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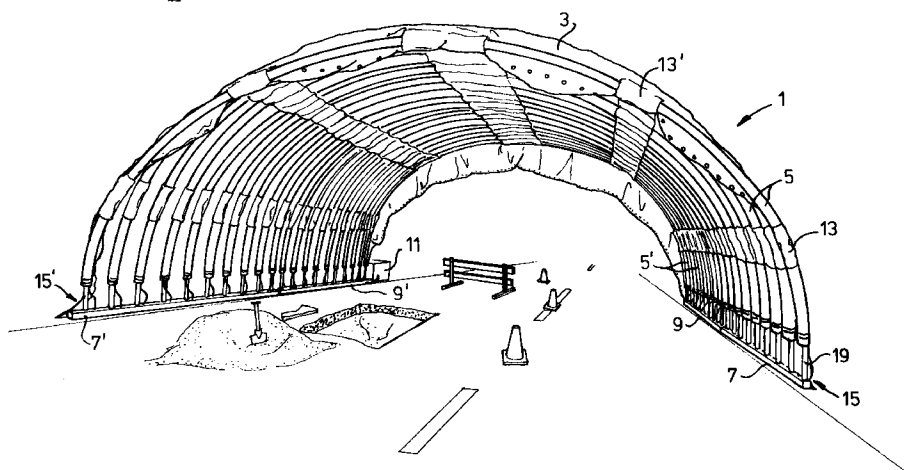
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(54) **Device for forming an elongated roof construction, and method device for erecting said roof construction**

(57) The invention relates to a device for forming an elongated roof construction, comprising a cover sheet and two or more flexible tubular inflatable suspension elements. Each suspension element is provided on both sides with a supporting foot which is connected to fixing elements situated along the longitudinal sides of the sheet. The suspension elements are each connected to an air supply duct. A roof construction is formed in a reli-

able and simple manner by bringing the suspension elements to pressure. The length of the device can be adapted to the desired dimensions by placing several identically shaped segments in a row, in which case the air supply ducts are interconnected. The suspension elements are preferably made of fire hoses.

fig -1



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## Description

The invention relates to a device for forming an elongated roof construction. The invention also relates to a method and a device for erecting said roof construction.

When work is being carried out on, for example, roads, railways, bridges and the like in the open air, it is generally desirable to be able to carry out the work sheltered from the weather. It is therefore an object of the present invention to provide a device for forming an elongated roof construction, by means of which a stable roof construction can be formed over quite a great length, for example several tens to hundreds of metres. It is a further object of the present invention to provide a device whereby a roof construction of relatively large cross-section can be erected and pulled down again in a quick and reliable manner. Yet a further object of the present invention is to provide an elongated roof construction which when dismantled takes up little space and is easy to transport.

To this end, the device according to the present invention is characterized in that it comprises:

- a cover sheet with two longitudinal sides,
- two or more flexible tubular inflatable suspension elements which extend crosswise between the longitudinal sides and are fixed to the cover sheet by means of fixing elements, the inflatable suspension elements being provided with a supporting foot at each end,
- along each longitudinal side at least one supporting element provided with fixing elements for detachable connection to a respective supporting foot of the inflatable suspension elements,
- along at least one longitudinal side an air supply duct, each inflatable suspension element being provided with an air supply aperture which is connected to the air supply duct.

Surprisingly, it has been found that a very stable, windproof and waterproof roof construction can be formed by means of the flexible tubular inflatable suspension elements. Owing to the fact that the supporting elements fix the ends of the tubular suspension elements provided with a foot, said suspension elements automatically assume a domed shape when inflated, with the result that the cover sheet is stretched in the shape of an arch. The width of the device according to the invention can be varied very simply by placing the supporting elements closer together or further apart.

Furthermore, the roof construction according to the invention can be erected very quickly by connecting the supporting feet of the suspension elements in their uninflated state to the supporting elements and then inflating the suspension elements groupwise. This means that separate segments of the roof construction can be erected in succession until the desired length has been reached.

Moreover, by selecting the appropriate length of the suspension elements, the cross-section of the roof construction can be adapted in a simple manner to the work to be carried out. Therefore, the roof construction can be used for, for example, work in tunnels, or on roads, railways or bridges.

Finally, the base of the roof construction according to the present invention, which is formed by the supporting elements, is very narrow, so that the roof construction can be supported on a narrow strip such as, for example, the crash barriers of a road.

The inflatable suspension elements are preferably shut off in an airtight manner at their ends, and are each provided with a valve for opening and closing the vent aperture. After inflation of the suspension elements, during which all these elements are connected to the air supply duct, each suspension element is shut off. If one element develops a leak, the construction according to the invention will not deflate completely, but the leak remains limited to a single suspension element. This makes the device very reliable, and it remains erected even if one or more suspension elements accidentally develop a leak as a result of work being carried out.

The roof construction is preferably constructed of a number of individual supporting elements, each comprising an air supply duct whose length essentially corresponds to the length of the supporting elements. These air supply ducts can be detachably interconnected by way of a valve situated between them. Each supporting element preferably comprises a number of fixing elements, for example six, for accommodating the supporting feet of the suspension elements. When all suspension elements connected to one supporting element are brought to pressure, a new supporting element with its air supply duct can be connected to the supporting element with the suspension elements already brought to pressure. When a new number of suspension elements are fixed to the newly connected supporting element, in which case the air supply ducts of the suspension elements are closed, the valve between the supply duct of the already positioned supporting element and the newly positioned supporting element can be opened. By then successively opening the air supply apertures of the newly placed, not yet inflated suspension elements, said suspension elements can be erected one by one, while the air is supplied by way of, for example, a compressor through the air supply duct of the supporting element positioned first. This means that the roof construction can be erected in a modular manner from essentially identically shaped cover sheets placed one behind the other and a multiplicity of mutually identically shaped supporting elements.

The inflatable suspension elements are preferably fixed to the inside of the cover sheet by means of cylindrical fixing tubes made of a sheet material through which the suspension elements are guided. When the suspension elements are inflated they stretch the cover sheet. Owing to the fact that the fixing tubes can slide

along the suspension elements, a very windproof construction is obtained. If there are unexpected gusts of wind, the sheet can slide along the suspension elements and deform, so that tearing thereof is prevented. When the wind load reduces, the device assumes its original shape again.

A detachable wall which has a movable wall suspension can be fixed in the device according to the invention. The wall suspension is formed here by a separate inflatable suspension element which by inflation can be brought into bearing contact with the interior of the cover sheet or into contact with an inflatable suspension element of the cover sheet. Using a wall suspension in which the length of the suspension element is slightly greater than the length of the suspension elements to which the sheet is fixed means that the wall is brought into close-fitting contact with the inner periphery of the roof construction. Walls for insulation against, for example, sound, dust and the like can be fitted in the roof construction in this way, in order to form separate compartments in the roof construction, in which various types of work can be carried out. The wall can be provided with a sliding or folding door.

The inflatable suspension elements preferably have a length of at least 4.5 metres, and preferably at least 10 metres. The inflatable suspension elements have a diameter of at least 5 centimetres, preferably at least 10 centimetres, and can very advantageously be made from fire hoses. Such hoses are very flexible and can withstand great pressure, for example pressures between 3 bar and 7 bar. At such pressures the hoses are erected to form very dimensionally stable structures if fixed at their end points.

A method for erecting the roof construction comprises the following steps:

- a. parallel positioning of the first two supporting elements at a predetermined mutual distance,
- b. connecting the fixing elements of suspension elements already fixed to a cover sheet - the number of which suspension elements corresponds to the number of fixing elements of a supporting element - in their uninflated state to the supporting elements, the valves of the suspension elements being in their closed position,
- c. inflating the suspension elements by opening the valve of the air supply duct and the valves of the suspension elements,
- d. connecting the air supply duct of a second pair of supporting elements to the air supply duct of the first pair of supporting elements,
- e. repeating steps b, c and d until a roof construction of a desired length is obtained, and preferably
- f. shutting off the air supply apertures of the inflated suspension elements.

By successively inflating segments of the roof construction, each segment comprising, for example, six suspension elements, and each supporting element

likewise having six fixing elements, it is possible to erect a very large roof construction by means of a compressor with a relatively low output. In this case the already inflated parts serve as a buffer, and only an individual segment need be inflated. The newly connected segment can again be inflated stepwise if desired, by successive opening of the valves of the suspension elements.

The roof construction according to the invention can be erected in a very simple manner by means of a mobile support on which a number of sheet layers containing the uninflated suspension elements are situated. The sheet layers in this case are supported by a vertically adjustable arm and two side arms hinged to the vertical arm. In the transporting state the vertical arm is situated in its lowest position, and the side arms are situated parallel to the vertical arm. When the sheet layers are being positioned, the vertical arm is moved upwards, during which the side arms extend sideways to a horizontal position. This means that the sheet layers are stretched sideways, so that they span the space between the supporting elements and can be connected easily thereto.

An embodiment of a roof construction according to the invention will be explained further with reference to the appended drawing, in which:

Figure 1 shows a perspective view of a shelter facility comprising a device according to the invention;  
 Figure 2 shows a part of two connected supporting elements with the supporting foot of two suspension elements connected thereto;  
 Figure 3 shows a front view of a device for positioning the roof construction according to the invention;  
 Figure 4 shows a front view of a movable wall accommodated in the device according to the invention; and  
 Figure 5 shows a section along the line V-V in figure 4.

Figure 1 shows a perspective view of a shelter device comprising a roof construction 1 according to the present invention. The roof construction 1 is placed over a part of a road surface on which work is being carried out. A cover sheet 3 is fixed to suspension elements 5, which are connected by their ends to supporting elements 7, 7' and 9, 9'. The supporting elements are situated on either side of the road surface and can, for example, rest against the road surface itself or against the crash barriers situated along the road. The longitudinal sides 15, 15' of the sheet 3 in this case run parallel to the longitudinal sides of the road surface. The inflatable suspension elements 5 are provided at their undersides with a supporting foot 19 which is connected to the supporting elements 7, 7', 9 and 9'. The cover sheet 3 is fixed by its inside by means of cylindrical fixing tubes or sleeves 13, 13' to the suspension elements 5.

The suspension elements 5 are brought to a pressure between 3 and 7 bar, preferably around 5 bar, by

means of a generator 11. The distance between the supporting elements 7, 7' and 9, 9' is, for example, 8 metres, while the maximum height of the roof construction 1 is, for example, 6 metres. The roof construction is of a modular design and consists of a number of supporting elements 7, 9 and 7', 9' placed in succession, and can vary in length between, for example, 6 metres and several hundred metres.

Figure 2 shows two interconnected supporting elements 7, 9. Each supporting element comprises a tube having, for example, a length of approximately 4 metres, provided with six fixing elements in the form of bushes 16 which are placed at a distance of 64 centimetres from each other. The supporting feet 19 of the suspension elements, which are preferably made of a fire hose 29, are accommodated in the bushes 16. An air supply aperture 27 in the supporting foot 19 is connected by way of a connecting hose 22 to an air supply duct 21. The air supply duct 21 is accommodated in the interior of the tube 17, which tube has, for example, a rectangular cross-section with an area of 10 by 10 centimetres. The air supply duct 21' of tube 9 is connected by way of a connecting hose 23 to the air supply duct 21. The air supply to the air supply duct 21' can be interrupted by means of a valve 25. Each fire hose 29 is connected by way of a separate connecting hose 22 to the air supply duct 21.

When the shelter facility 1 is being erected, supporting elements 7 and 7' will be placed on either side of the road surface. The supporting feet 19 of the suspension elements 5 are then placed in the bushes 16, while the suspension elements are in an uninflated state. The valve 25 is closed in this case. The suspension elements are then filled one by one with air, for example by successive opening of the valves 26 of said suspension elements. After the last suspension element has been filled, the air supply duct 21 is connected to the air supply duct 21' of the next supporting element 9. The valves 26' of the suspension elements which are connected to the supporting element 9 are closed here. The valve 25' is then opened, so that compressed air is supplied to the air supply duct 21'. The suspension elements 5' connected to the supporting element 9 are brought to pressure one by one by successive opening of the valves 26'.

The fire hose 29, which has, for example, a diameter of approximately 12.5 cm, is connected by way of clamping couplings 31 to the supporting foot 19.

Owing to the very narrow base of the roof construction according to the present invention, the supporting elements, having, for example, a cross-section of 10 times 10 centimetres, the roof construction according to the present invention can be mounted on a very narrow surface. The available space inside the roof construction therefore remains at a maximum, and said roof construction can be erected in positions which would otherwise be difficult to reach, for example on the top of crash barriers, or along the inside of a tunnel.

After the suspension elements 5, 5' have been

brought to pressure, for example to a pressure of 3 to 7 bar, the valves 26, 26' are closed. This ensures that the suspension elements 5, 5' are isolated from one another, so that in the event of a leak occurring in one of the suspension elements the pressure remains constant in the other elements.

Figure 3 shows a mobile undercarriage 34 for positioning the device 1 according to the invention. A vertical arm 37 and two hinged side arms 39, 41 are placed on the undercarriage 34. Draped over the arms 37, 39, 41 are, for example, 20 sheet elements 35. The suspension elements 36 are already fixed uninflated to the sheet elements 35, which have a length of, for example, 6 metres crosswise to the suspension elements. During transportation of the sheet elements 35 the arms 37, 39, 41 are situated in the vertical position shown by the dashed and dotted line. When the sheet elements 35 are being positioned, the side arms 39, 41 swing out sideways, and the central arm 37 is moved upwards. The supporting feet 38 are then situated near the already positioned supporting elements 40, 40' and can be fitted therein in a simple manner by hand. After the supporting elements 36 of the top sheet segment draped over the arms 37, 39, 41 have been brought to pressure, said top sheet is standing clear of the arms, as indicated by the arc-shaped dashed and dotted line. The undercarriage 34 can then be taken to the next position, after which the process is repeated.

Figure 4 shows a front view of the wall 47 which is placed crosswise to the lengthwise direction of the device according to the invention. The wall 47 comprises a wall suspension 48 in the form of an inflatable element. The inflatable element of the wall suspension 48 is identical to the inflatable suspension elements 46 of the device, but has a slightly greater length and is, for example, 5 centimetres longer than the suspension elements 46. During inflation of the wall suspension 48, which rests with its supporting feet 49, 49' in a separate supporting element 53, 53', the wall comes to rest tightly in a sealing manner against the inside wall of the suspension element 46 or against the sheet connected thereto. A sliding, roll-up or folding door 50 is situated in the wall.

Figure 5 shows a cross-section through the wall suspension 48 along the line V-V in Figure 4. As can be seen, the wall suspension comprises two flexible tubes 46, which at the top side of the wall 47 are situated in a doubled-over part thereof. A sufficiently rigid suspension of the wall 47 can be obtained by using two parallel flexible tubes.

## Claims

1. Device for forming an elongated roof construction, characterized in that the device comprises:
  - a cover sheet with two longitudinal sides,
  - two or more flexible tubular inflatable suspension elements which extend crosswise

between the longitudinal sides and are fixed to the cover sheet by means of fixing elements, the inflatable suspension elements being provided with a supporting foot at each end,

- along each longitudinal side at least one supporting element which is provided with a fixing element for detachable connection to a supporting foot of an inflatable suspension element, 5
  - along at least one longitudinal side an air supply duct, each inflatable suspension element being provided with an air supply aperture which is connected to the air supply duct. 10
2. Device according to Claim 1, characterized in that the inflatable suspension elements are shut off in an airtight manner at their ends, and are each provided with a valve for opening and closing the air supply aperture. 15
3. Device according to Claim 1 or 2, characterized in that along each longitudinal side at least two separate supporting elements are situated in line with each other, each having along at least one longitudinal side an air supply duct whose length essentially corresponds to the length of the supporting element, while the air supply ducts can be detachably interconnected by way of at least one valve situated at the end of the air supply duct of at least one of the supporting elements. 20 25 30
4. Device according to one of the preceding claims, comprising at least two separate identical cover sheets to be placed after one another, and a multiplicity of mutually identically shaped supporting elements. 35
5. Device according to one of the preceding claims, characterized in that the inflatable suspension elements are fixed to the inside of the cover sheet by means of cylindrical fixing tubes made of a sheet material through which the inflatable suspension elements are guided. 40
6. Device according to one of the preceding claims, comprising a wall which extends crosswise to the lengthwise direction of the device and is fixed to a movable wall suspension comprising a separate inflatable suspension element which by inflation can be brought into bearing contact with the interior of the cover sheet or with an inflatable suspension element of the cover sheet. 45 50
7. Device according to one of the preceding claims, characterized in that the inflatable suspension elements have a length of at least 4.5 metres, preferably at least 10 metres. 55
8. Device according to one of the preceding claims,
- characterized in that the inflatable suspension elements have a diameter of at least 5 cm, preferably at least 10 cm.
9. Device according to Claim 7 or 8, characterized in that the inflatable suspension elements are formed from fire hoses.
10. Method for erecting an elongated roof construction from a flexible cover sheet according to one of Claims 1 to 9, comprising the following steps:
- a. parallel positioning of the first two supporting elements at a predetermined mutual distance,
  - b. connecting the supporting feet of suspension elements already fixed to a cover sheet - the number of which suspension elements corresponds to the number of fixing elements of a supporting element - in an uninflated state of the suspension elements to the supporting elements, the valves of the suspension elements being in their closed position,
  - c. inflating the suspension elements by opening the valve of the air supply duct and the valves of the suspension elements,
  - d. connecting the air supply duct of a second pair of supporting elements to the air supply duct of the first pair of supporting elements,
  - e. repeating steps b, c and d until a roof construction of a desired length is obtained.
11. Method according to Claim 10, characterized in that after inflation of the supporting elements the air supply apertures of the inflated suspension elements are shut off.
12. Device for erecting an elongated roof construction with the device according to Claims 1 to 9, comprising a mobile support for a number of sheet layers containing the uninflated suspension elements, comprising a vertically adjustable vertical arm and two side arms which are hinged to the vertical arm and swing towards the vertical arm when the vertical arm moves downwards, and swing away from the vertical arm when said arm moves upwards.

fig-1

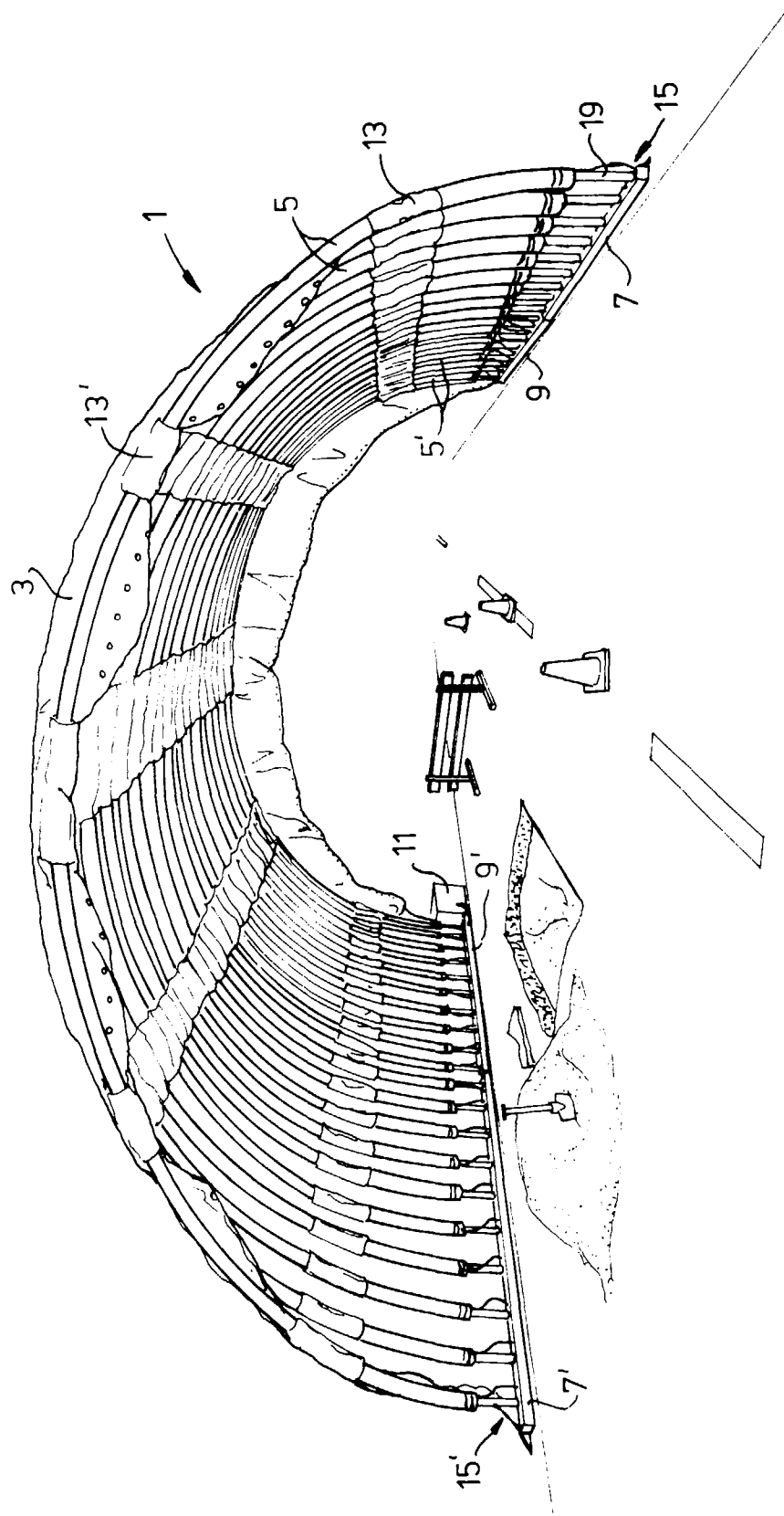


fig - 2

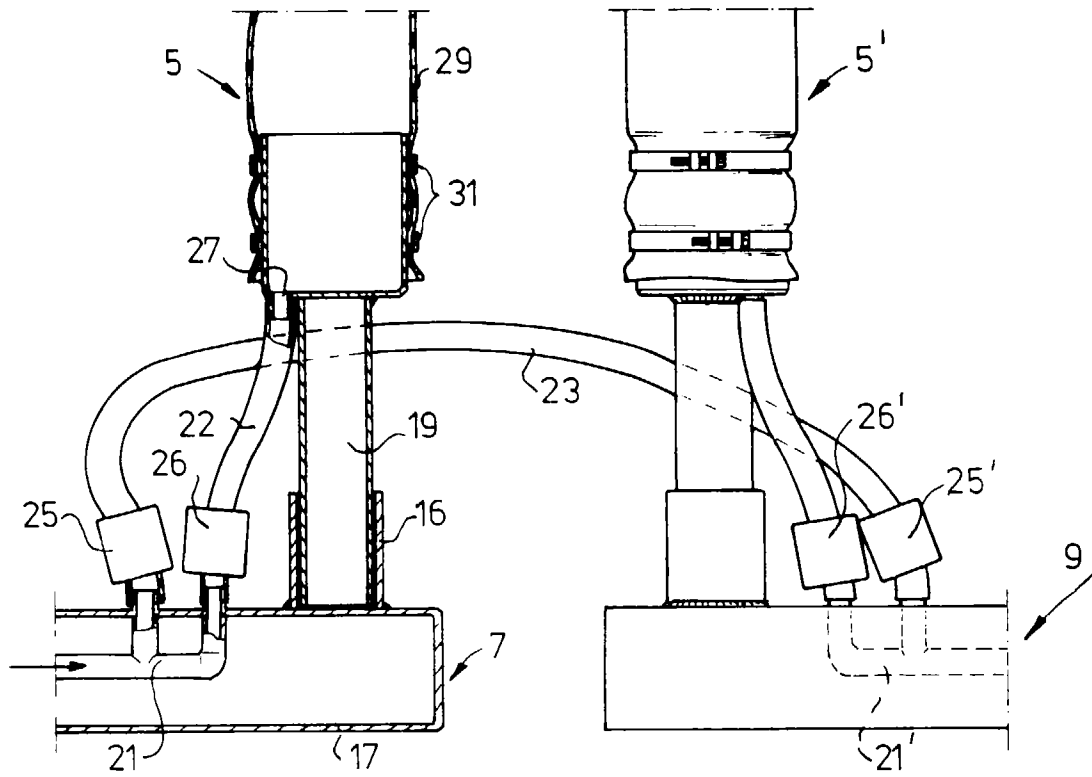


fig - 3

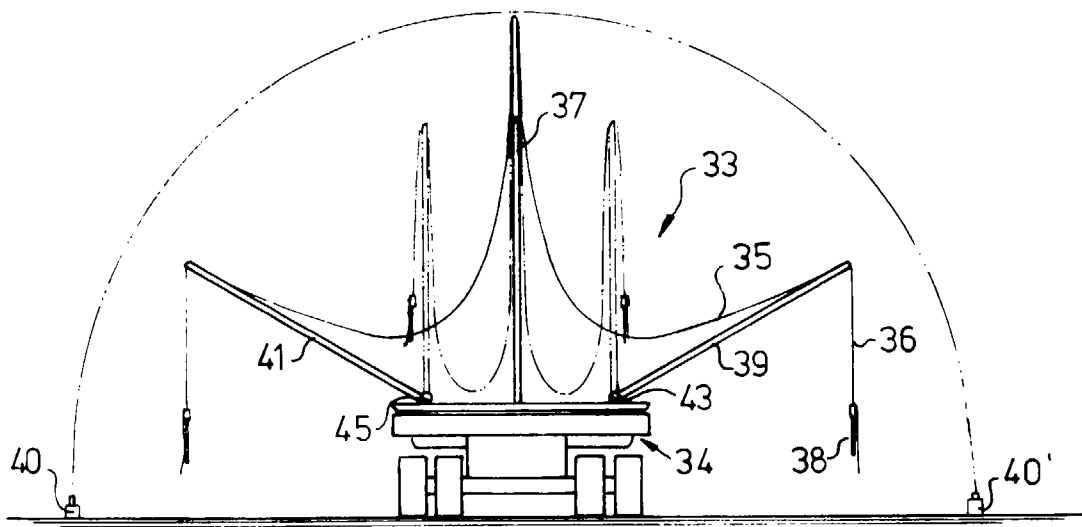


fig - 4

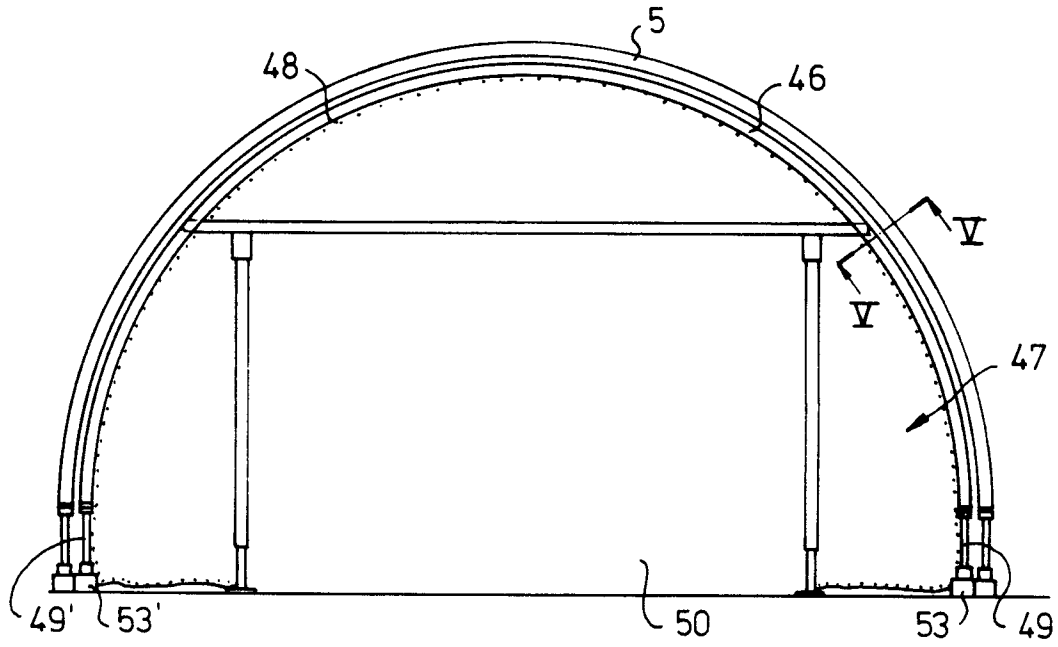
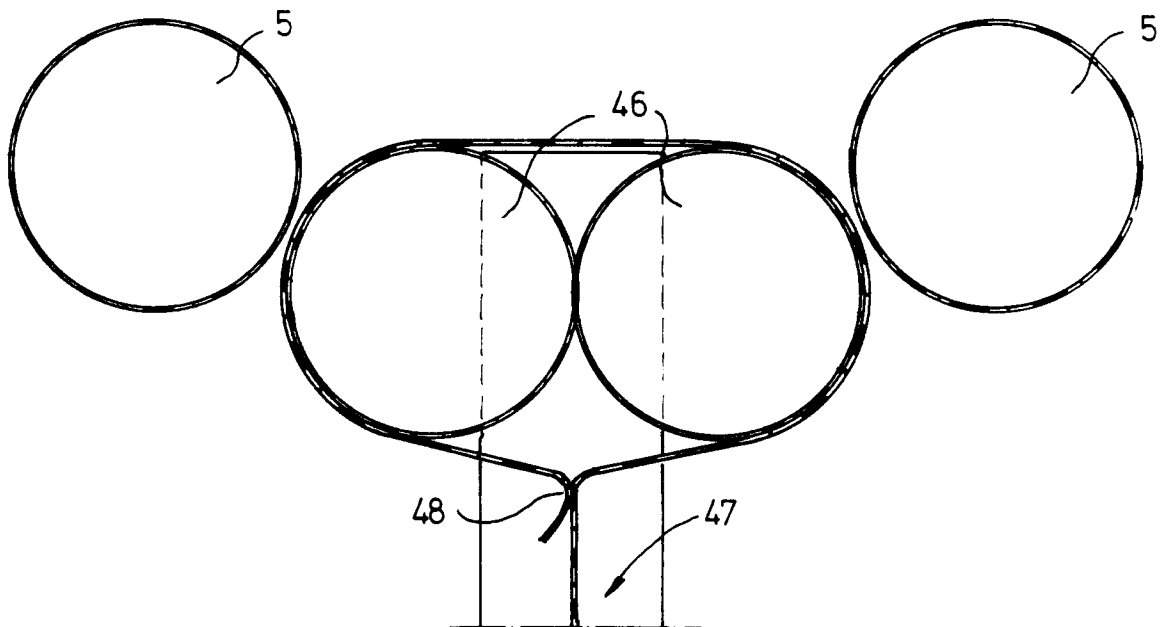


fig - 5







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## EUROPEAN SEARCH REPORT

Application Number  
EP 97 20 1506

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.6)
X	DE 26 45 311 A (AISENBERG JULIAN BORISOVITSCH) 13 April 1978 * page 9, line 10 - line 27 * * figure 1 *	1,2,7,8	E04H15/20
X	US 4 918 877 A (DUTKA WALTER J) 24 April 1990 * the whole document *	1	
A	EP 0 201 012 A (GOODRICH CO B F) 12 November 1986 * page 3, line 16 - page 4, line 12 * * page 4, line 34 - page 6, line 19 * * page 7, line 34 - page 8, line 22 * * page 8, line 23 - page 9, line 4 * * figures 1,2,6,15 *	1,4,6-8, 10	
A	EP 0 494 053 A (EUROVINIL IND SPA) 8 July 1992 * column 2, line 57 - column 3, line 12 * * column 3, line 55 - column 4, line 17 * * figures 1-3 *	1,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E04H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 August 1997	Examiner Vrugt, S
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