25. In practice,
25 small stub sections 10a (Figure 4) may initially be

welded in position as shown prior to the frame members 10 themselves, the final connection of the frame members 10 being effected on site along field joints W.

5 The attachment of the bracing struts 17 is by similar means to that described above, with flat metal plates 32 being welded in position between plates 20 and extending from the front edge 36 of plates 20 back to the outer edge and plate 24. In
10 this case, the bracing strut 17 is of lesser diameter than the separation of both plates 20 and plates 32. This means that four additional triangular metal plates 34, as well as the four usual specially-shaped metal plates 33, must be used to effect aligned
15 connection of the bracing strut 17. As before, plates 33 are shaped along one edge to conform to the contour of the squared-off end edge 35 of the bracing strut 17, and the result is a gradual transition over a continuous surface from the circular cross-section
20 of the bracing strut to the rectangular cross-section of the braced wedge-shaped structure that is defined by plates 20, 24, 25 and 32. Again as before, small stub sections 17a (Figure 4) may initially be welded
25 in position prior to the bracing struts 17 themselves, the final connection of the bracing struts 17 being

effected on site along field joints X.

The connection of the support legs 12 is similar in principle to the above described connections, there being a pair of parallel metal plates 40 welded in position on top of upper plate 20. Plates 40 are spaced apart by a distance approximately equal to the diameter of the support leg 12. The plates 40 are aligned with and parallel to plates 32 which, as described earlier, are welded in between plates 20. A flat metal plate 44, terminating at its upper end in a point, is welded in position along the edges of plates 40 with its bottom edge abutting upper plate 20. A gusset plate 47 is welded in between plates 20 to brace the wedge-shaped section at this point, and a gusset plate 51 is welded between plates 40 towards the upper end thereof. A triangular-shaped plate 43 is also welded in position and, together with the pointed ends 41 of plates 40 and 44, forms an abutment for the support leg 12. As before, specially-shaped curved triangular plates 45 are used to complete the connection of the support leg 12. These curved plates 45 have been shaped along one edge 46 to conform to the contour of squared-off end edge 42 of the support leg 12, resulting in a gradual transition over a continuous surface from the circular cross-section of the support leg to the rectangular cross-section

defined by plates 40, 43 and 44. Once again, for convenience, small stub sections 12a are initially welded in position prior to the support legs 12, the final connection of the support legs being effected
5 on site along field joints Y.

For the connection of the sleeve member 18, a metal plate 50 is welded in position across a pair of level edges which are defined in each plate 40. Plate 50 and plates 20 each have a hole therein in order
10 to receive the sleeve member 18. The sleeve member is braced in position by means of plates 52 and 53 which are welded between it and plates 47 and 32 respectively (Figure 5).

The sleeve member 18 is arranged with its axis in
15 the same plane as the plane defined by the axes of the support leg 12 and the bracing strut 17, which is a vertical plane. Furthermore, the axis of the sleeve member 18 passes through the point of intersection between the axes of the support leg 12 and the
20 bracing strut 17. This means that when a pile is driven through the sleeve member 18 into the sea bed, the result is a well-braced stable anchorage for the foot of the structure.

In deeper waters, a single pile may not be able
25 to provide adequate anchorage for the foot of the

structure. Thus, in an alternative embodiment, which is shown in Figures 6 and 7, three sleeve members 80, 81, 82 are provided in the joint at each foot of the structure. The middle sleeve member 81 has its
5 axis in the same plane as the plane defined by the axes of the support by 12 and the bracing strut 17, which again is a vertical plane, and the axes of the outer two sleeve members 80 and 82 lie parallel to this plane, and preferably also vertically. Again, the axis of the
10 middle sleeve member 81 passes through the point of intersection between the axes of the support leg 12 and the bracing strut 17. Of course, in this alternative embodiment, the shape of some of the support plates in the joint will be different from those of the first
15 embodiment. In particular, the pair of flat plates 83 are larger than their counterparts, plates 20, and top plate 84 which retains the sleeve members 80, 81 and 82 at their upper ends is also larger than its counterpart, plate 50. The result, once again, when a pile is driven
20 through each of the sleeve members into the sea bed is a well-braced, stable anchorage for the foot of the structure.

Of course, it will be understood that the joint configuration would be equally as suitable for anchoring
25 the foot of a land-based construction as for the offshore

tower structure described above. The number of sleeve members in the joint could also be varied, of course, depending upon the number of piles considered necessary for firmly anchoring each foot, although it is not
5 essential that each pile must have its own individual sleeve member.

CLAIMS

1. A tower structure having at least two tubular
elements (12, 17) having longitudinal axes which meet at a foot
5 for the structure, each tubular element being connected
to at least two flat metal plates (20, 40), said plates
symmetrically spaced one on each side of the longitudinal
axis of their associated tubular element,
plate means (46, 33) for providing a gradual transition
10 between the flat plates and their associated tubular
element to form a continuous surface between each flat
plate and its associated tubular element, the joint
between the at least two tubular elements being effected
by joining together their associated flat plates, and
15 sleeve means (18) for receiving one or more piles therethrough
whereby to anchor the foot, the sleeve means being
rigidly attached directly or indirectly to the said
flat plates with the axis of the sleeve means in a plane
parallel to or coincident with the plane of the axes of
20 the tubular elements.

2. A tower structure as claimed in claim 1 wherein
the axis of the sleeve means is arranged to pass through
the point of intersection of the axes of the two tubular
elements.

25 3. A tower structure as claimed in claim 1 or claim
2 wherein the axis of the sleeve means is arranged

vertically.

4. A tower structure as claimed in any preceding claim wherein the sleeve means comprises a tubular sleeve for the or each pile.

5. A tower structure as claimed in any preceding claim wherein one of the tubular elements is a horizontal bracing strut and the other tubular element is an inclined support leg.

6. A tower structure as claimed in claim 5 comprising two further tubular elements arranged one on either side of the bracing strut and forming part of a base frame.

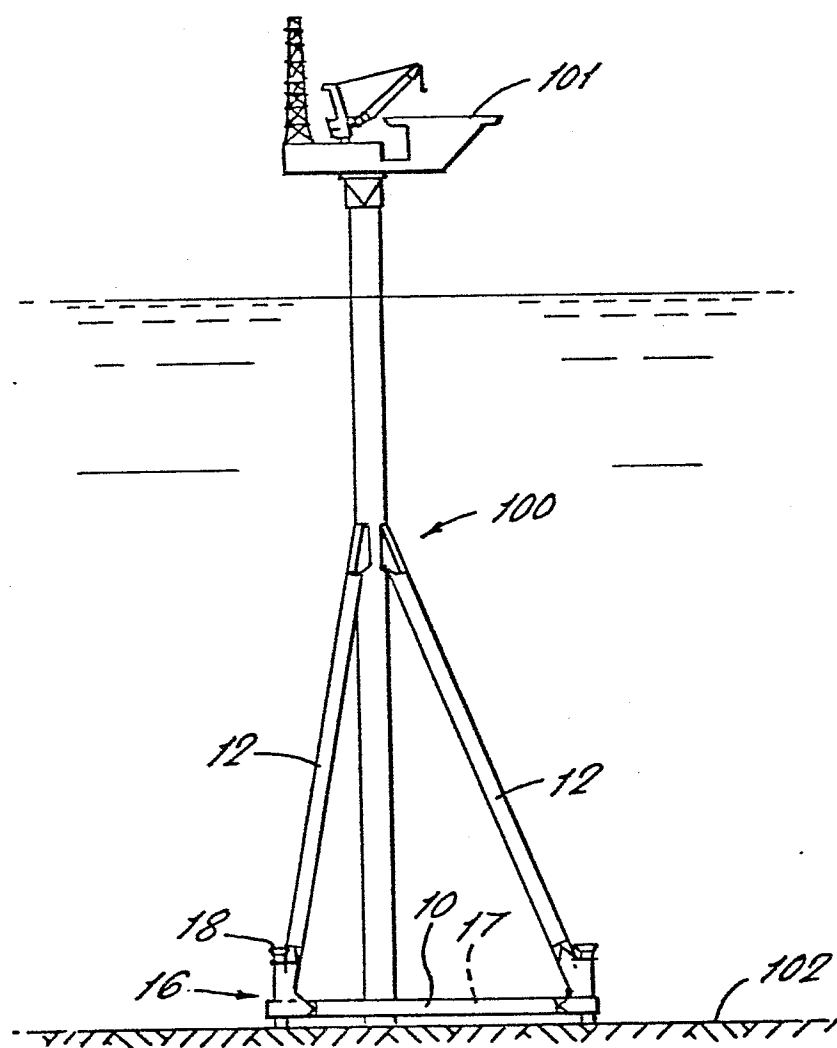
7. A tower structure as claimed in claim 7 wherein the base frame is horizontal.

8. A construction for supporting an offshore platform incorporating a tower structure as claimed in any preceding claim.

9. A construction as claimed in claim 8 having a central column and three support legs with a foot at the bottom of each leg.

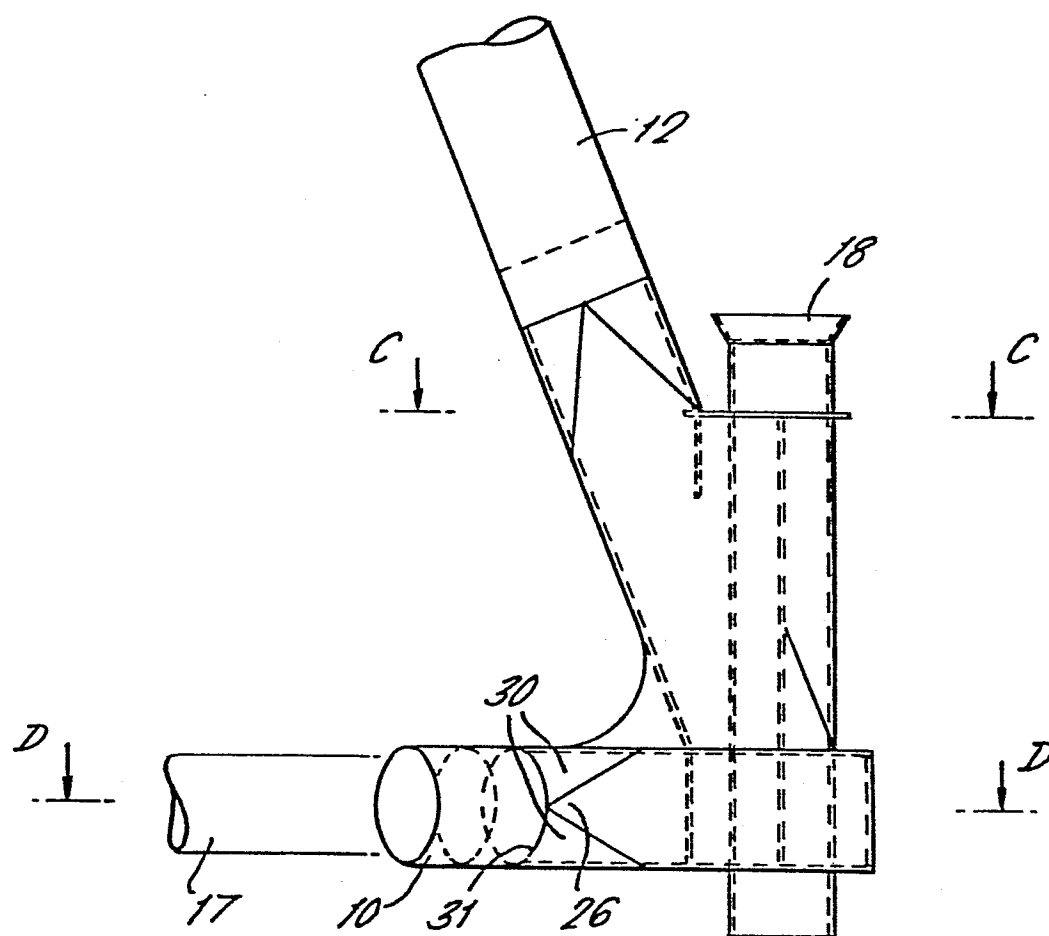
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FIG. 1.



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FIG. 2.



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FIG. 3.

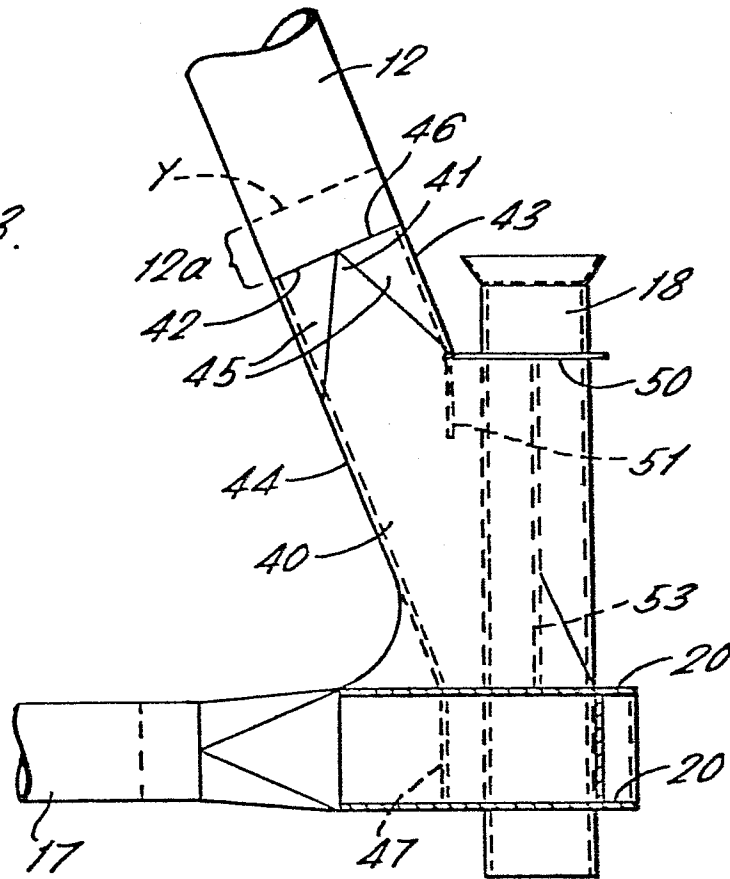


FIG. 4.

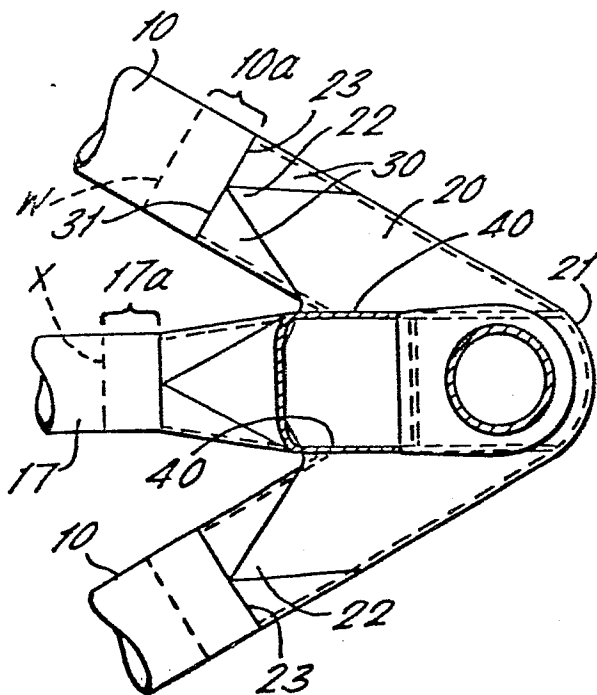
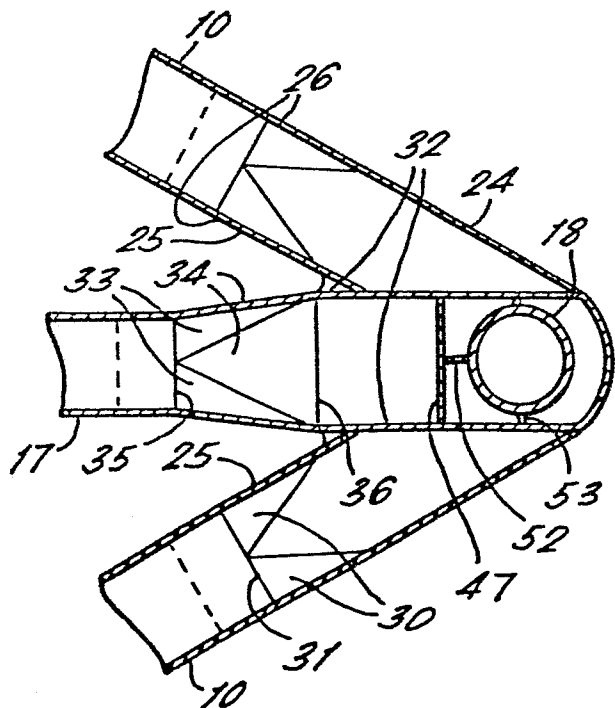


FIG. 5.



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FIG. 6.

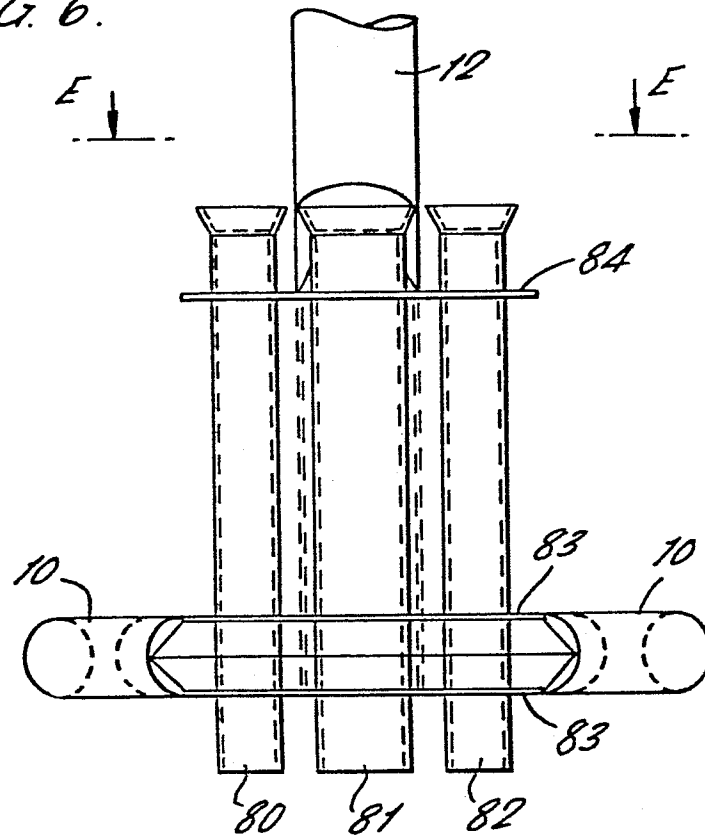
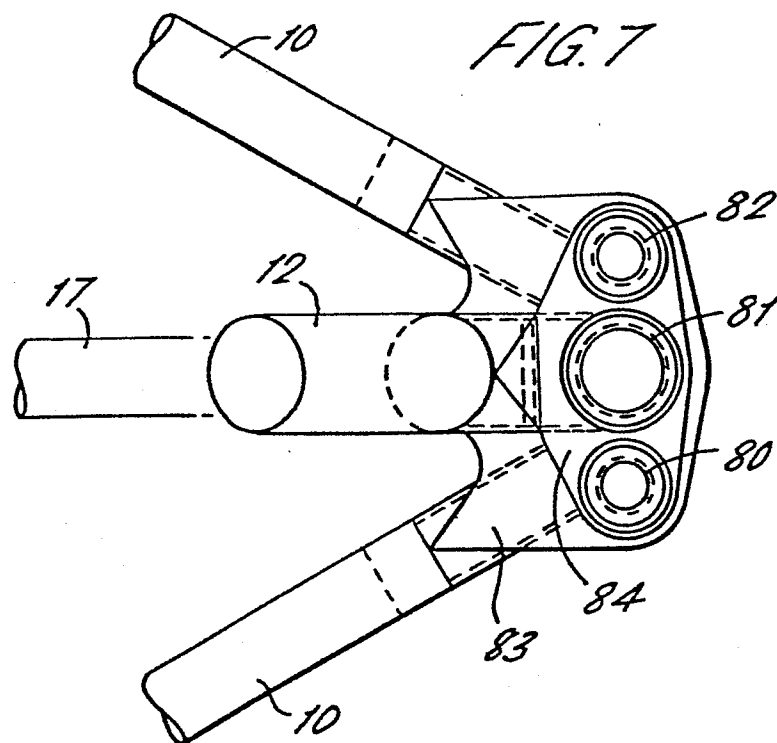


FIG. 7





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	DE-A-2 325 020 (TEXACO) * Pages 11-14; figures 1,5 *	1-4	E 02 B 17/02 E 04 B 1/58
A	--- NL-A-7 111 008 (MARCON) * Whole document *	1	
A	--- US-A-3 585 801 (KOEHLER) * Column 8,9; figures 1,2 *	1	
A,D	--- EP-A-0 059 651 (HEEREMA) * Pages 4-8; figures 1-3 *	1,6-9	
A,D	--- EP-A-0 094 156 (HEEREMA)		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			E 02 B E 04 B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29-06-1984	Examiner HANNAART J.P.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			