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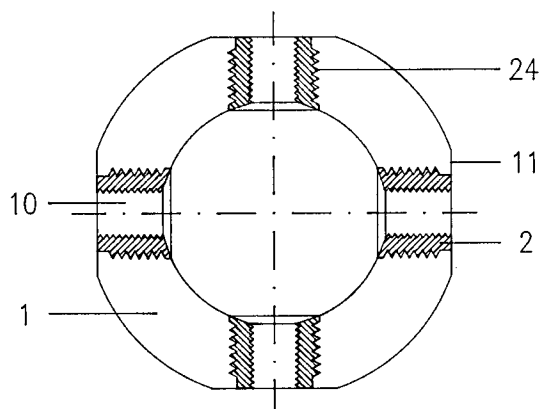
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54 **Aluminium alloy-steel composite node for three-dimensional structures.**

57 An aluminum alloy (1) node which has special steel parts (2). These parts have threaded radial holes (10), where pipes can be connected with the aid of special mechanisms.

The node is useful for the construction of buildings with extra aesthetic requirements.



SECTION A-A

FIGURE 3

This invention relates to an aluminum alloy node for use in three-dimensional structures for buildings with extra aesthetic requirements.

Nodes of this type are hollow spheres with partial flat surfaces distributed on their outer surface bearing threaded radial holes where pipes can be connected with the aid of special mechanisms.

5 The forces are transmitted from the pipes to the node through the node threads which are highly stressed.

Unfortunately, most classical aluminum alloys that are used for nodes manufacturing are limited in their load bearing capacity. However, they have the advantage of light weight as compared to heavy steel nodes especially in cases for which architectural reasons enforce the use of large diameter nodes.

10 An object of the present invention is to improve the limited load bearing capacity of aluminum alloy nodes by also keeping the advantage of such alloys light weight.

The result is a high strength node with low manufacturing cost.

This is achieved by using special high strength steel parts with threaded holes. Their outer surface has either tooth-shaped projections or grooves.

15 These parts are placed on the desired positions in the mold before casting the aluminum alloy.

After solidification, the aluminum alloy tightens the special parts in its mass, due to its greater coefficient of thermal expansion.

For the construction of the node, aluminum alloys are used whose principal alloying element is silicon or copper.

20 The advantages of this invention are that the resulting node is ready for use, the special steel parts can be produced in automatic lathe at low cost, the aluminum alloy is not highly stressed because of the distribution of the forces through the special parts, and the outcoming node has light weight.

The invention will be further described, by way of example only, with reference to the accompanying figures, in which:

25 Figure 1 shows a part of a structure where the node is used according to the invention.

Figure 2 shows two views of a node according to the invention.

Figure 3 shows a section of a node according to the invention.

The structure according to figure 1 is called three-dimensional structure or space frame and comprises the nodes 1 and bars 9.

30 The structure according to figure 1 is useful for the construction of buildings with extra aesthetic requirements, such as exhibition pavillions, shopping centers, shops, covered sports facilities, airport halls, hotel facilities, tourism facilities, universities, theaters, museums, libraries, etc.

The nodes are hollow spheres 1 with partial flat surfaces 11, distributed on their outer surface, bearing threaded radial holes 10.

35 Bars comprise one pipe 9 and two connection mechanisms 12, which connect the bar ends to the nodes.

Each aluminum alloy node 1 has at least one high strength steel part 2.

The special part 2 has a threaded radial hole 10 and at least one tooth-shaped projection or groove at its external surface 24.

40 For the construction of nodes 1, an aluminum alloy with silicon as principal alloying element is used , which has the following weight per cent composition:

Aluminum	remainder
Silicon	6,5 - 7,5
Iron	0,20 max
Copper	0,20 max
Manganese	0,10 max
Magnesium	0,40 - 0,70
Zinc	0,10 max
Titanium	0,04 - 0,20
Beryllium	0,04 - 0,07
Others	0,10 Total

55 Aluminum alloy nodes 1 have been heat treated as follows:

Solution heat treatment at 543 ° C for 12 hours provided no portion of the heat treat oven exceeds 548 ° C.

Quenching in water at 65 ° C to 100 ° C.

Precipitation heat treatment at 154 ° C for 8 hours.

**Claims**

1. An aluminum alloy node (1) for use in three-dimensional structures for buildings with extra aesthetic requirements comprising at least one steel part (2), which bears a threaded radial hole (10).
- 5 2. A node according to claim 1, in which the steel part (2) has at least one tooth-shaped projection or groove at its external surface (24).
- 10 3. A node according to any one of claims 1 or 2, in which the magnesium content in the aluminum alloy is more than 0,1% and less than 1,0%
4. A node according to any one of claims 1 to 3, in which the silicon content in the aluminum alloy is more than 2% and less than 20%
- 15 5. A node according to any one of claims 1 to 4, in which the titanium content in the aluminum alloy is more than 0,04% and less than 0,40%
6. A node according to any one of claims 1 to 5, in which berillium content in the aluminum alloy is more than 0,04% and less than 0,07%
- 20 7. A node according to any one of claims 1 to 6, in which the copper content in the aluminum alloy is more than 0,1% and less than 10%
- 25 8. A node according to any one of claims 1 to 7, in which the manganese content in the aluminum alloy is more than 0,05% and less than 0,40%

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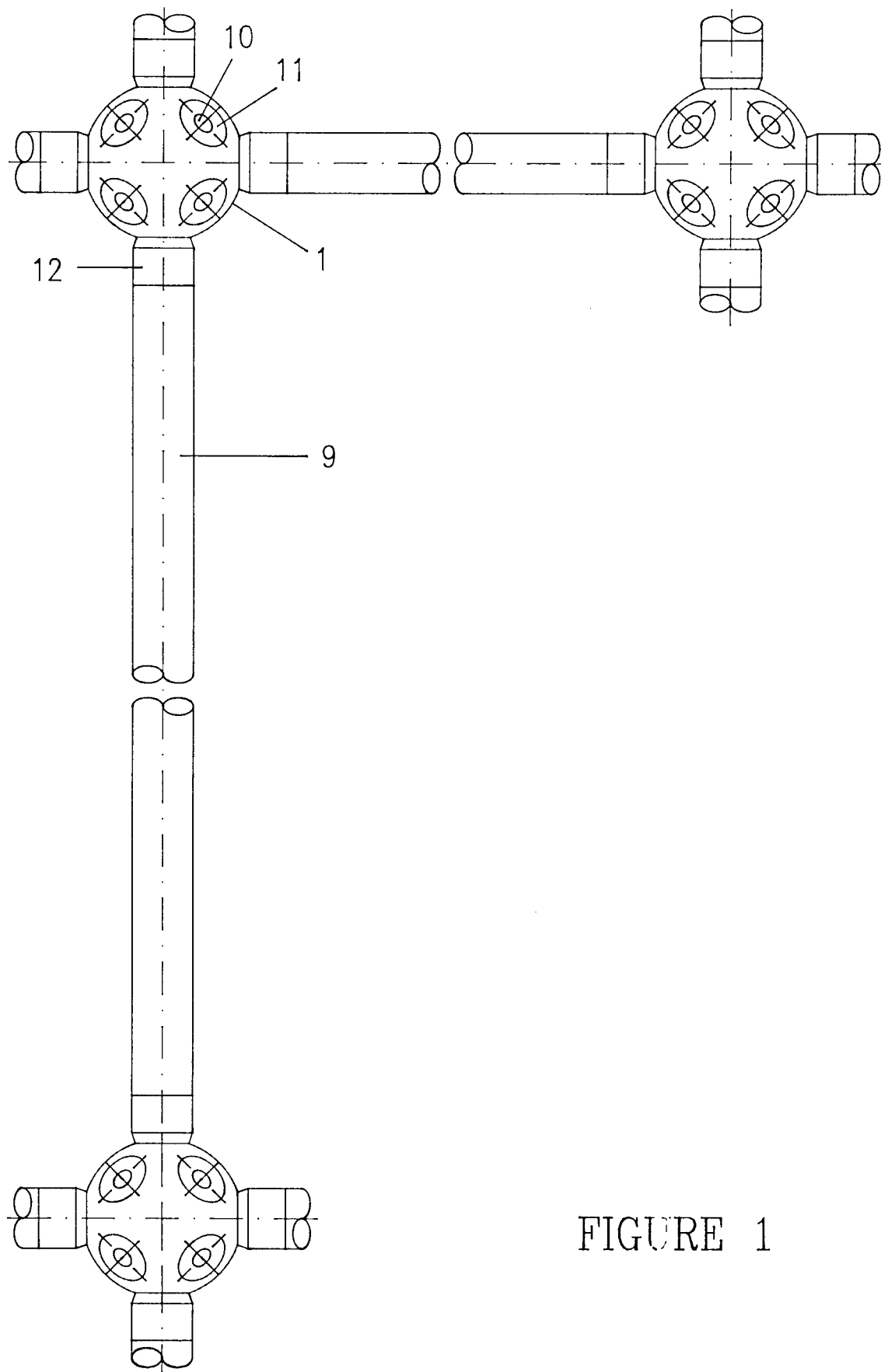
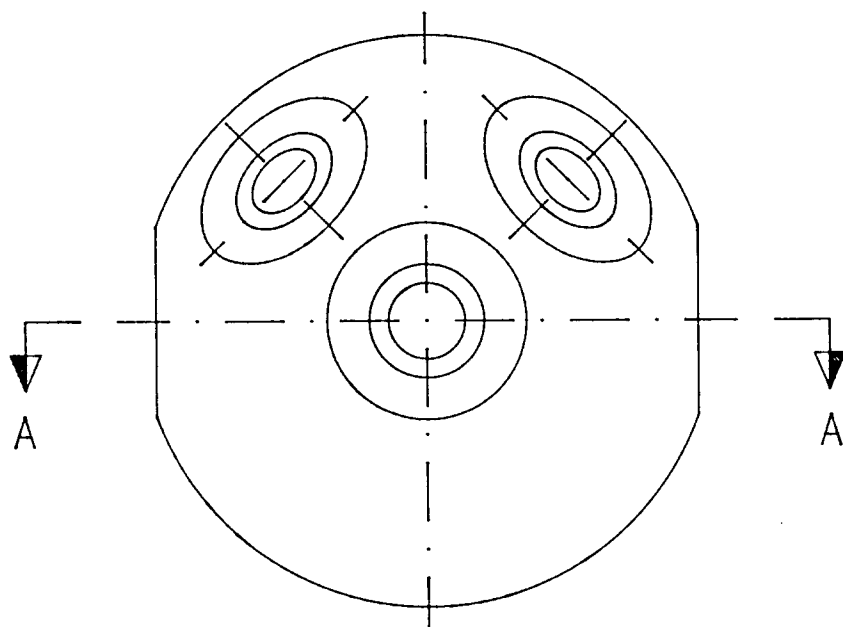
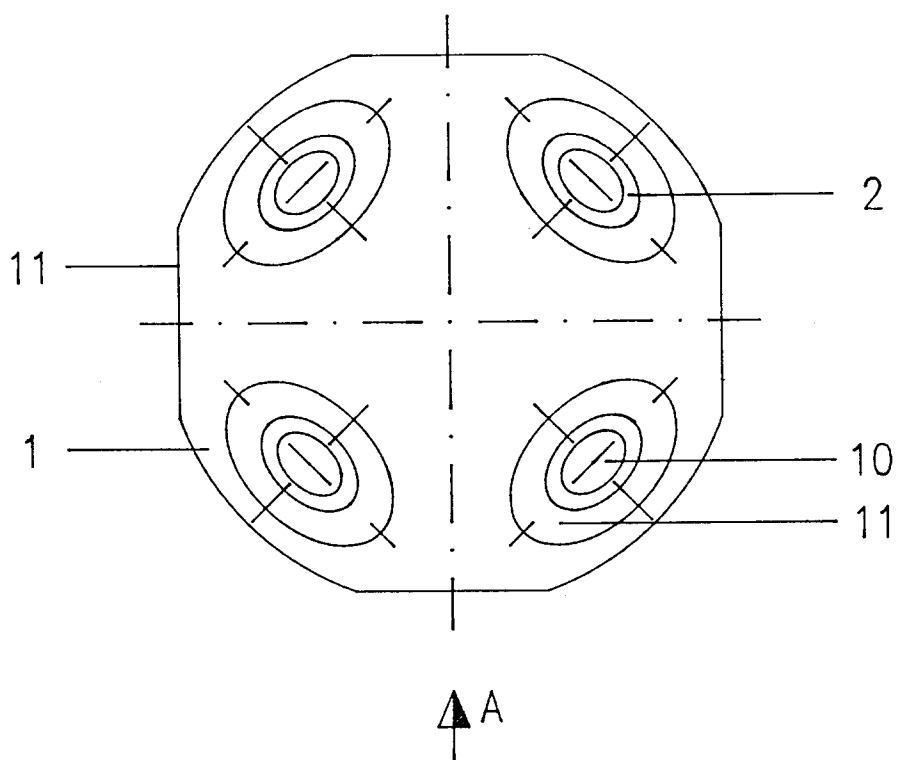
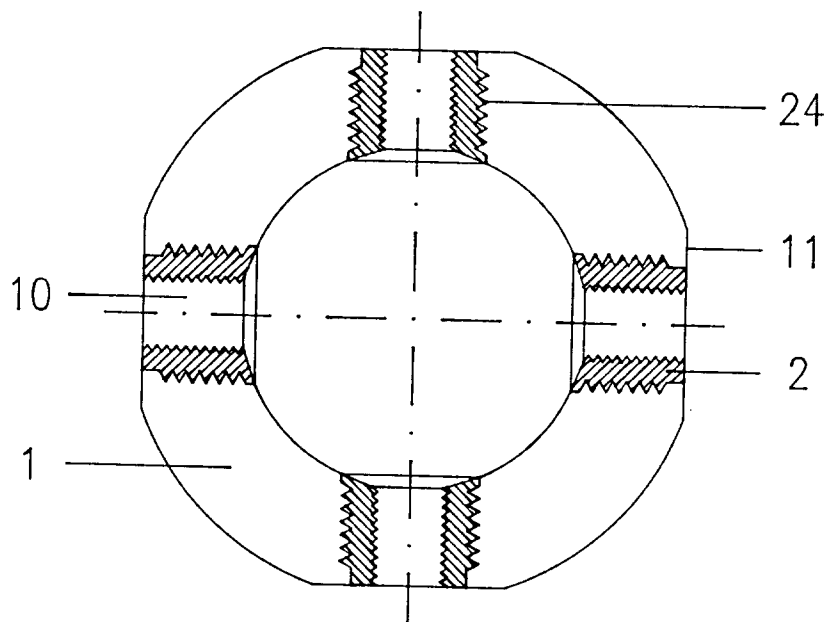


FIGURE 1



VIEW A

FIGURE 2



SECTION A-A

FIGURE 3



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## EUROPEAN SEARCH REPORT

Application Number

EP 93 60 0005

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.5)
Y	FR-A-1 154 854 (BERCAIRE) * the whole document * ---	1,2,4,7	E04B1/19
Y	GB-A-2 090 934 (TAPPEX THREAD INSERTS) * page 1, line 1 - line 9 * * page 1, line 34 - line 37 * ---	1,2,4,7	
A	EP-A-0 277 790 (SUTCLIFFE GROUP LTD) * column 4, line 43 - column 5, line 3; figures 4-6 * ---	1,2	
A	EP-A-0 145 393 (AE PLC) * page 1, line 1 - line 16 * * page 5, line 13 - page 6, line 16; figure 1 * ---	1	
A	FR-A-2 559 556 (VIRY S.A.) * page 4, line 5 - page 5, line 3; figure 2 * ---	1	
A	EP-A-0 386 606 (SCANDINAVIAN SPACE CONSTRUCTION A/S) ---		TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	FR-A-2 653 837 (TRAM S.A.R.L.) -----		E04B A47B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 JUNE 1993	Examiner PORWOLL H.P.
<b>CATEGORY OF CITED DOCUMENTS</b> 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			