



(12) **PATENT**

(11) **345341**

(13) **B1**

NORWAY

(19) **NO**

(51) **Int Cl.**

E21D 11/00 (2006.01)

E21D 11/04 (2006.01)

E21D 11/38 (2006.01)

Norwegian Industrial Property Office

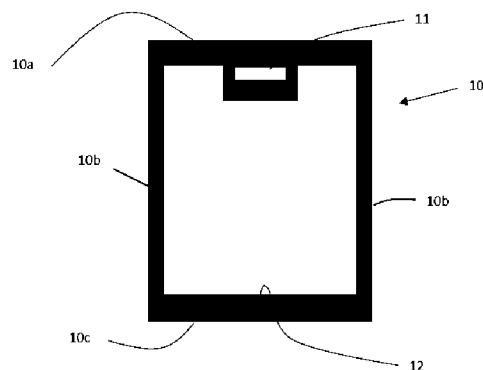
(21)	Application nr.	20171522	(86)	International Filing Date and Application Number
(22)	Date of Filing	2017.09.22	(85)	Date of Entry into National Phase
(24)	Date of Effect	2017.09.22	(30)	Priority
(41)	Publicly Available	2019.03.25		
(45)	Granted	2020.12.21		
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(54) Title **A tunnel profile element and a method of assembling a tunnel profile element.**

(56) References
Cited:
CN 104329102 A
US 2004/0050100 A1
EP 1564369 A1
DE 4403978 A1
EP 2287414 A1

(57) Abstract

The present invention disclose a tunnel profile element comprising a lightweight body constituted by foam glass panels sprayed with unbroken polyurea layer providing a fire resistant coating, and which is providing increased mechanical integrity of the tunnel profile element.



A tunnel profile element

FIELD OF THE INVENTION

The present invention is related to a tunnel profile element comprising sidewalls, roof
5 and floor elements of foam glass plates that are assembled and sprayed with an
unbroken layer of polyuria covering all visible outside surfaces of the tunnel profile
element.

BACKGROUND OF THE INVENTION

10 Road and railway tunnels are usually expensive to make, and security issues related
to possible fires and accidents inside tunnels are well known challenges in the prior
art. Conventional methods of building tunnels usually comprises drill and blast
methods providing the necessary and intended tunnel profile at correct dimensions.
15 It is also common to adapt and assemble concrete wall elements, thermal isolation,
fire protections, electric wires, communication lines, traffic lights, electric lightning,
water drainage etc. corresponding to the tunnel profile.

In recent years, it is common to provide images of the raw rock tunnel walls by
20 scanning the rock faces of the drilled and blasted tunnel with a moving laser thereby
identifying locations on the walls suitable for drilling bolts holding concrete wall
elements being assembled afterwards. The information from computerized images
captured via the laser scanning can be used to direct and position drilling equipment
moving inside the tunnel while drilling. Then the mounting of the concrete elements
25 is much easier and faster after the bolts have been attached to the rock walls.

The weight of concrete is high and the ability to handle heavy weight objects inside a
limit space like a tunnel limits the practical size of concrete wall elements of tunnels.

30 Further, tunnels need to be equipped with additional infrastructure elements like
escape-route tunnels, emergency communication systems, warning systems, airing
channels that can remove smoke from fires etc., and that can remove exhaust from
cars etc. Supplying fresh air from the outside of the tunnel is also necessary. It is
also necessary that any additional infrastructure element is fire and water protected,
35 for example.

Prior art tunnel designs include many parts providing solutions to respective technical problems. The concrete walls provide protection against parts of rock that may loosen from the tunnel rock faces and fall onto the traffic lanes or railway tracks, for example. Protection against ice formation and frost control is necessary since water freezing to ice increases in volume as known in prior art. The forces induced on the surroundings from freezing water, for example water left in cracks in the rock face of the tunnel, can be large in magnitude and can result in breaking stones free from the rock wall of the tunnel. Further, frost may make for example the roads in the tunnel very slippery. When concrete wall elements are assembled, it may be left voids between the concrete element surfaces facing the rock surface of the tunnel. Water may assemble in these voids, and if the ice formation protection is insufficient, the water in the voids may cause structural damage to the concrete walls of the tunnel.

US 200700138857 A1 disclose a vehicle with a milling arrangement on the top side of the machine. The milling arrangement includes a milling device for grinding an upper tunnel wall surface like tunnel ceilings of traffic tunnels. Such a vehicle with the milling arrangement is suitable for treating tunnel walls such that a desired limited surface roughness and removal of carbon black is achieved. This assures that a lining, which is applied to the tunnel ceiling and wall surface, is sufficiently attached to the surfaces.

US 8662796 B2 disclose a method for lining tunnel walls or ceilings with protective nets or the like, web-shaped protective net material is unwound from a reel and is fastened to the tunnel walls or ceiling by tie bolts. The reel is rotatable arranged. The rotation of the reel about a shaft is controlled in order to unwind the protective net material, the shaft being mechanically moved in steps along the tunnel walls or ceiling together with the reel. The stretching and mechanically fastening of the protective net are preferably executed when unwound in each step.

US 3561223 A disclose a tunnel making machine adapted not only to tunnel through the earth, but also to concurrently form a concrete wall in the tunnel. Forms for the concrete wall are erected by the machine at the head end thereof and are removed by the machine at the tail end thereof. The forms remain in place only long enough for the concrete to harden and are constantly reused, those from the tail end being transferred to the head end in a continuous process of form reuse. Removal of the

forms at the tail end of the machine leaves the tunnel complete rearward of the machine with a smooth concrete wall or bore.

CN 101638990 B disclose a fireproof thermal-insulation layer of a tunnel and a construction method thereof. The fireproof thermal-insulation layer comprises a polyurethane thermal-insulation layer connected with two linings of the tunnel and an external fireproof layer, wherein the fireproof layer is made by pressing one or two kinds of medium-alkali glass fiber cloth and non-woven fabric, which are taken as basal materials, and waterproof and fireproof components.

CN 104329102 A disclose a cold-proof heat insulation structure for a highway tunnel in a cold area and a construction method of the cold-proof heat insulation structure. The occurrence of damage to tunnels in a high-altitude cold rich-water area can be effectively prevented, and the construction quality and the driving safety are ensured. The cold-proof heat insulation structure comprises a bonding layer, a heat insulation layer, a protection layer and a reinforcing layer, wherein the bonding layer is formed by bonding mortar, the heat insulation layer is bonded on the base surface of a wall body of the tunnel structure through the bonding layer and is formed by foam glass products, the protection layer is arranged on the surface of the heat insulation layer and is formed by light-weight coating mortar, the reinforcing layer is arranged on the heat insulation layer through the light-weight coating mortar of the protection layer, and the reinforcing layer is an alkaline-resistant glass fibre gridding cloth.

The cost of making safe road and railway tunnels are high and therefore there is a need of improved tunnel designs providing cheaper tunnels that preferably are simpler to build, faster to build and which requires less maintenance and improved lifetime. It is also a need of facilitating simple and cheap installation of additional infrastructure elements in tunnels.

OBJECT OF THE INVENTION

It is a further object of the present invention to provide an alternative to the prior art.

In particular, it may be seen as an object of the present invention to provide a lightweight tunnel profile element facilitating lining of tunnel profiles as well as installation of respective tunnel infrastructure elements.

5 SUMMARY OF THE INVENTION

Thus, the above described object and several other objects are intended to be obtained in a first aspect of the invention by providing a tunnel wall element constituted by a lightweight element having thermal insulating properties coated with a fireproof coating increasing the mechanical integrity of the lightweight element.

- 10 An aspect of the present invention is to provide a tunnel profile element adaptable to respective aperture dimensions of raw tunnels, wherein the tunnel profile element comprises foam glass panels, wherein at least a tunnel floor element, at least respective sidewall elements and at least a roof element of foam glass panels are hold together by a sprayed unbroken surface layer of polyurea on all outside surfaces
15 of an assembled profile tunnel profile element.

Respective aspects of the present invention may each be combined with any of the other aspects. These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

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DESCRIPTION OF THE FIGURES

- The tunnel wall element and the method of building tunnel walls with the tunnel wall elements according to the present invention will now be described in more detail with reference to the accompanying figures. The accompanying figures illustrates an
25 example of embodiment of the present invention and is not to be construed as being limiting to other possible embodiments falling within the scope of the attached claim set.

Figure 1 illustrates an example of a tunnel profile element according to the present invention.

- 30 Figure 2 illustrates another example of a tunnel profile element according to the present invention.

Figure 3 illustrates another example of a tunnel profile element according to the present invention.

Figure 4 illustrates another example of a tunnel profile element according to the present invention.

- 5 Figure 5 illustrates another example of a tunnel profile element according to the present invention.

Figure 6a – 6b illustrates an example of assembling tunnel profile elements according to the present invention.

DETAILED DESCRIPTION OF AN EMBODIMENT

- 10 Although the present invention has been described in connection with the specified embodiments, it should not be construed as being in any way limited to the presented examples. The scope of the present invention is set out by the accompanying claim set. In the context of the claims, the terms "comprising" or "comprises" do not exclude other possible elements or steps. The mentioning of
15 references such as "a" or "an" etc. should not be construed as excluding a plurality. The use of reference signs in the claims with respect to elements indicated in the figures shall also not be construed as limiting the scope of the invention. Furthermore, individual features mentioned in different claims, may possibly be advantageously combined, and the mentioning of these features in different claims
20 does not exclude that a combination of features is not possible and advantageous.

A first aspect of the present invention is to combine water, fire and frost prevention features in a lightweight tunnel profile element constituted by assembled foam glass panels sprayed with a layer of unbroken polyurea.

- 25 Figure 1 illustrates an example of a rectangular shaped tunnel profile elements 10 according to the present invention.

- Av profile element is made with a periphery dimension adapted to the aperture of a raw tunnel profile wherein the profile element is intended to be used. The length of a tunnel profile element according to the present invention is in principle arbitrary but is usually manufactured with a set of different lengths for a specific tunnel. When
30 lining a raw tunnel with tunnel profile elements according to the present invention, a plurality of tunnel profile elements is inserted into the tunnel opening from one end

of the tunnel, one element after the other. The tunnel profile elements are attached together thereby covering the complete periphery and length of the raw tunnel surface including the raw tunnel roof, the raw walls of the tunnel as well as the bottom or floor of the raw tunnel. If the tunnel is straight, longer tunnel profile
5 elements may be made with a same length. If there are curves in the tunnel, smaller length of the tunnel profile elements makes the lining smother along the curved tunnel section. It is also within the scope of the present invention that for example the width of a tunnel profile element at the side of the profile element facing inwards to the interior of the tunnel can be larger or smaller than the width of the profile
10 element facing towards the raw tunnel side surfaces. In this manner, the elements can be adapted and assembled according to any type of curved tunnel surfaces.

The roof element of the tunnel profile element illustrated in Figure 1 is arranged with an additional infrastructure element 11 being for example an element of an airing channel. At the bottom or floor of the tunnel profile element 10 there is an opening
15 12 adapted to receive fluids, for example surface water, wherein the opening 12 is in fluid communication with a drainage pipe arranged below the bottom of the tunnel profile element 10. The opening 12 may not be present in all tunnel profile elements according to the present invention.

Figure 2 illustrates another example of embodiment comprising further additional
20 infrastructure elements 13, 14. The additional infrastructure elements 13, 14 may be used as additional airing channels, for example supplying fresh air into the tunnel from the outside of the tunnel. In such a case, additional openings will be arranged on a side surface of the airing channels 13 and 14 as well as the airing channel 11 discussed above. However, these additional infrastructure elements may be used to
25 support other items like power cables, communication lines etc.

Figure 3 illustrates another example of embodiment of the present invention wherein an escape-route tunnel element 15 is arranged on an adjacent sidewall element 10b of a tunnel profile element (10). The roof 16 of the escape-route element 15 is inclined downwards relative to the adjacent sidewall element 10b. Water inside rocks
30 of the tunnel can then flow over the inclined roof 16 and down on the side of the escape-route element 15 and be collected by arranged channels at the bottom of the raw tunnel.

Figure 5 illustrates another example of embodiment of the present invention, wherein the roof element 10a of the tunnel profile element is curved, and wherein an airing channel 11 is arranged on an outside surface of the roof element 10a. The figure 5 illustrates an example, wherein an escape-route tunnel element is arranged on both sides of the tunnel profile element 10. In addition, an additional channel 17 is arranged on top of the left most escape-route element 15. For example, an emergency communication line may be arranged inside the channel 17.

Further examples of additional infra structure elements that can be added to a tunnel profile element 10 according to the present invention, can be fire proof and water tight cabinets. Inside such cabinets it is possible to store for example fire extinguishers, an emergency telephone etc. The cabinet is made of polyurea sprayed foam glass panels, including an adapted cabinet door.

Figure 6a, Figure 6b and Figure 6c illustrates some principles that is used when joining a first tunnel profile element 20 to another tunnel profile element 20a.

The tunnel profile element is illustrated as a rectangular object with a certain thickness. The illustration is not intended to illustrate an actual tunnel profile element, but only the principle of how to join tunnel profile elements.

With reference to Figure 6a and Figure 6b, when spraying polyurea on a tunnel profile element 10 according to the present invention, a patch 19, 19a of polyurea is made extending outwardly from an edge of a surface 18 of the tunnel profile element 10, and which is flush with the surface 18. When joining a first tunnel profile element 20 with a second tunnel profile element 20a, the second tunnel profile element is joined to the first tunnel profile element 20 by applying polyurea 21 on an outside surface of the patch 19 facing towards the inner side of the tunnel. Then the second tunnel profile element 20a is positioned onto the surface of the patch having polyurea. The second tunnel profile element 20a is pushed towards the first tunnel profile element 20. Polyurea may also be applied over the joint between the first and second tunnel profile element 20, 20a on the surface facing towards the interior of the tunnel. A completely water and fireproof joint is established.

An alternative of using a polyurea sprayed foam glass panel in the floor element 10c of a tunnel profile element 10 as illustrated for example in Figure 1, is to install tunnel profile elements without floor elements 10c. Afterwards it is possible to distribute smashed foam glass plates (granulated foam glass) for example on the

raw tunnel bottom and add a layer of asphalt on top of the smashed foam glass. The smashed foam glass provides the necessary frost insulation of the floor element 10c.

It is also possible to add reinforcement rods inside foam glass panels used in a floor element 10c of a tunnel profile element 10. The rods may be of steel or be made from a composite material.

Lightning is also part of an infrastructure of a tunnel. According to an aspect of the present invention, LED lights may be integrated into surfaces of the polyurea sprayed foam glass panels according to the present invention. Power and control signals can be conveyed to respective LED lights via added channels 11, 13, 14 etc. illustrated in Figure 1 and Figure 2.

Besides providing light inside the tunnel, LED lights can also contribute to the safety of driving inside a tunnel. For example, when a profile of a tunnel is rectangular, reference Figure 1, the tunnel may be experienced to be somehow narrow. If LED lights are arranged to make the illusion of a star filled sky, the visual impression of the tunnel changes dramatically. In long tunnels, drivers may experience the tunnel as extremely monotone, which may affect their awareness. It is possible to arrange sections of LED lights with different colors, intensity, and it is possible to change colors automatically within time periods, or by external control signals a known in prior art.

The weight of a typical tunnel profile element 10 according to the present invention is about 30Kg/m². The thickness of the sides of the tunnel profile is typically about 10cm of foam glass panels with an additional thickness of polyurea of 0,5cm. However, the thickness can be increased if the frost conditions are severe in a tunnel. Therefore, a thickness of 25cm is also possible. The weight will increase accordingly.

Assembling of a tunnel profile element according to the present invention can be done by fastening respective foam glass panels in a support structure that is adapted or adaptable to specific dimensions of a tunnel profile element 10. Then a polyurea can be sprayed onto all surfaces of the tunnel profile element. A main aspect of the design is that it is not necessary to glue together respective panels forming the tunnel profile element before applying the polyurea. The polyurea itself holds the tunnel profile element together. It is also possible to add further foam glass panels or plates inside the support frame, wherein the added plates or panels constitute for

example channels as discussed above. Added plates of panels can be sprayed with polyurea at the same time as the other foam glass panels of the tunnel profile element, or after the other panels are cured. An example of a method of assembling a tunnel profile element is disclosed below.

- 5 According to an example of embodiment of the present invention, a tunnel profile element 10 adaptable to respective aperture dimensions of raw tunnels comprises foam glass panels, wherein at least a tunnel floor element 10c, at least respective sidewall elements 10b and at least a roof element 10a of foam glass panels are hold together by a sprayed
10 unbroken surface layer of polyurea on all outside surfaces of the assembled tunnel profile element 10.

Further, additional polyurea sprayed foam glass panels may constitute at least one airing channel element 11 arranged adjacent to the roof element 10a of the tunnel
15 profile element 10.

Further, additional polyurea sprayed foam glass panels may constitute at least one escape-route tunnel element 15 arranged adjacent to at least one of the sidewalls 10b of the tunnel profile element 10.
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Further, a roof element 16 of the escape-route tunnel element 15 may be inclined downwards relative to the adjacent sidewall element 10b of the tunnel profile element 10.

- 25 Further, the escape-route tunnel element 15 may comprise additional service channel elements 11, 13, 14, 17 constituted by additional polyurea sprayed foam glass panels.

Further, additional polyurea sprayed foam glass panels may constitute at least one
30 channel element arranged adjacent to the floor element 10c and/or the respective sidewall elements 10b and/or the roof element 10a of the tunnel profile element 10.

Further, additional polyurea sprayed foam glass panels may constitute at least one cabinet, including a hinged door element of the cabinet, arranged adjacent to a
35 sidewall element of the tunnel profile element.

Further, a plurality of assembled smaller polyurea sprayed foam glass panels may constitute a curved roof surface.

Further, the profile shape of the tunnel profile element may be rectangular.

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Further, the weight of a tunnel profile element is about 30 kg/m².

Further, a thickness of respective foam glass panels is typically about 10 cm.

- 10 Further, the foam glass panels may be constituted by a plurality of sandwiched thinner foam glass plates,
wherein a joint between a first thinner foam glass plate adjacent to a second thinner foam glass plate is covered by a third thinner foam glass plate located above or below the first and second thinner foam glass plates, wherein the sprayed unbroken
15 polyurea layer is applied on the outer surfaces of the respective sandwiched foam glass plates, thereby forming a panel.

- Further, a floor element 10c may arranged with a fluid drainage opening 12 being in fluid communication with a drainage pipe arranged below the floor element 10c of
20 the tunnel profile element 10.

Further, granulated recirculated glass may constitute respective foam glass panels.

- Further, additional support elements resting on the floor of the raw tunnel is
25 supporting the floor element 10c of the tunnel profile element 10.

Further, additional reinforcements rods may be included in the foam glass panels of the floor elements.

- 30 Further, a layer of smashed foam glass covered by asphalt may constitute the floor element 10c of the tunnel profile element 10.

Further, LED lights may be arranged in respective sidewall elements 10b and/or roof elements 10a of a tunnel profile element according to the present invention.

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Further, the LED lights in the roof element 10a may be configured as a star filled sky.

5 Further, the LED lights may be configured to change color on a regular basis, or in accordance with an externally submitted command.

According to an example of embodiment of the present invention, a method of assembling a tunnel profile element according to the present invention comprises steps of:

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- defining a shape and dimension of the tunnel profile element,
- arranging a support frame with the shape and dimension of the defined tunnel profile element,
- fastening respective adapted foam glass panels in the support frame,
- 15 - spraying an unbroken layer of polyurea on all visible outside surfaces of the foam glass panels resting in the support frame constituting the tunnel profile element.

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Further, additional foam glass panels arranged in the support frame may constitute further units of a finished tunnel profile 10 according to the present invention.

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Further, the additional foam glass panels may be sprayed with polyurea at the same time as the other outside surfaces of the other foam glass panels of the tunnel profile element is sprayed.

Further, the additional foam glass panels are sprayed after the other outside surfaces of the tunnel profile element is sprayed and cured.

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Further, the sprayed polyurea layer may extend outside at least an edge of a surface, and flush with said surface, constituting an outwardly protruding patch 19 of the tunnel profile element.

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Claims:

1. A tunnel profile element (10) adaptable to respective aperture dimensions of
raw tunnels, wherein the tunnel profile element (10) comprises foam glass
panels,
c h a r a c t e r i z e d b y:
wherein at least a tunnel floor element (10c), at least respective sidewall
elements (10b) and at least a roof element (10a) of foam glass panels are
hold together by a sprayed unbroken surface layer of polyurea on all outside
surfaces of an assembled profile tunnel profile element (10).
2. The tunnel profile element of claim 1, wherein additional polyurea sprayed
foam glass panels constitute at least one airing channel element (11)
arranged adjacent to the roof element (10a) of the tunnel profile element
(10).
3. The tunnel profile element of claim 1, wherein additional polyurea sprayed
foam glass panels constitute at least one escape-route tunnel element (15)
arranged adjacent to at least one of the sidewalls (10b) of the tunnel profile
element (10).
4. The tunnel profile element of claim 3, wherein a roof element (16) of the
escape-route tunnel element (15) is inclined downwards relative to the
adjacent sidewall element (10b) of the tunnel profile element (10).
5. The tunnel profile element of claim 3, wherein the escape-route tunnel
element (15) comprises additional service channel elements (17) constituted
by additional polyurea sprayed foam glass panels.
6. The tunnel profile element of claim 1, wherein additional polyurea sprayed
foam glass panels constitute at least one channel element (11, 13, 14, 17)
arranged adjacent to the floor element (10c) and/or the respective sidewall
elements (10b) and/or the roof element (10a) of the tunnel profile element
(10).

- 5 7. The tunnel profile element of claim 1, wherein additional polyurea sprayed foam glass panels constitute at least one cabinet, including a hinged door element of the cabinet, arranged adjacent to a sidewall element of the tunnel profile element (10).
8. The tunnel profile element of claim 1, wherein a plurality of assembled smaller polyurea sprayed foam glass panels constitute a curved roof surface.
- 10 9. The tunnel profile element of claim 1, wherein the profile shape of the tunnel profile element (10) is rectangular.
10. The tunnel profile element of claim 1, wherein the weight of a tunnel profile element is about 30 kg/m².
- 15 11. The tunnel profile element of claim 1, wherein a thickness of respective foam glass panels typically is about 10 cm.
- 20 12. The tunnel profile element of claim 1, wherein the foam glass panels are constituted by a plurality of sandwiched thinner foam glass plates, wherein a joint between a first thinner foam glass plate adjacent to a second thinner foam glass plate is covered by a third thinner foam glass plate located above or below the first and second thinner foam glass plates, wherein the sprayed unbroken polyurea layer is applied on the outer surfaces of the respective sandwiched foam glass plates thereby constituting the panel.
- 25 13. The tunnel profile element of claim 1, wherein a floor element is arranged with a fluid drainage opening (12) being in fluid communication with a drainage pipe arranged below the floor element (10c) of the tunnel profile element.
- 30 14. The tunnel profile element of claim 1, wherein additional support elements resting on the floor of the raw tunnel is supporting the floor element of the tunnel profile element.
- 35 15. The tunnel profile element of claim 1, wherein additional reinforcement rods are included in the foam glass elements of the floor elements (10c).

16. The tunnel profile element of claim 1, wherein LED lights are arranged in respective sidewall elements (10b) and/or roof elements (10a).

17. The tunnel profile element of claim 16, wherein the LED lights in the roof element (10a) is configured as a star filled sky.

18. The tunnel profile element of claim 16-17, wherein the LED lights are configured to change color on a regular basis, or in accordance with an externally submitted command.

19. A method of assembling a tunnel profile element of any claim 1-18, characterized by steps of:

- defining a shape and dimension of the tunnel profile element (10),
- arranging a support frame with the shape and dimension of the defined tunnel profile element, and fastening respective adapted foam glass panels inside the support frame,
- assembling the profile element (10) by spraying an unbroken layer of polyurea on all visible outside surfaces of the foam glass panels resting in the support frame constituting the tunnel profile element (10).

20. The method of claim 20, wherein additional foam glass panels arranged in the support structure constitute further units of a finished tunnel profile.

21. The method of claim 21, wherein the additional foam glass panels are sprayed with polyurea at the same time as the other outside surfaces of the other foam glass panels of the tunnel profile element is sprayed.

22. The method of claim 22, wherein the additional foam glass panels are sprayed after the other outside surfaces of the tunnel profile element is sprayed and cured.

23. The method of claim 20, wherein the sprayed polyurea layer extends outside at least an edge of a surface, and flush with said surface, constituting an outwardly protruding patch (19) of the tunnel profile element.

Krav:

1. Tunnelprofilelement (10) tilpasningsbart til respektive åpningsmål av ubearbeidede tunneler, hvor tunnelprofilelementet (10) omfatter skumglassplater, karakterisert ved at:
i det minste et tunnelgulvelement (10c), i det minste respektive sideveggelementer (10b) og i det minste et takelement (10a) dannet av skumglassplater holdes sammen av et sprayet uavbrutt overflatelag av polyurea på alle utside-overflater av et sammenstilt tunnelprofilelement (10).
2. Tunnelprofilelement ifølge krav 1, hvor ytterligere polyurea sprayede skumglassplater omfatter minst ett luftekanalelement (11) anordnet ved siden av takelementet (10a) til tunnelprofilelementet (10).
3. Tunnelprofilelement ifølge krav 1, hvor ytterligere polyuretan sprayede skumglassplater omfatter minst ett rømningsvei-tunnelement (15) anordnet ved siden av minst én av tunnelprofilelementets (10) sidevegger (10b).
4. Tunnelprofilelement ifølge krav 3, hvor et takelement (16) eller rømningsvei-tunnelement (15) er skråstilt i forhold til det tilstøtende sideveggelementet (10b) til tunnelprofilelementet (10).
5. Tunnelprofilelement ifølge krav 3, hvor rømningsvei-tunnelement (15) omfatter ytterligere servicekanalelementer (17) dannet av ytterligere polyurea sprayede skumglassplater.
6. Tunnelprofilelement ifølge krav 1, hvor ytterligere polyurea-sprayede skumglassplater omfatter minst ett kanalelement (11, 13, 14, 17) anordnet ved siden av gulvelementet (10c) og / eller de respektive sideveggelementer(10b) og / eller takelementet (10a) til tunnelprofilelementet (10).
7. Tunnelprofilelement ifølge krav 1, hvor ytterligere polyuretan-sprayede skumglassplater danner minst ett skap, inkludert et hengslet dørelement til skapet anordnet tilstøtende et sideveggelement av tunnelprofilelementet (10).

8. Tunnelprofilelement ifølge krav 1, hvor en flerhet av mindre polyurea sprayede skumglassplater danner en buet takflate.

5 9. Tunnelprofilelement ifølge krav 1, hvor profilformen til tunnelprofilelementet (10) er rektangulært.

10. Tunnelprofilelement ifølge krav 1, hvor vekten av et tunnelprofilelement er ca. 30 kg / m².

10 11. Tunnelprofilelement ifølge krav 1, hvor en tykkelse av respektive skumglassplater typisk er ca. 10 cm.

12. Tunnelprofilelement ifølge krav 1, hvor skumglassplatene er dannet av et antall tynne lagdelte skumglassplater,
15 hvor en forbindelse mellom en første tynnere skumglassplate tilstøtende en andre tynnere skumglassplate er dekket av en tredje tynnere skumglassplate plassert over eller under den første og den andre tynnere skumglassplaten, hvor det sprayede ubrutte polyurea-laget påføres på de ytre utside-overflatene av de respektive lagdelte-skumglassplatene og danner dermed panelet.

20 13. Tunnelprofilelement ifølge krav 1, hvor et gulvelement er anordnet med en fluiddreneringsåpning (12) som er i fluidforbindelse med et dreneringsrør anordnet under gulvelementet (10c) av tunnelprofilelementet.

25 14. Tunnelprofilelement ifølge krav 1, hvor ytterligere støtteelementer som hviler på gulvet av den ubearbeidede tunnelen støtter gulvelementet til tunnelprofilelementet.

15. Tunnelprofilelement ifølge krav 1, hvor ytterligere forsterkningselementer er inkludert i skumglasselementene til gulvelementene (10c).

30 16. Tunnelprofilelement ifølge krav 1, hvor LED-lys er anordnet i respektive sideveggelementer (10b) og / eller takelementer (10a).

17. Tunnelprofilelementet ifølge krav 16, hvor LED-lampene i takelementet (10a) er
35 konfigurert som en stjernefylt himmel.

18. Tunnelprofilelement ifølge krav 16-17, hvor LED-lampene er konfigurert til å endre farge regelmessig, eller i samsvar med en eksternt sendt kommando.

19. Fremgangsmåte ved montering av et tunnelprofilelement ifølge et hvilket som helst av kravene 1-18, k a r a k t e r i s e r t v e d trinnene:

- å definere en form og dimensjon av tunnelprofilelementet (10),
- å arrangere en støtteramme med formen og dimensjonen til det definerte tunnelprofilelementet,
- å feste respektive tilpassede skumglassplater i støtterammen,
- å sette sammen tunnelprofilelementet (10) ved å spraye et ubrutt lag av polyurea på alle synlige ytre overflater av skumglassplattene som hviler i støtterammen som danner tunnelprofilelementet (10).

20. Fremgangsmåte ifølge krav 19, hvor ytterligere skumglassplater anordnet i bærerammen omfatter ytterligere enheter av en ferdig sammenstilt tunnelprofil.

21. Fremgangsmåte ifølge krav 20, hvor de ytterligere skumglassplater sprayes med polyurea samtidig som de andre utvendige sidene til de andre skumglassplatene til tunnelprofilelementet blir sprayet.

22. Fremgangsmåte ifølge krav 20, hvor de ytterligere skumglassplatene sprayes etter at de andre utvendige sidene av tunnelprofilelementet er sprayet og herdet.

23. Fremgangsmåte ifølge krav 19, hvor det sprayede polyurea laget strekker seg utenfor minst en kant av en overflate og i plan med overflaten, som danner en utstikkende lapp (19) av tunnelprofilelementet.

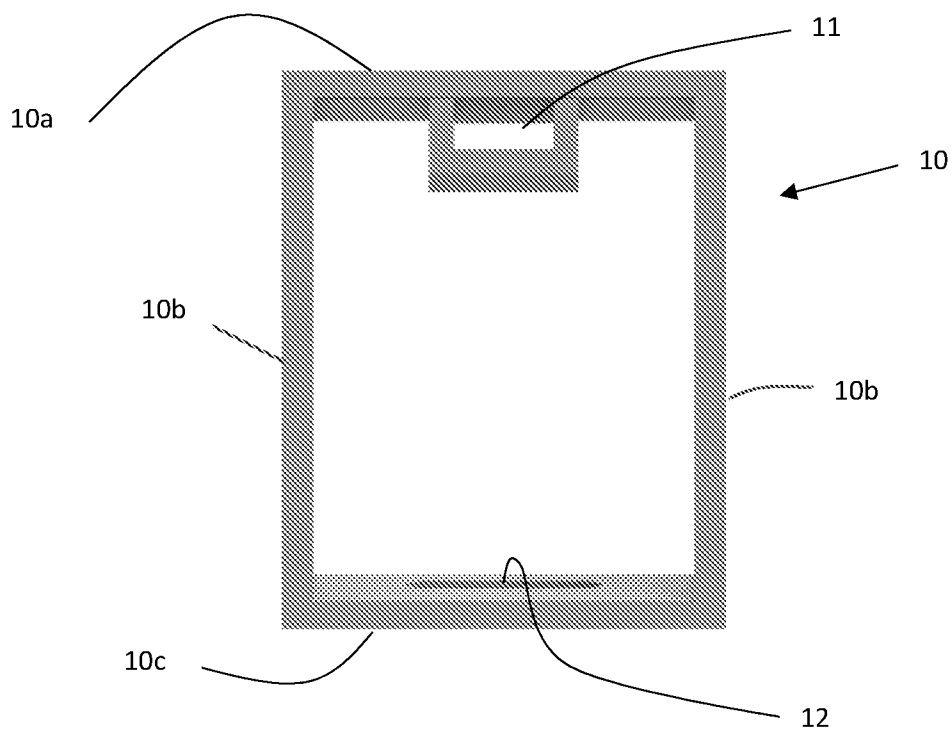


Figure 1

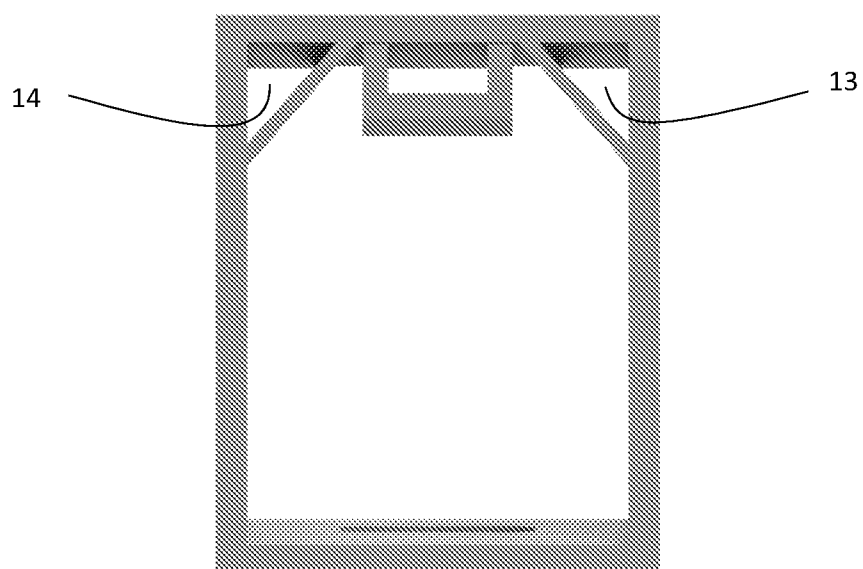


Figure 2

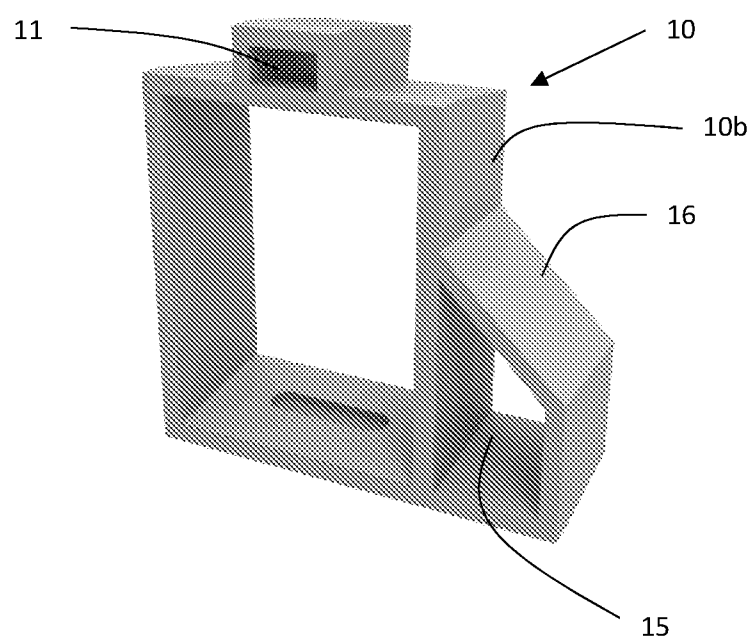


Figure 3

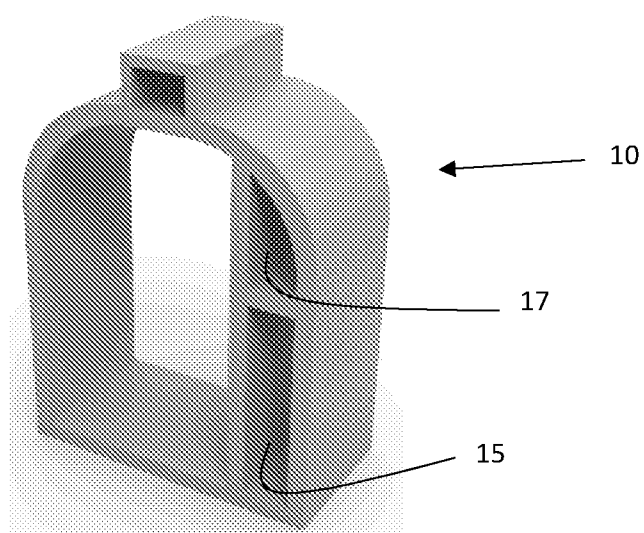


Figure 4

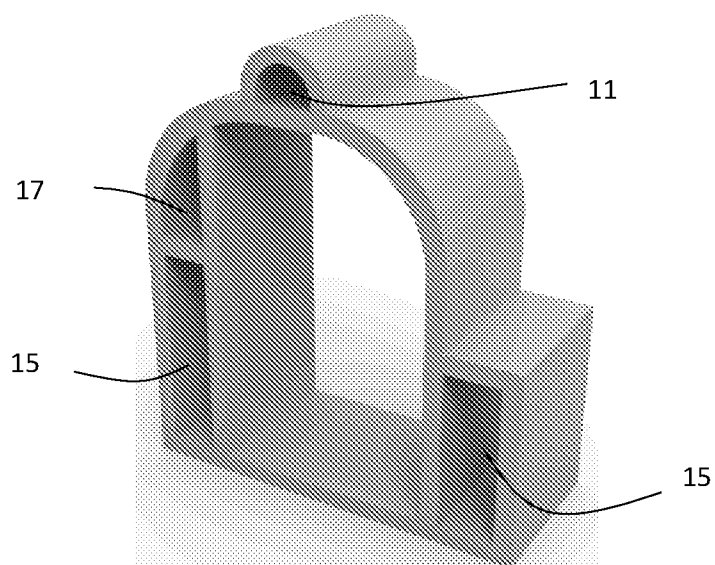


Figure 5



Figure 6a

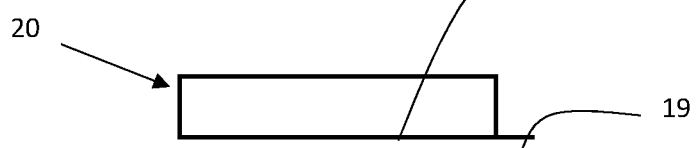


Figure 6b

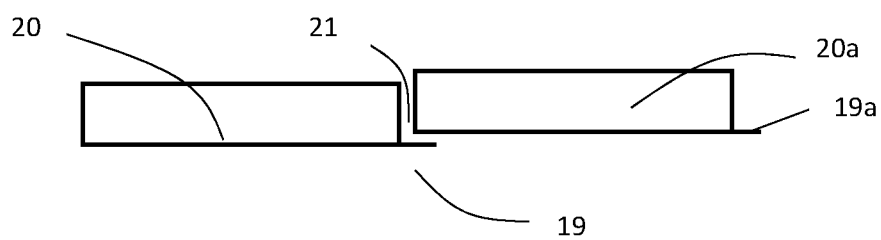


Figure 6c