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(54) **MOUNTING METHOD OF A FLEXIBLE LIGHT-BEARING TUNNEL IN A TUNNEL SKYLIGHT**

(57) The solution provides a method of assembling of the light-bearing of the tunnel skylight, eliminating the need for trimming, which is to adjust the length of the light-bearing tunnel through its stretching between the inner and outer element of the tunnel skylight in the state after the installation of these elements respectively in the ceiling or wall of the room and the roof.

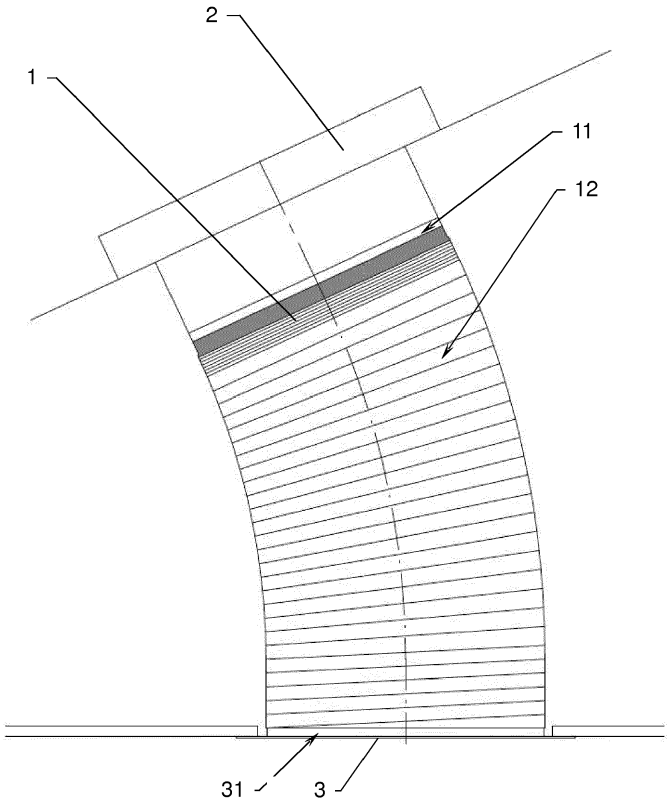

Fig. 4a

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Description

[0001] The present invention relates to a method for coupling and mounting of the flexible light-bearing tunnel in the tunnel skylight, consisting of elements in delivery condition.

[0002] Typical design of tunnel skylights essentially consist of three main components: an outer element, a light-bearing tunnel and an inner element. The outer element is mounted in the outer partition of the building. The roof slope is it in the most solutions, and in such solution the outer element is referred to as a roof element. There are also solutions in which the outer element is mounted in the outer wall of the building. The inner element is mounted in one of the inner partitions, i.e. in the ceiling or the inner wall of the illuminated room and is used for the direct emission of the conducted light into the room. It is connected with the outer element via light-bearing tunnel, which preferably has the shape of a expediently circular tube coated inside with the layer of the excellent light reflecting material. There are other cross-sectional shapes of the light-bearing tunnel, but the simplest and cheapest solution is round tube: rigid, flexible or corrugated. Basically, the mounting method of the tunnel skylights consist of two stages. The assembly of the outer element in the outer partition and the assembly of the inner element in the inner partition is the first stage. The mounting of the light-bearing tunnel and linking with the outer and the inner element is the second stage being the subject of the invention.

[0003] It is known state of the art, wherein the skylight is equipped with the flexible light-bearing tunnel of the length specified by the manufacturer. There are solutions also known from the market in which the flexible tube of the skylight is terminated with a rigid tube serving as a connecting element to the body of the outer element of the skylight. The required length of the light-bearing tunnel varies due to a freedom of arrangement of the outer element of the skylight mounted in the outer partition relative to the inner element mounted in the inner partition. In the case of an excessed length of the light-bearing tunnel it is shortened by cutting away the superfluous part during final assembly of the building. In most cases the edge of the light-bearing tunnel after trimming should be in one plane, eg. to create a circle perpendicular to the axis. Such a method of preparation of the light-bearing tunnel increases the risk of damage during installation and requires special care when cutting, which in practice forces the execution of the operation by a trained person with high manual dexterity. As is apparent from the description, this assembly method is laborious. Furthermore, in case of a bad evaluation of the required length the repetition of cutting too long light-bearing tunnel is necessary. In the case trimming of the light-bearing tunnel too short the exchange for new and repeat of the operation may even be required. Preparation of the length of the light-bearing tunnel for the specific solution in consultation with the supplier or the manufacturer may be a special solution and making installation easier. However, this requires the prior effort to determine the exact dimensions and negotiations with the supplier. The requirement for precise adjustment of the length of the light-bearing tunnel stems from the condition of maximum flow of light through the tunnel skylight, which is satisfied by properly tensioned flexible light-bearing tunnel without unnecessary bends and undulations of the inner surface.

[0004] The mounting method of the light-bearing of the tunnel skylight, eliminating the need for its trimming and such a preparation of the kit that could be in this range of activities quickly and without tools installed is the goal of the proposed invention.

[0005] A solution to the implementation of the present purpose is the subject of the invention as defined by the method of the mounting of the light-bearing tunnel on the inner element, usually embedded in the ceiling of the illuminated room or on the outer element embedded usually in the roof of the building. The light-bearing tunnel consists essentially of two parts: the rigid tube and the flexible tube. The flexible tube is the easily deformable element made essentially from a thin shell, to which the resilient wire shaped in the form of a helical coilon is attached on the outer surface. The stroke of the winding of the spiral and the number of coils are dependent on projected maximal extension of the light-bearing tunnel. Such prepared flexible tube is slid over on the part of the rigid tube. The remaining part of rigid tube is used as the mounting part, for connecting the light-bearing tunnel to the outer element, the inner element or the other flexible tube. During the operations of sliding on the rigid tube the spiral reduces its stroke, preferably to a value slightly larger than the diameter of the wire of the spiral and the elastic tube is assembled between the spiral and the outer surface of the rigid tube. The flexible tube can also be compressed in a separate operation prior to sliding on the rigid tube. This operation allows the preparation and delivery of the flexible tube compressed separately.

[0006] In the delivery condition, in which a flexible tube is compressed and sliding on the rigid tube, the light-bearing tunnel is the prefabrication ready for assembly. Mutual relation of the flexible tube and the rigid tube diameters must be selected so that the elastic pressure of the flexible tube with the spiral to the outer surface of the rigid tube guarantee protection against self slipping off the flexible tube under the influence for example the force of gravity. There are a number of alternative ways to mount depending on the delivery condition of the prefabrication consisting essentially of an outer element, the inner element and the light-bearing tunnel, which consists of rigid tube and pulled over it the flexible tube.

[0007] The following options of preparation of the prefabrication may take place in the delivery condition:

A - the light-bearing tunnel is attached to the outer element of the skylight,

B - the light-bearing tunnel is attached to the inner

element of the skylight,

C - the light-bearing tunnel is an integral part of the outer element of the skylight,

C - the light-bearing tunnel is an integral part of the inner element of the skylight,

E - the light-bearing tunnel is a separate element combined during the assembly with the outer or inner element or with the other light-bearing tunnel of the skylight; such a solution allows to make the prefabrication consist of the rigid tube and the flexible tube which, during the assembly is stretched to the desired length and coupled with the inner element of the skylight,

F - the flexible tube is not connected to the rigid tube and is the separate element axially compressed and secured against accidental stretching; the connection with the rigid tube or the other elements of the skylight is carried out during installation in building. The connection with the rigid tube must be after the sliding on secured against the accidental slipping.

[0008] The length of the rigid tube in the part with the pushed flexible tube is preferably similar to the length of the flexible tube compressed and fastened to the rigid tube. However, in this state, substantially the flexible tube does not extend beyond the rigid tube.

[0009] The assembly of the inner element of the skylight in the inner partition limiting the room, to which the light have to be supplied, is the first step of the method of installation. In parallel, the outer element must be installed in the outer partition, usually in the roof.

[0010] The next stage of assembly, which is the **operation** I of the invention, this is the sliding of the flexible tube on the rigid tube and securing of the unstretched end of the flexible tube against the slipping with, for example, adhesive tape. This operation is ignored in cases where in delivery condition the flexible tube is slided on the rigid tube and secured against accidental slipping.

[0011] The next step of assembling this is **operation II,** a combination of the rigid tube of the light-bearing tunnel with the outer or inner element. This operation occurs in the case where in the supply condition the light-bearing tunnel is not connected with said elements.

[0012] The next **operation III,** this is the stretching of the light-bearing tunnel to the desired length. This action involves pulling of the flexible tube by its free end, this leads to the sequential coil after coil, automatic stretching of the flexible tube and slippage of subsequential coils of the flexible tube from the rigid tube. During this operation, the self-resilient formation of the flexible tube of the light-bearing tunnel occurs by sliding of the subsequential coils from the rigid tube, increasing the stroke between subsequential coils, and thus, the development of the complex surface of the flexible tube. In this way, such a portion of the light-bearing tunnel is developed that is required for maximum shortest connection of the inner element of the skylight with its outer element. The axially compressed light-bearing tunnel is slightly tight mounted on the rigid tube, which protects it from accidental slipping and ensure that the development of the coil after coil from the side provided to connect to the inner element of the skylight. Easily jerky strip, eg. paper in the form of a strip, sticked parallel to the axis on the outer side of the collapsed light-bearing tunnel in the delivery condition may be an additional protection. The sections of the strip break off in the sequence of developed coils of the light-bearing tunnel.

[0013] In the case where the length of one light-bearing tunnel is inadequate for various reasons, an its extension may be used by combining two or more. Connecting of the light-bearing tunnels one with other is the **operation IV**. It involves the application of the developed part of the flexible tube of the one light-bearing tube on the rigid tube of the another tunnel. If the length of the light-bearing tunnel is sufficient, the operation IV is ignored.

[0014] The connection of the flexible tube of the light-bearing tunnel with the unconnected element of the skylight, which may be, depending on the options previously described, the inner or outer element is the next stage of the assembly. These are the steps as one of the operations Va, Vb and Vc. The connection of the light-bearing tunnel and the inner or outer element must be secured against accidental disconnection, using e.g. the adhesive tape.

[0015] The **operation Va** involves the connection of the light-bearing tunnel with the inner element. This case occurs when the rigid tube in the supply condition is connected to the outer element of the skylight or the connection was made during the earlier steps.

[0016] The **operation Vb** involves the connection of the light-bearing tunnel with the outer element, in the case where the rigid tube in the supply condition is connected to the inner element or the connection was made during the previous operation.

[0017] The **operation Vc** is substantially the submission of operations **II,** Va, and Vb. It involves the connection of the light-bearing tunnel with the outer and inner element. These operations are performed in the case where in the delivery condition the light-bearing tunnel appears as a separate element, not connected with the outer or the inner element. The retaining of identical dimensions and centres of connecting means of the light-bearing tunnel with both the outer element and with the inner element of the skylight is possible, this allow for selection of the direction of the development of the light-bearing tunnel.

[0018] The protection against self-development of the remaining undeveloped coils of the light-bearing tunnel e.g. with adhesive tape is ending stage of the assembly. The method of the manufacturing and the mounting being the subject of the invention provides a development of only a required length of the light-bearing tunnel without

having to shorten it in the event of excess length. The mentioned excess remains undeveloped on the rigid tube, which has a significant impact on the maintenance of a high transmittance of the light beam. This is a result of the restrictions to the minimum amount of bends and curves and smooth stretched inner surface of the light-bearing tunnel. Simplicity, the fast installation time and the maximum efficiency of the skylight are thus assured.

[0019] The ability to re-overlap of the free turns of the flexible tube on the rigid tube, which gives full freedom during assembly and allows the strong straining of the light-bearing tunnel after its connection with the outer element and the inner element is an additional advantage of the proposed invention.

[0020] Subsequential steps of the assembly of the light-bearing tunnel according to the invention are shown in the simplified drawings from Fig. 1 to Fig. 4b,

[0021] The Fig. 1 shows the light-bearing tunnel consist of the circular rigid tube and slipped on it axially compressed flexible tube. This is the state after the operation and installation for option F, as well as the delivery condition for options E. The drawing contains a side view and a fragment of the longitudinal section through the wall of the light-bearing tunnel.

[0022] The Fig. 2a in the side view shows the state of the tunnel skylight assembly after operation **I** and **II** for option A and C, after which the light-bearing tunnel is connected to the outer element of the skylight.

[0023] The Fig. 2a in the side view shows the state of the tunnel skylight assembly after operation I and II for option B and D, after which the light-bearing tunnel is connected to the inner element of the skylight.

[0024] The Fig. 3 in the side view shows the state of the skylight tunnel assembly after the operation IV which is the optional case E, which consists in applying of the developed part of the flexible tube of one light-bearing tunnel on the rigid tube of the another light-bearing tunnel.

[0025] The Fig. 4a in the side view shows the state of the tunnel skylight assembly after operation Va or Vc for options A, C, E or F, after which the light-bearing tunnel, stretched from the side of the outer element is connected to the inner element of the skylight.

[0026] The Fig. 4B shows the state of the tunnel skylight assembly after operation Vb or Vc for options B, D, E or F, after which the light-bearing tunnel, stretched from the side of the inner element is connected to the outer element of the skylight.

[0027] Methods of assembling in examples of the execution depend on the particular options given in the description as cases from A to F, being the description of the preparation of the prefabrication to the assembly.

[0028] **In the first example of the execution,** the light-bearing tunnel 1 is in delivery condition in the configuration of the **option A,** i.e. is removable attached to the outer element 2 of the skylight. The light-bearing tunnel 1 consist of the rigid tube 11 and the flexible tube 12, by means of which it is removable connected to the outer element 2. The shell 121 and the spiral 122 are components of the flexible tube 12. In the **option C** similar to the option A, the rigid tube 11 is permanent joined with the outer element 2 of the skylight. The light-bearing tunnel 1 in the supply condition according to the option A or C is shown in the simplified Fig. 2a. In this case of the execution, the method of the assembly consist of sequentially operations III and Va. In the operation Va the flexible tube 12 is applied to the circular mounting flange 31 of the inner element 3. Condition of the system after the above operations is shown in Fig. 4a.

[0029] **In a second example of the execution,** the light-bearing tunnel 1 in delivery condition is in the configuration of the **option B,** i.e. it is removable attached to the inner element 3 of the skylight or in configuration of the **option D** similar to the option B, in which the rigid tube 11 is permanent joined with inner element 3 of the skylight. The light-bearing tunnel 1 in the supply condition according to the option B or D is shown in the simplified Fig. 2b. In this case of the execution, the method of the assembly consist of sequentially operations III and Vb. In the operation Vb the flexible tube 12 is applied to the circular mounting flange 21 of the outer element 2. Condition of the system after the above operations is shown in Fig. 4b.

[0030] **In the third example of the execution,** the light-bearing tunnel **1** in delivery condition is in the configuration of the **option E,** i.e. it is a separate part combined during the assembly with the outer element 2 and inner element 3 and, if necessary, an additional light-bearing tunnel 1 ' of the skylight. The light-bearing tunnel 1 in the supply condition according to the option E is shown in the Fig. 1.

[0031] In case of the option E, the method of the assembly consist of sequentially operations II, III and Vc. In the option E, there are two possible configurations. First, wherein the rigid tube 11 is connected to the outer element 2 and the flexible tube 12 is applied to the mounting flange 31 of the inner element 3 and the second wherein the rigid tube 11 is joined to the inner element 3 and the flexible tube 12 is applied to the mounting flange 21 of the outer element 2 In case of necessary of the extension of the light-bearing tunnel, it is possible to supplement of the assembly process with the operation IV of the assembly of the light-bearing tunnel 1 ' of the skylight, after operation III. The operation IV in one of possible variants consists of the putting of the end of a flexible tube 12 of the light-bearing tunnel 1 on the rigid tube 11' of the additional light-bearing tunnel 1', and following operation Vc consists of the putting of the end of a flexible tube 12' on the mounting flange 31 of the inner element 3. Condition of the system after the above operations is shown in Fig. 3.

[0032] **In a fourth example of the execution,** not shown in the drawings the light-bearing tunnel 1 is provided in the configuration of the **option F,** whereby the flexible tube 12 in delivery condition is a separate element, not pre-connected with the rigid tube 11, compressed axially and secured against accidental stretch-

ing. The sliding of the flexible tube 12 on the rigid tube 11 during assembly is an operation I, that is primary to all other operations of the invention.

[0033] In each of the above showed examples of the execution the connection of the imposed flexible tube 12 with the rigid tube 11 or with the mounting flanges 21 and 31 must also be secured, e.g. by means of adhesive tape. Additionally undeveloped coils of the flexible tube 12 remaining on the rigid tube 11 shall be secured against accidental unwanted spreading, e.g. by gluing them with adhesive tape.

Claims

1. The method of assembling of the flexible tunnel skylight for conducting the sunlight into the room inside the building, consisting essentially of an inner element mounted substantially within the inner partition, the light-bearing tunnel with the length matched during the assembly and outer element mounted in the opening of the outer partition of the building, wherein the light-bearing tunnel, consisting of the flexible tube integrated with the elastic flexible helical coil and a substantially the rigid tube, connected in the supply condition or during installation in a building with the outer element or the inner element is engaged with the inner or the outer element in the assembly process at the building **characterized in that** the flexible tube (12) of the light-bearing tunnel (1) in the supply condition is compressed axially and in the supply condition or in the assembly process is slid over the rigid tube (11), and increasing the length of the light-bearing tunnel (1) in assembly operations is carried out in the operation III of stretching, and detaching the flexible tube (12) from the rigid tube (11).

2. The mounting method according to claim 1, **characterized in that** the flexible tube (12) integrated with the coil (122) in the supply condition is slipped substantially wholly on the rigid tube (11) and a resilient pressure of the flexible tube using a helix (122) to the outer surface of the rigid tube (11) provides protection against accidental slipping.

3. The mounting method according to claim 1, **characterized in that** the flexible tube (12) in the supply condition is a separate element axially compressed and secured against accidental stretch
and the sliding and connected to the rigid tube (11) is performed in the operation I during installation in the building.

4. The mounting method according to claim 1, **characterized in that** the light-bearing tunnel (1) is protected against stretching in the form of the easily breaked off tape connecting spiral coils (122) of the flexible tube (12).

5. The mounting method according to claim 1, **characterized in that** the light-bearing tunnel (1) in the supply condition is attached to the outer element (2) or the inner element (3) of the skylight.

6. The mounting method according to claim 1, **characterized in that** the rigid tube (11) of the light-bearing tunnel (1) is the integral part of the outer element (2) or the inner element (3) of the skylight.

7. The mounting method according to claim 1, **characterized in that** the light-bearing tunnel (1)in the supply condition is the separate element combined during assembly with the outer element (2) or the inner element (3) or additional light-bearing tunnel (1') of the skylight.

8. The mounting method according to claim 3, **characterized in that** it comprises the operation I of the assembly of the light-bearing tunnel (1) by sliding of the flexible tube (12) on the rigid tube (11).

9. The mounting method according to claim 5 or 6, **characterized in that** it contains the operation of the connecting of the rigid tube (11) of the light-bearing tunnel (1) with the outer element (2) or the inner element (3).

10. The mounting method according to any of the preceding claims, **characterized in that** it comprises the operation III of the stretching of the flexible tube (12) of the light-bearing tunnel (1) to the required length, consisting of a flexible tube (12) is pulled by its free end.

11. The mounting method according to claim 10, **characterized in that** it comprises the operation IV of the connection of at least two light-bearing tunnel (1, 1') by sliding of the end of the flexible tube (12) of the light-bearing tunnel (1) on the rigid tube (11') of the additional light-bearing tunnel (1').

12. The mounting method according to claim 10 or 11, **characterized in that** it contains the operation Va of the connecting of the flexible tube (11) of the light-bearing tunnel (1) with the mounting flange (31) of the inner element (3).

13. The mounting method according to claim 10 or 11, **characterized in that** it contains the operation Vb of the connecting of the flexible tube (11) of the light-bearing tunnel (1) with the mounting flange (21) of the outer element (2).

14. The mounting method according to claim 10 or 11, **characterized in that** it comprises the operation of

Vc of the connection the light-bearing tunnel (1) with the outer element (2) and the inner element (3), by connecting the rigid tube (11) to the outer element (2) and applying the flexible tube (12) on the mounting flange (31) of the inner element (3) or alternatively by the connection of rigid tube (11) to the inner element (3) and application of the flexible tube (12) to the mounting flange (21) of the outer element (2)

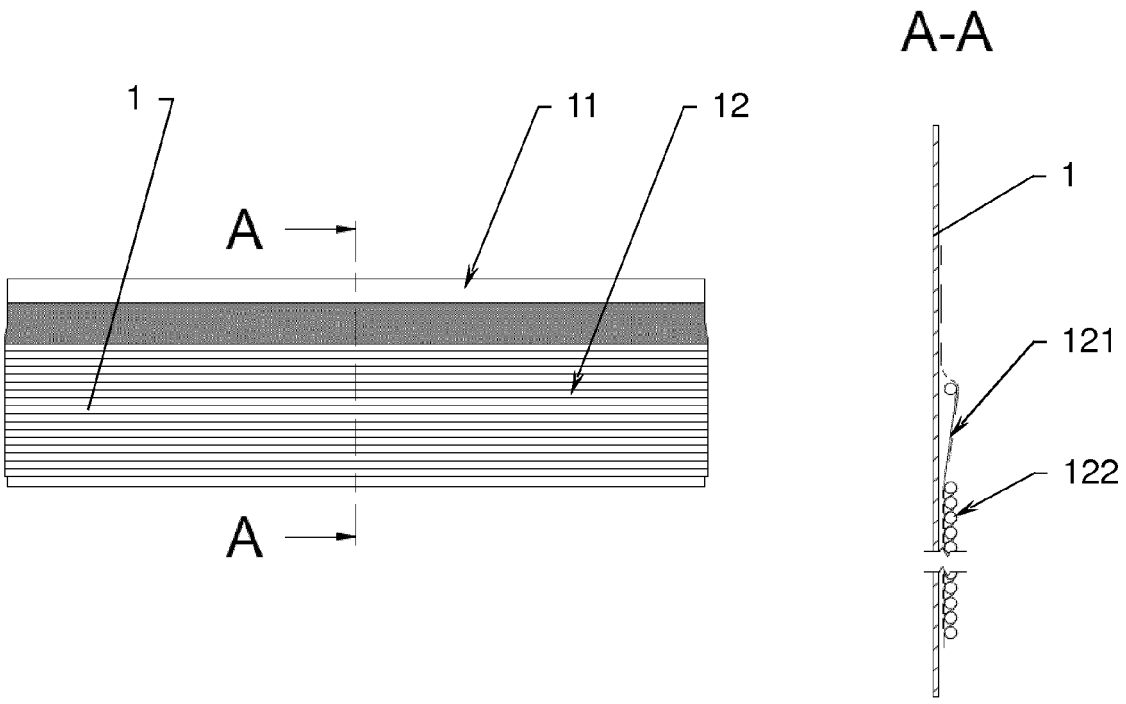

Fig. 1

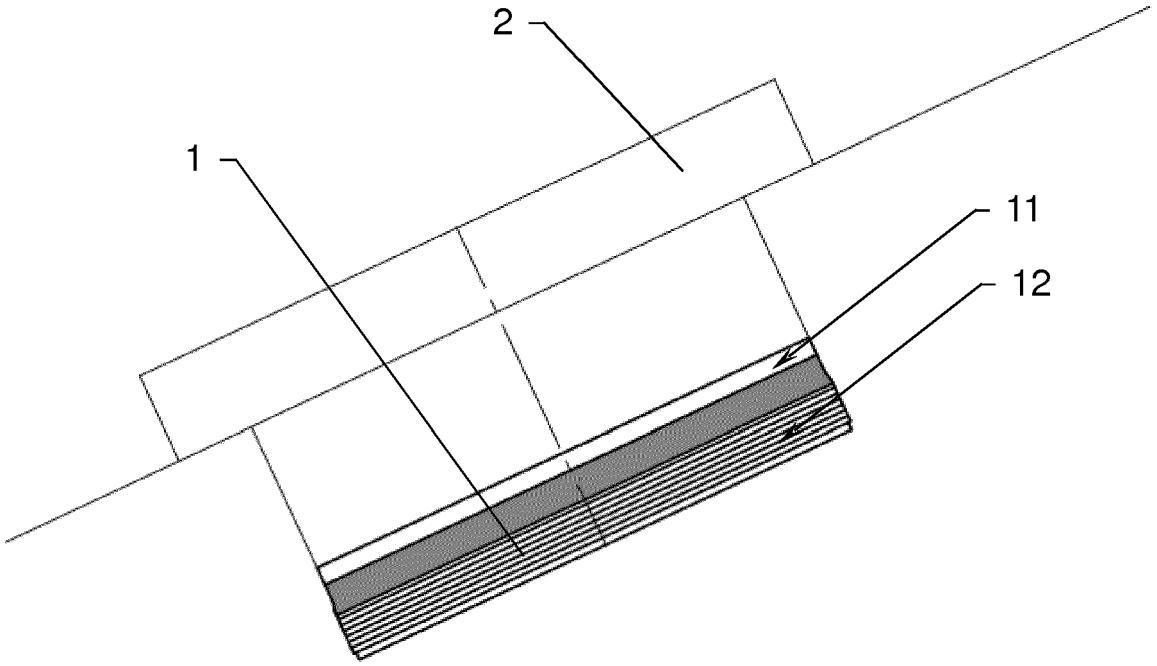

Fig. 2a

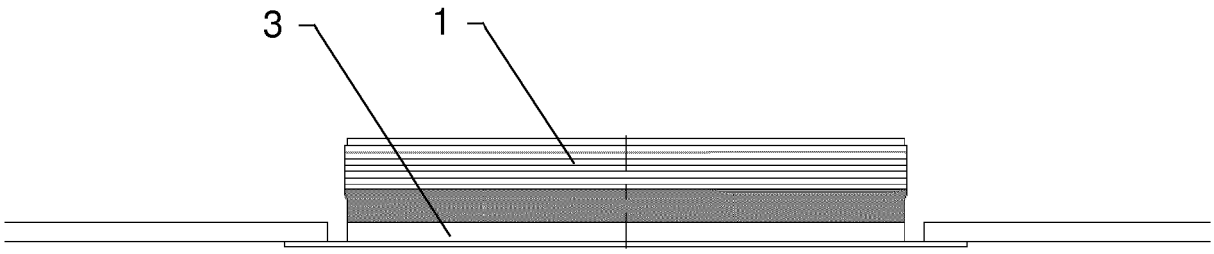

Fig. 2b

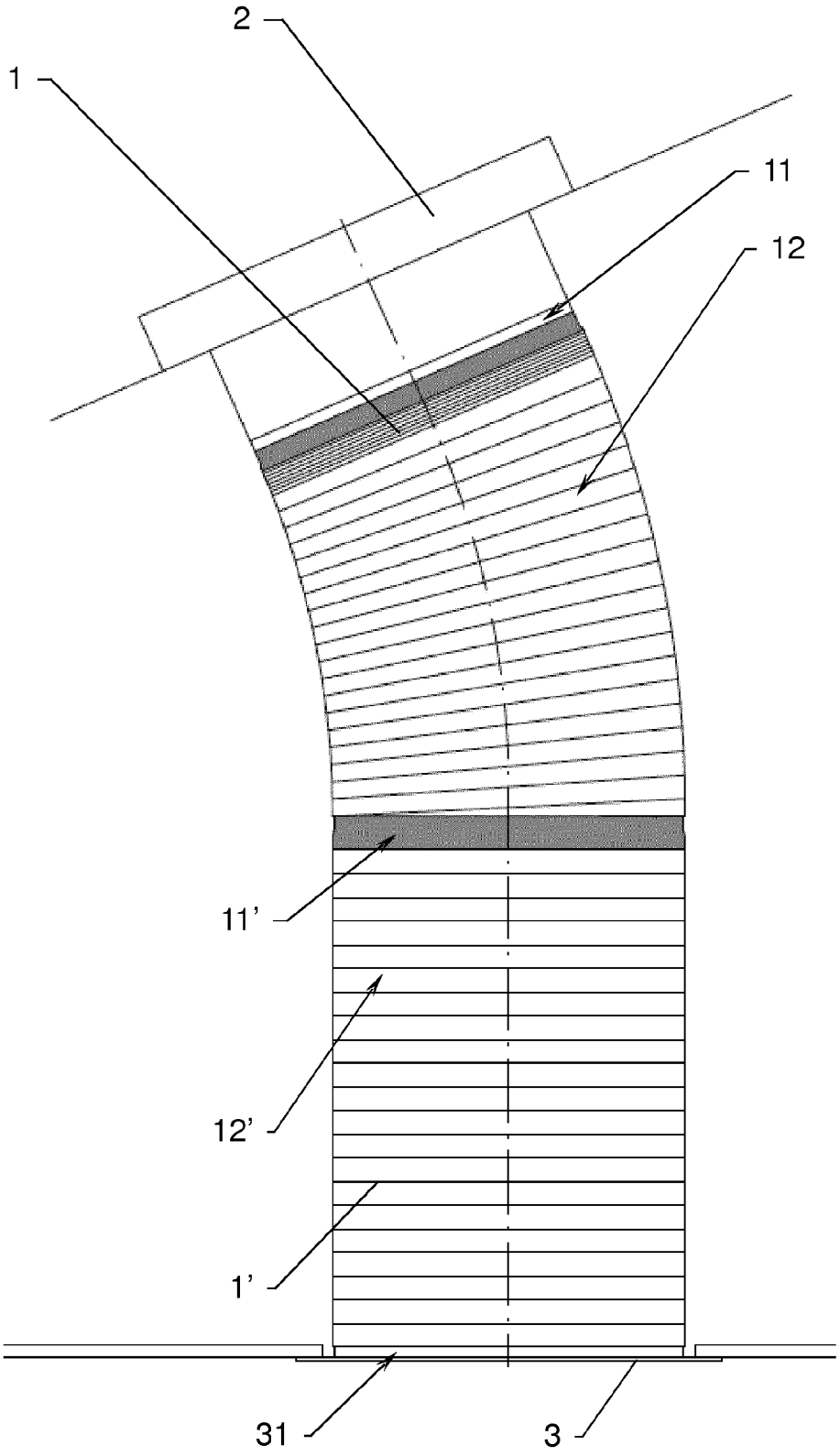

Fig. 3

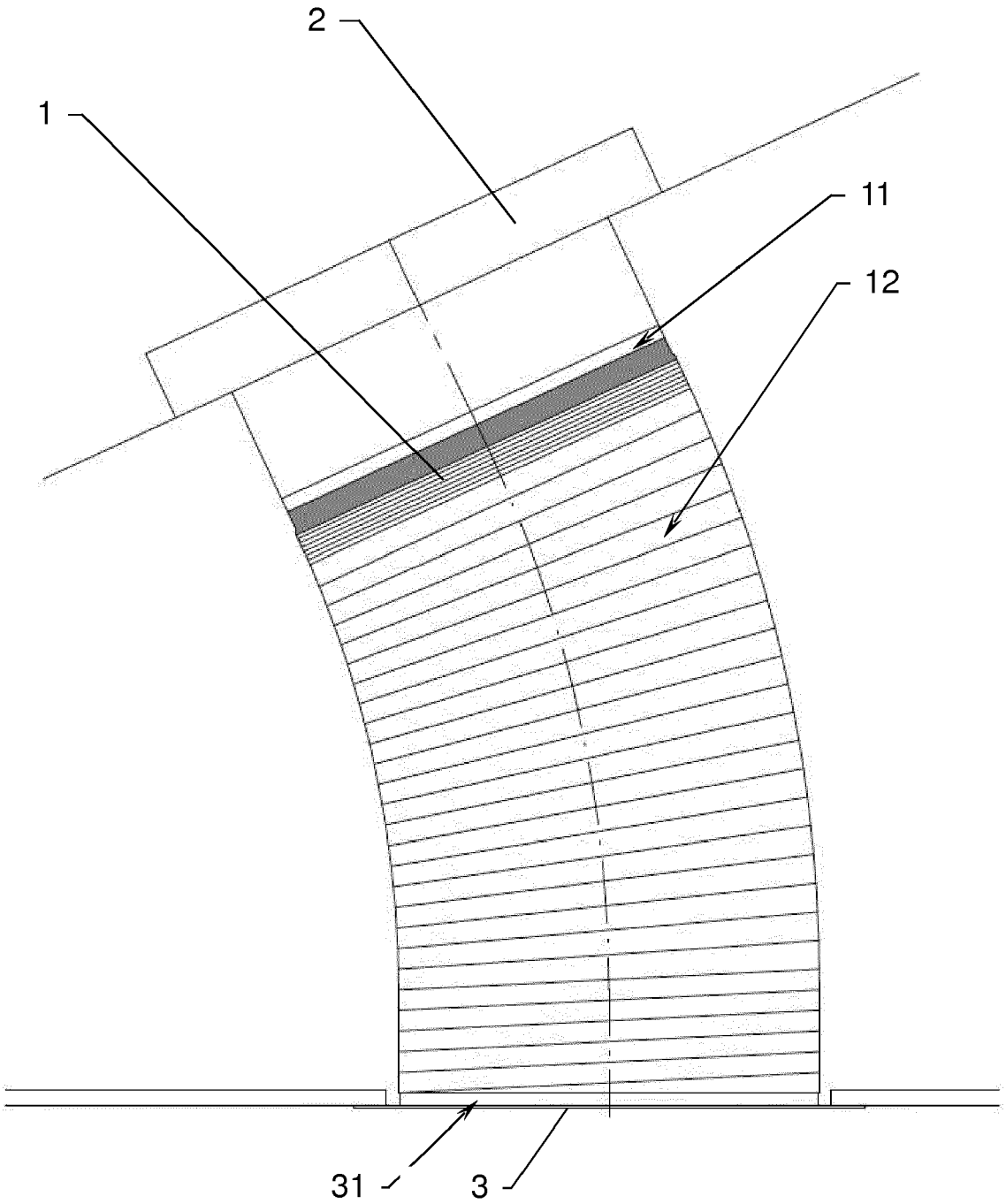

Fig. 4a

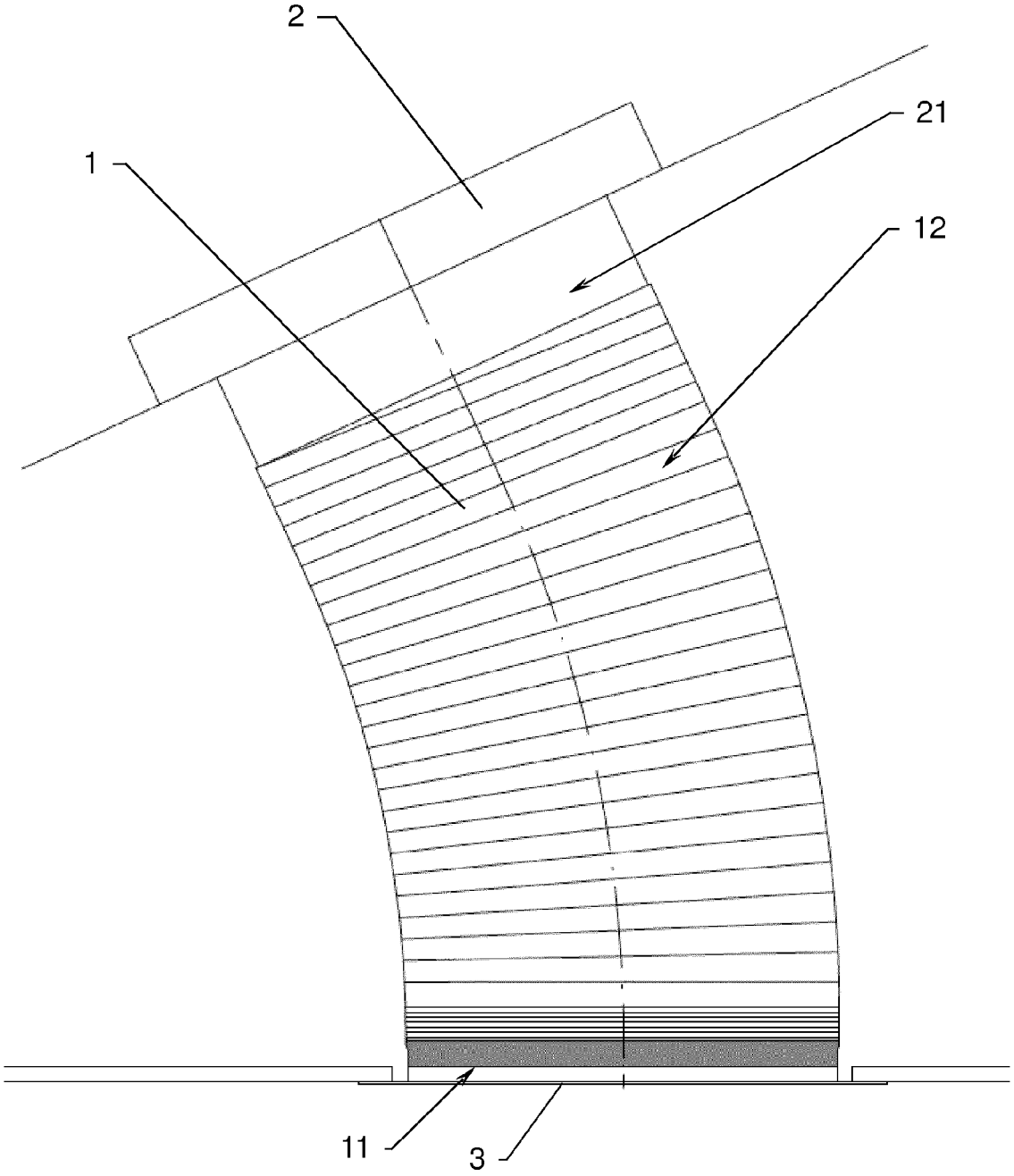

Fig. 4b

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 9094

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 339 900 A (FREEMAN WILLIAM T) 20 July 1982 (1982-07-20) * column 1, line 34 - column 2, line 23; figures 1-4 *	1,3-14	INV. E04D13/03 E04B9/32
X	JP H10 8658 A (SUMITOMO FORESTRY) 13 January 1998 (1998-01-13) * abstract; figures 1-3,5 *	1,3, 5-10, 12-14	
A	EP 2 381 047 A2 (VKR HOLDING AS [DK]) 26 October 2011 (2011-10-26) * figure 1 *	11	
A	EP 0 313 461 A1 (SIPLAST SA [FR]; SPIRAGAINE SA [FR]) 26 April 1989 (1989-04-26) * figures 2,3a,3b *	2	
A	WO 02/25032 A2 (STUDIO DOM SP Z O O [PL]) 28 March 2002 (2002-03-28) * abstract *	4	

TECHNICAL FIELDS SEARCHED (IPC)
E04D
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 April 2015	Leroux, Corentine

CATEGORY OF CITED DOCUMENTS

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29-04-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4339900 A	20-07-1982	NONE	
JP H108658 A	13-01-1998	NONE	
EP 2381047 A2	26-10-2011	NONE	
EP 0313461 A1	26-04-1989	DE 3860830 D1	22-11-1990
		EP 0313461 A1	26-04-1989
		FR 2621940 A1	21-04-1989
WO 0225032 A2	28-03-2002	PL 111432 U1	25-03-2002
		WO 0225032 A2	28-03-2002

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