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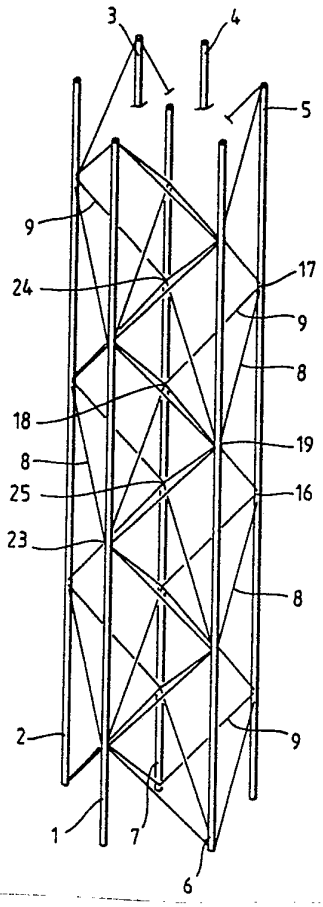
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(54) Title: OFFSHORE TRUSS WORK TYPE TOWER STRUCTURE

(57) Abstract

Method of constructing an offshore truss work type tower structure, and a tower structure comprising outer legs and leg connecting trusses, where all legs being parallel, trusses between outer legs and trusses arranged inwardly from outer legs, being diagonally arranged, one or more internal leg or legs being arranged in equidistance from adjacent legs, all trusses from and between outer legs being arranged diagonally and secured to the legs by welding to forged nodal points whereby each nodal point on an outer leg being arranged at a level intermediate two nodal point level on adjacent legs.



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Offshore truss work type tower structure

This invention is related to an offshore truss work type tower structure comprising outer legs and leg connecting trusses, and a method for construction of such structure.

Tower structures of the truss work type which typically are used as offshore platforms are traditionally constructed with inclined legs, having decreasing cross section area against the top of the tower. This type of design provides a good stability in operational position, however, due to the conical shape, inhibits certain problems by constructing as well as launching. Furthermore the conical shape has some limitations by towers with increasing depts. Due to gas and oil exploration at increasing depth, other platform designs have to be taken into consideration and by the fixed platform type, the conically shaped tower is unsuitable.

By the tower structure according to the invention several problems related to connecting tower sections and launching, are avoided as the tower cross section substantially is the same along the tower hight the tower being prismatic. The advantages of the tower structure according to the invention regularly will be understood by the features stated in the characterizing clauses of the claims.

By design a tower structure having a prismatic shape, trusses or brazings could have been arranged in the outer panels, thereby providing a hollow type tower. This, however, would result in a large number of crossing trusses in the panels, which would mean a large number of nodal points.

By provition of internal legs or a center leg, the necessity of having crossing trusses in the outer panels is avoided.

Furthermore the prismatic shape of the tower brings the advantage of a large number of uniform nodal points and a minimum amount of nodal point types.

By the designing of the simplest form of the tower struction according to the invention, a prismatic tower structure having a hexagonal cross section with one center leg, is provided. By the single hexagon tower structure, a nodal point in an outer leg will have six truss connections,

two trusses to each of adjacent legs and two trusses to the center leg, all trusses thereby being arranged diagonally. At each nodal point level on the center leg, there also will be six truss connections. Such a hexagonal tower structure therefore will have 2 nodel point types.

In a tower structure having 2 partly overlapping hexagons, in this connection defined as doble hexagon, six of the outer legs also will have six truss connections at every nodal point level, whereas the two outer midlegs will have eight truss connections. In the doble hexagon type tower structure there are provided two internal legs being connected with horizontal trusses. The internal legs will have two different nodal point, one having seven truss connections and one having five truss connections, where one truss is arranged horizontally and the rest are arranged diagonally. The doble hexagon type therefore principally will have four different nodal point types.

The doble hexagon tower structure type provides a remarkably increased strength on the width the addition of three outer legs, both in a direction perpendicular to the connection between the internal legs and substantially in this direction.

By the addition of further two outer legs, a triple hexagon tower structure can be achieved which increases the tower strength remarkably in all directions. In the triple hexagon tower structure type the amount of truss connections in the nodal points within the same four outer legs and the outer midlegs whereas all nodal points of the internal points will have five truss connections as all truss connections between the three internal legs will be arranged horizontally. Therefore there will be only three nodal point types in the triple hexagon tower.

By this a few nodal points types, however a large number of each type, the principal of forged nodal points advantagely can be used. Principally the truss length in the outer panels is the same, as well as in the radial and center panels and each weld is made substantially as

a butt weld which advantagely simplifies the welding as well as the examination of welds.

On the drawing Fig. 1 discloses schematically a perspective part of a single hexagonal tower structure according to the invention, Fig. 2 discloses a doble hexagonal tower structure, Fig. 3 discloses a triple hexagonal tower structure, Fig. 4, 5 and 6 disclose construction steps for a single, doble and triple hexagonal tower structure respectively. Fig. 1, 2 and 3 for clarity only disclose the truss work part in front of the center leg.

The principal of the offshore truss work type tower structure according to the invention in its simplest embodiment, is disclosed in Fig. 1 by a single hexagonal tower structure.

The tower structure of Fig. 1 comprises outer legs 1-6 and a center leg 7. A nodal point 19 on leg 6 and a nodal point 22 on leg 2 as well as a corresponding nodal point on leg 4 are arranged at the same level. From the nodal point 19 trusses 8 extend upwards to nodal point 17 on leg 5 and nodal point 21 on leg 1 and downwards to nodal point 16 on leg 5 and 23 on leg 1. Nodal points 16 and 23 as well a third nodal point on leg 3 are arranged at the same level and between two levels for nodal points on leg 6.

In addition to trusses 8 two legs 5 and 6 for establishing the outer panels, trusses 9 extend from nodal point 19 upwards to a nodal point 24 and downwards to a nodal point 25 on the center leg 7. Nodal point 24 on the center leg 7 is arranged at the same level as the nodal points 17 and 21 on legs 5 and 1 respectively.

In a same manner the doble hexagonal tower structure on Fig. 2 and the triple hexagonal tower structure on Fig. 3 is constructed. However, horizontal trusses 10 are arranged between the internal legs 26 and 27 at each nodal point in the doble hexagonal tower structure as disclosed in Fig. 2 and between each nodal point on the internal legs 28, 29 and 30 in the triple hexagonal tower

structure disclosed on Fig. 3.

Fig. 4 discloses one method for constructing a single hexagonal tower structure where a radial panel between leg 2 and the center leg 7 first is constructed at the ground level and thereafter turned around center leg 7 to a position where legs 7 and 2 are connected with leg 1 thereby providing a triangle shaped structure. Simultaneously an outer panel is constructed consisting of legs 3 and 4 with connecting trusses, which panel thereafter is turned around leg 4 in such a way that trusses may be connected between outer legs 3 and 2 and between the outer legs 3, 4 and the center leg 7.

Thereafter the substructure consisting of legs 1-4 and 7 is lifted in position and an outer panel consisting of legs 5 and 6 with connecting trusses is constructed at ground level and thereafter turned around leg 6. In this position trusses can be connected between legs 4 and 5 and between 1 and 6 as well as between the center leg and trusses 5 and 6.

A doble hexagonal tower structure may be constructed according to Fig. 5 by welding together outer legs 1 and 4 as well as internal leg 26 on the ground level and simultaneously a panel comprising outer legs 6 and 11 and internal leg 27. Thereafter the panels are turned around leg 1 respectively 6, outer panel comprising legs 2 and 3, respectively 12 and 13 are constructed on the ground level and turned around legs 2 respectively 13 whereafter trusses between outer legs 3 and 4, 2 and 1 as well as 11 and 12 and 6 and 13 may be inserted as well as the internal trusses between center leg 26 and outer legs 2 and 3, respectively center leg 27 and outer legs 12 and 13. Thereafter the substructure consisting of outer legs 1-4 and internal leg 26 is turned around leg 1 and trusses may be secured between legs 4 and 11, 1 and 6, 4 and 27 and 26 and 6, as well as the horizontal trusses 10 between the internal legs 26 and 27.

By constructing a triple hexagonal tower structure

the structure disclosed in Fig. 5 can be turned around leg 1 to the position disclosed in Fig. 6, an outer panel consisting of legs 14 and 15 is constructed at the ground level and thereafter turned around leg 15 whereafter trusses may be secured between legs 13 and 14 and 6 and 15. In a case of a triple hexagonal tower structure the internal legs 28, 28 and 30 are connected with horizontal trusses 10 when the structure is turned to the position disclosed in Fig. 6.

Patent claims

1. Offshore truss work type tower structure comprising outer legs and leg connecting trusses, CHARACTERIZED IN all legs being parallel, trusses between outer legs and trusses arranged inwardly from outer legs, being diagonally arranged, one or more internal leg or legs being arranged in equidistance from adjacent legs, all trusses from and between outer legs being arranged diagonally and secured to the legs by welding to forged nodal points whereby each nodal point on an outer leg being arranged at a level intermediate two nodal point levels on adjacent legs.

2. Tower structure according to claim 1, CHARACTERIZED IN the tower structure having a hexagonal cross section with one center leg.

3. Tower structure according to claim 1, CHARACTERIZED IN the tower structure having a cross section comprising two partly overlapping hexagons, the internal leg of one hexagon thereby being an outer leg of the other hexagon and vice versa, and the trusses between the two internal legs being arranged perpendicularly to the legs.

4. Tower structure according to claim 1, CHARACTERIZED IN the tower structure having a cross section comprising three hexagons, the internal leg of one hexagon being an outer leg of the two other hexagons and vice versa and the trusses between the three internal legs being arranged perpendicularly to the legs.

5. Method of constructing an offshore truss work type tower structure according to claims 1-4, CHARACTERIZED IN constructing the panels of the tower structure on site in such a way that no displacement of panels must be performed, only turning of panels substantially around one leg resting on the ground level, thereby enableing welding of trusses to the legs at lowest possible levels.

6. Method according to claim 5, CHARACTERIZED IN constructing at ground level a first panel comprising a second outer leg and a center leg as well as connecting

trusses, turning the first panel round the center leg and connecting the second leg with a first leg and the first leg with the center leg, thereby simultaneously constructing a second panel comprising third and fourth leg, turning the second panel around the fourth leg and connecting second and third legs as well as third and fourth leg to the center leg, turning the substructure consisting of first, second, third, fourth and center leg around first leg and connecting the substructure with a third panel consisting of fifth and sixth legs, thereby completing a tower structure section having hexagonal cross section.

7. Method according to claim 5, CHARACTERIZED IN constructing two doble panels at ground level, consisting of first and fourth outer legs and one internal leg, respectively sixth and eleventh outer legs and one internal leg, turning the doble panels around first leg respectively sixth leg, constructing outer panels comprising second and third, respectively twelfth and thirteenth legs which are turned around second leg respectively thirteenth leg, each of which panels are connected with its respective doble panel, whereafter one of the substructures is turned around the first leg and the two substructures being connected to each other by trusses, whereby the trusses between the internal legs being arranged perpendicularly to the legs, a doble hexagon tower structure hereby being completed having two hexagons partly overlapping.

8. Method according to claim 7, CHARACTERIZED IN the doble hexagon tower structure being turned around the first leg to an upright position and a furhter panel consisting of fourteenth and fifteenth leg being connected to the doble hexagon tower structure, whereby the trusses connecting the internal legs all being arranged perpendicularly to the legs.

Fig. 1.

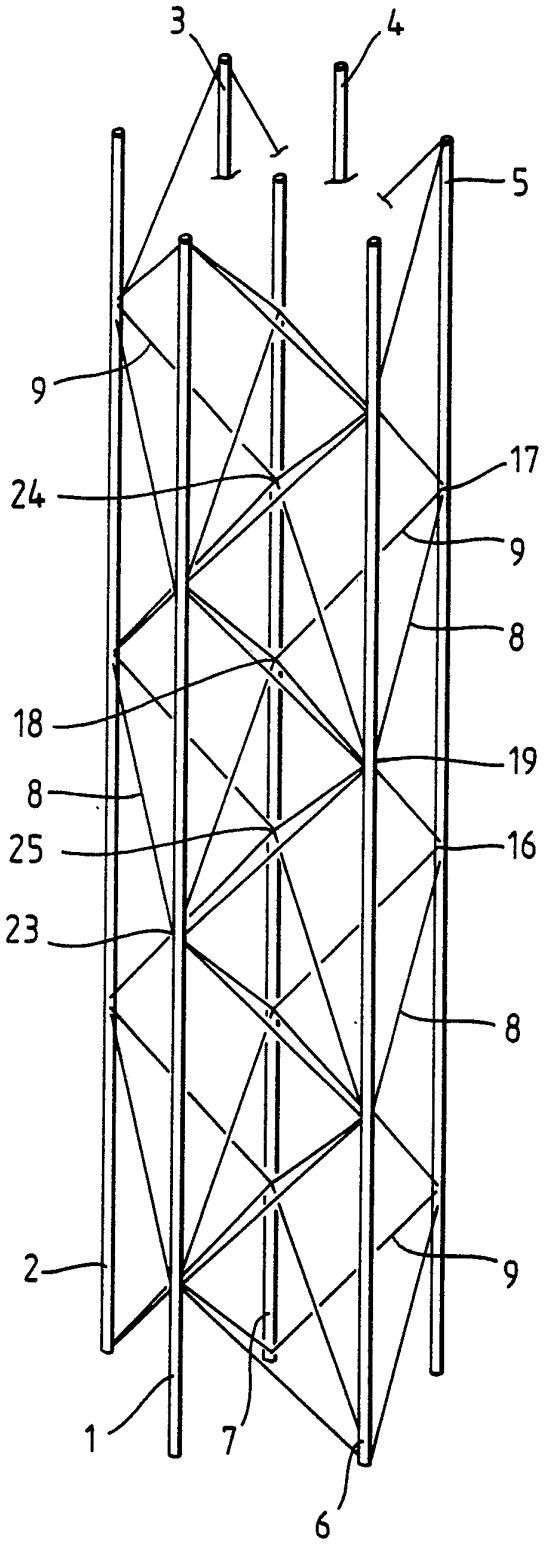


Fig.2.

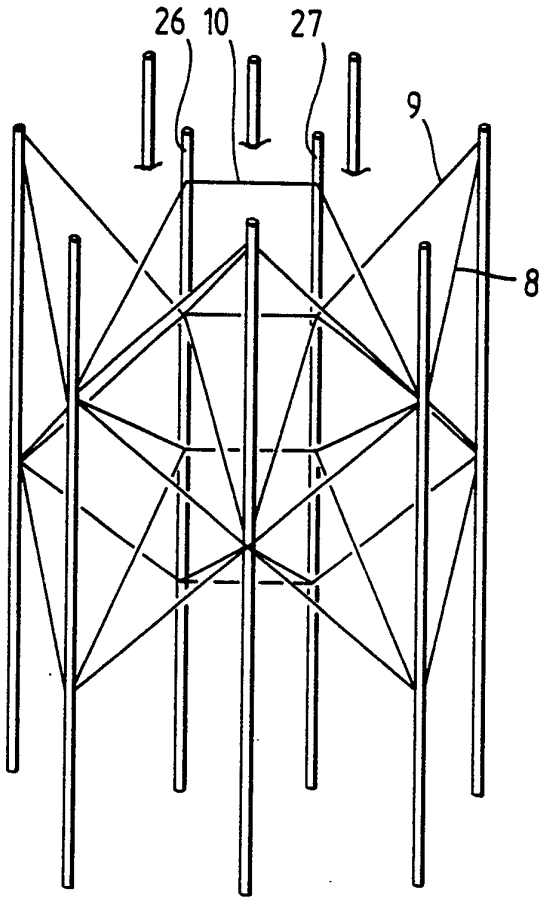


Fig.3.

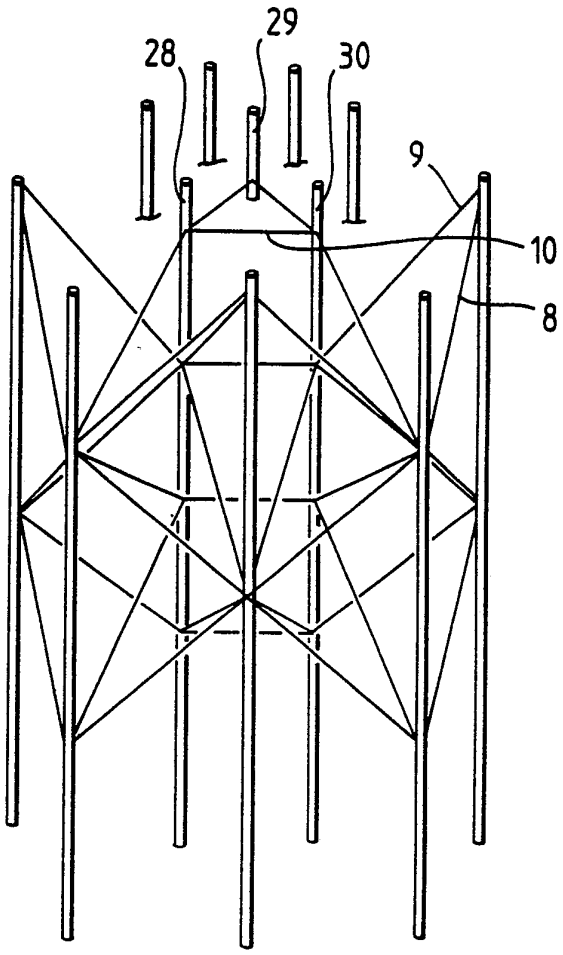


Fig.6.

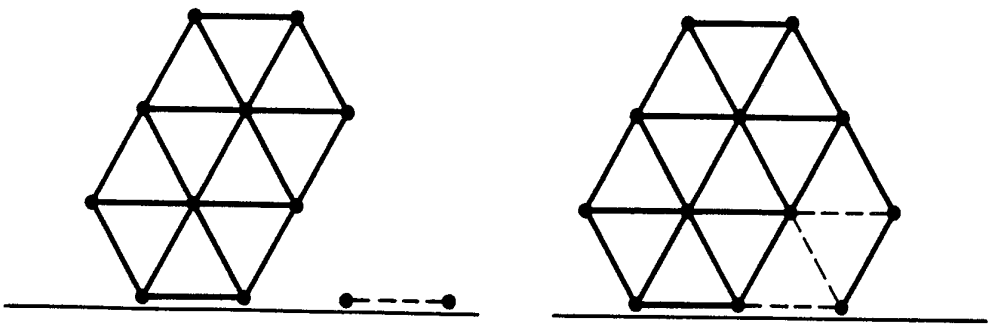


Fig.4.

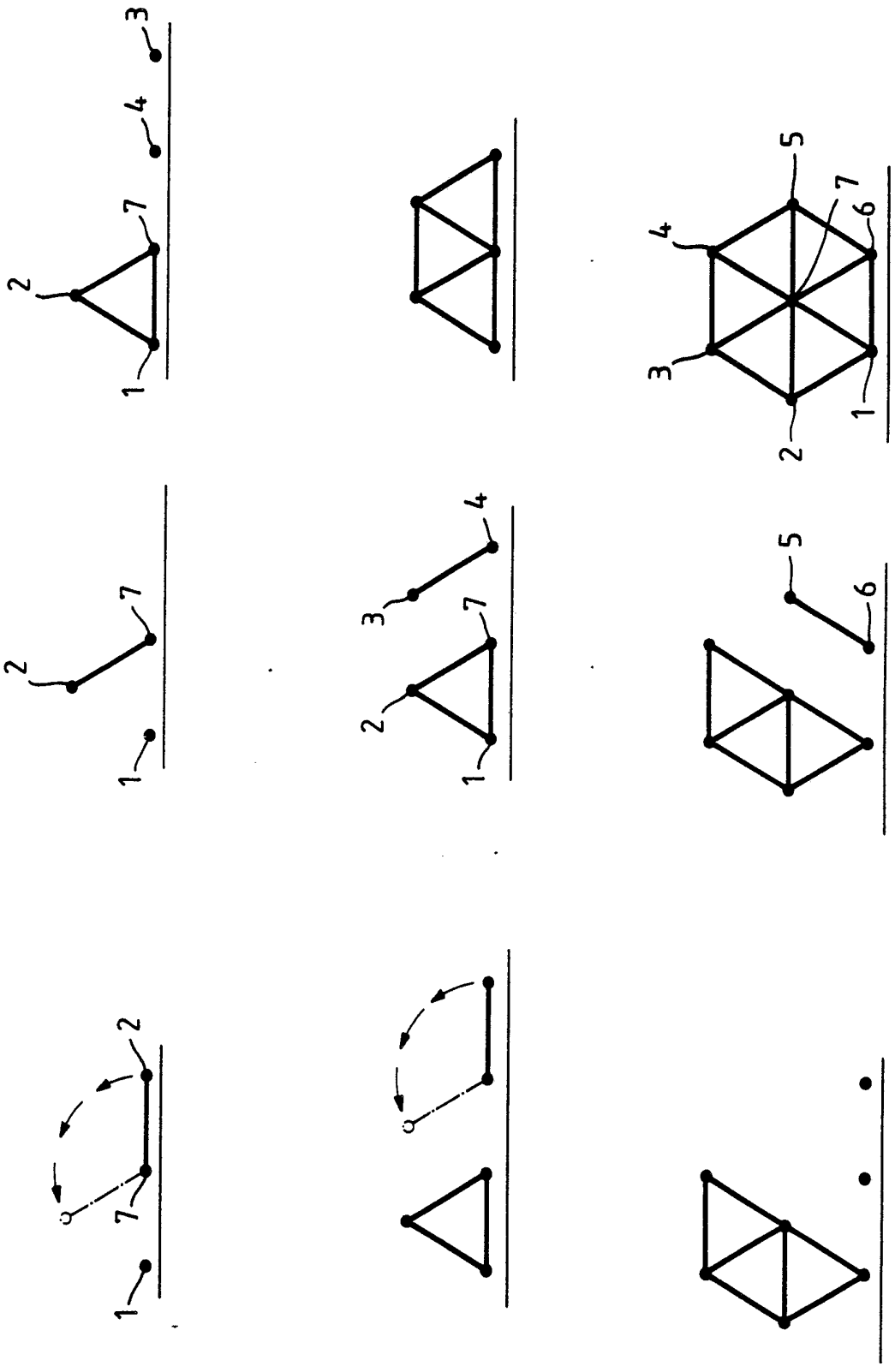
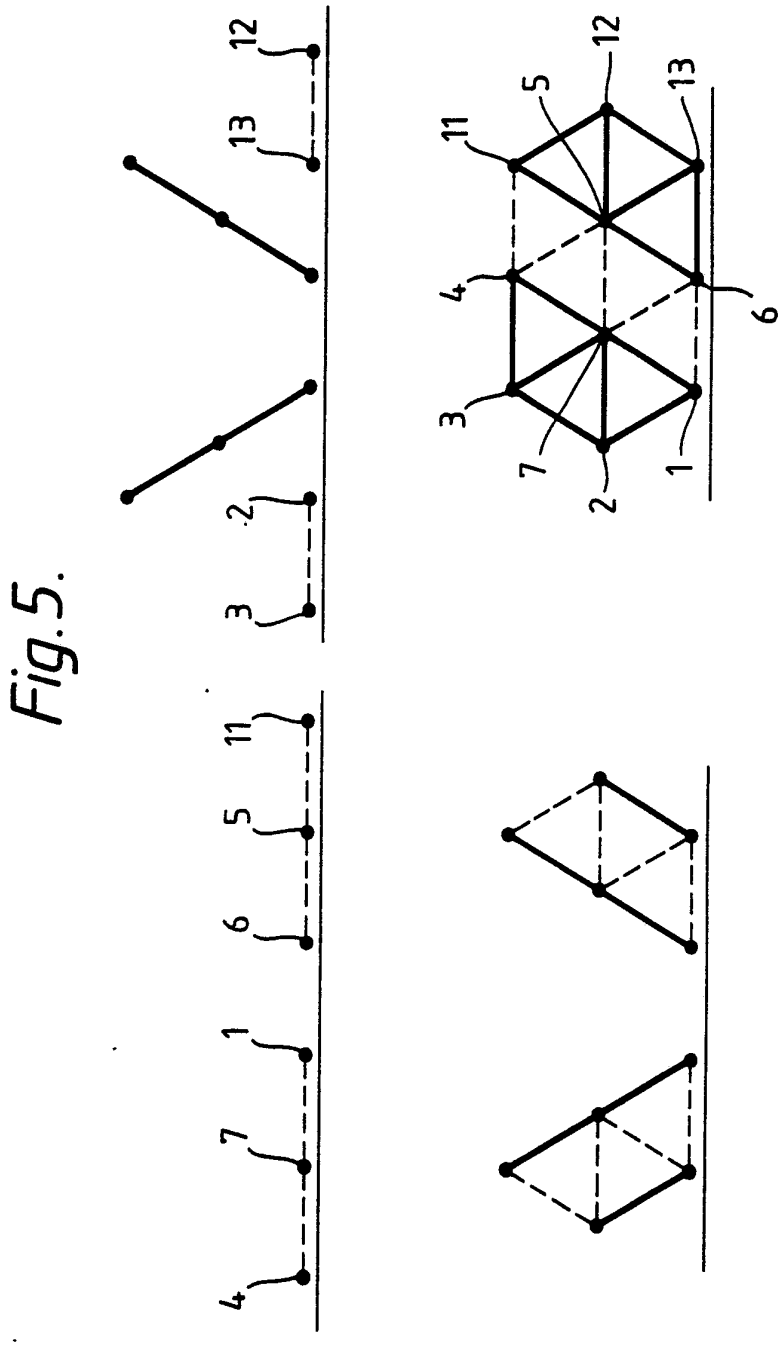


Fig.5.



INTERNATIONAL SEARCH REPORT

International Application No PCT/NO85/00057

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC [4]

E 02 B 17/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	E 02 B 17/00-/04; E 04 H 12/08
US Cl	61: 86-102; 405: 196-202

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	NO, B, 125 150 (RICHMOND TOWER BUILDING) 24 July 1972	
A	NO, B, 150 647 (RAYMOND INTERNATIONAL BUILDERS INC) 13 August 1984	
A	DE, B2, 2 235 258 (TECNOMARE S.p.A.) 28 October 1976	
A	GB, A, 2 123 883 (COMPAGNIE FRANCAISE DES PETROLES) 8 February 1984	
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