(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 569 785 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.11.2019 Bulletin 2019/47

(51) Int Cl.:
E04B 1/94 *(2006.01)*

(21) Application number: **18171971.7**

(22) Date of filing: **14.05.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **HILTI Aktiengesellschaft**
9494 Schaan (LI)

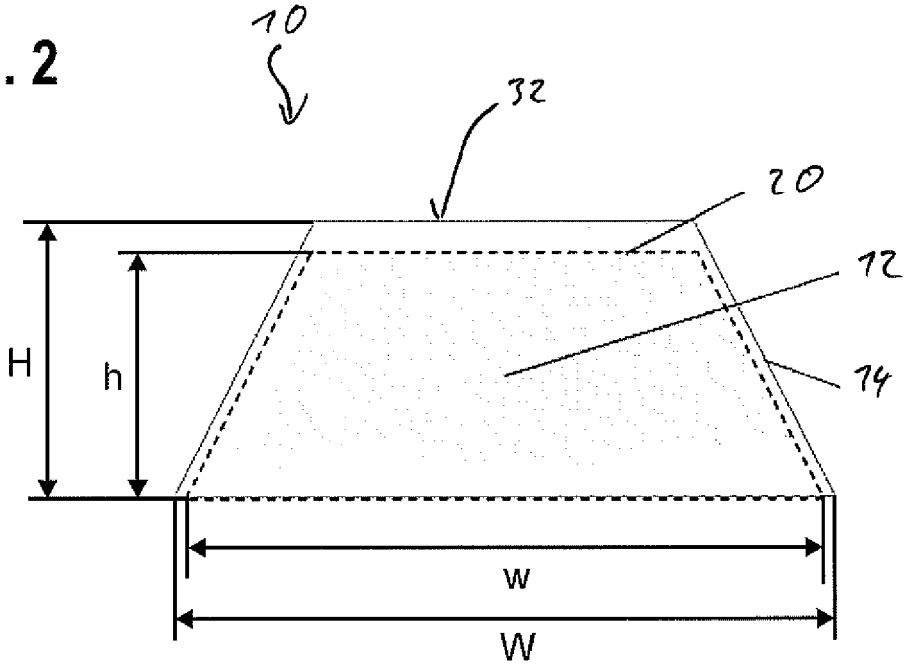
(72) Inventors:
- **Klein, Manfred**
  86916 Kaufering (DE)
- **Förg, Christian**
  86862 Lamerdingen (DE)
- **Phifer, Kevin**
  9434 Au (CH)

(74) Representative: **Hilti Aktiengesellschaft**
Corporate Intellectual Property
Feldkircherstrasse 100
Postfach 333
9494 Schaan (LI)

(54) **SEALING ELEMENT FOR SEALING A FLUTE OF A FLUTED METAL DECK**

(57) A sealing element (10) for sealing a flute of a fluted metal deck is described. The sealing element (10) comprises a body (12) and a coating (14) surrounding the body (12). The body (12) has a predefined geometry adapted to seal the flute, wherein the body (12) is flexible and the cross sectional area of the body (12) in a direction perpendicular to the flute axis is larger than the cross sectional area (20) of the flute the sealing element (10) is designed to seal.

Fig. 2



EP 3 569 785 A1

Description

[0001] The present invention relates to a sealing element for sealing a flute of a fluted metal deck.

[0002] Fluted metal decks are known in the art. Very often, they are used in combination with wall configurations, especially drywall configurations. In this case, a ceiling runner is attached to the underside of the metal deck and a floor runner is attached to the floor. Between those two runners, studs are mounted in a way that a relative movement between the ceiling runner and the studs is permitted in a vertical direction. The studs, the ceiling runner and the floor runner form a frame to which gypsum boards can be attached in order to build a drywall configuration.

[0003] Usually, a defined movement joint is left between the lower side of the metal deck and the upper edges of the gypsum boards.

[0004] In order to provide a deck and wall configuration which is air-tight, sound-attenuating or even sound-proof, fire-resistant, smoke-proof and/or thermally isolating, the flutes of the metal deck and the movement joint have to be sealed.

[0005] This is especially important for fire rated walls.

[0006] According to the state of the art, mineral wool is stuffed into the gaps mentioned above from both sides of the wall and subsequently coated, e. g. with a sprayable coating which acts as a smoke stopper.

[0007] The process of sealing involves several working steps and thus is cumbersome. Moreover, it involves working with mineral wool. As this material can cause skin irritation, workers have to put on protective clothing when in contact with mineral wool.

[0008] Furthermore, the quantity of mineral wool filled into the gaps and the quality of performing this work is heavily dependent on the person fulfilling this task. The result is a variation in the sealing quality.

[0009] Applying the spray coating represents an additional working step. Since the gypsum boards are already installed at the time the coating is being applied, the spray needs to be applied from both sides of the wall. This is time consuming for an operator having to perform this task.

[0010] The object of the invention is to further improve the sealing of fluted metal decks, especially by improving the sealing of the regular flutes between adjacent fluted deck elements or in one of the fluted deck elements of a fluted metal deck.

[0011] The invention provides a sealing element for sealing a flute of a fluted metal deck, comprising a body and a coating surrounding the body. The body has a predefined geometry adapted to seal a flute between adjacent fluted deck elements or in one of the fluted deck elements of the fluted metal deck. The body is flexible and the cross sectional area of the body in a direction perpendicular to the flute axis is larger than the cross sectional area of the flute the sealing element is designed to seal. In this way, the sealing element is pre-portioned and oversized to provide a suitable amount of sealing material that ensures a secure sealing of a flute. Because the body is flexible, the shape of the sealing element can be adapted to the individual shape of a flute, thereby guaranteeing a tight fit, especially when the sealing element is pressed into the flute. Further, the coating prevents the user from getting into contact with the material of the body so protective clothing is not necessary even if the body material would otherwise warrant such protection.

[0012] In an embodiment of the invention, the shape of the cross section of the body corresponds to the shape of the cross section of the flute the sealing element is designed to seal. Thus, providing a better fit and seal. In the context of the invention, unless stated otherwise, all cross sections extend perpendicular to the direction the flutes extend in.

[0013] Usually flutes of a fluted metal deck have a generally trapezoidal cross section. Therefore, a preferred shape of the cross section of the body is a corresponding trapezoid.

[0014] The body may be made of mineral wool, especially a formaldehyde-free mineral wool. Mineral wool has multiple advantageous characteristics, like being fire-resistant, sound-attenuating and thermally isolating. Also, mineral wool is relatively inexpensive and easy to shape. Because of the coating surrounding the body, the user is protected from getting into contact with the material itself.

[0015] In a further embodiment of the invention, the body is made of multiple adjacent layers of mineral wool, especially wherein the layers are oriented parallel to the cross sectional area of the body, i.e. the layers extend perpendicular to the flute axis. This enables the body to better adapt to the overall flute geometry, especially if the flute geometry varies along the flute axis, because each layer can individually adapt the shape of the corresponding section of the flute.

[0016] The coating may be made of a thin plastic film which is flexible and easily adaptable to provide a tight sealing of the flute.

[0017] In an embodiment of the invention, the coating is stretchable which allows the coating to tightly fit to various shapes.

[0018] The rigidity of the coating can be lower than the rigidity of the body. In this way, a higher compression strength is needed to deform the body than the coating which results in a sealing element wherein the body is able to push the coating into form and not the other way around. Thus, when the sealing element is inserted in a flute, the body pushes the coating adjacent to the metal deck, thereby tightly sealing the flute.

[0019] In a further embodiment of the invention, the body is tightly enveloped by the coating, so that there is minimal to no air between the coating and the body. This prevents the formation of air blisters when the sealing element is inserted into a flute. Also, the coating material for surrounding the body is kept to a minimum.

[0020] In another embodiment of the invention, the coating is provided in the form of a bag, wherein the maximum volume of the bag is larger than the volume of the body, i.e. the bag is oversized in regard to the body. This enables the coating to tightly fit to the outline of the flute without creating additional pressure to the body. As a result a softer body material can be used which is more easily adaptable to the shape of a flute.

[0021] To prevent the sealing element from forming air blister when the sealing element is inserted in a flute, the coating is not air tight. Thus, air can pass from inside of the coating to the surrounding and vice versa so that air pressure can equalize.

[0022] Different embodiments of the invention are shown in the attached drawings.

- Figure 1 shows a perspective view of a sealing element according to an embodiment of the invention,
- Figure 2 shows a cross sectional view of the sealing element of figure 1,
- Figure 3 shows a perspective view of the sealing element of figure 1 with a cutaway section showing the internal structure,
- Figure 4 shows a cross sectional view of a fluted metal deck section with a sealing element according to figure 1,
- Figure 5 shows a schematic cross sectional view of a sealing element according to another embodiment of the invention,
- Figure 6 shows a perspective of the sealing element of figure 5, and
- Figure 7 shows a cross sectional view of a wall configuration with a sealing element according to figure 5.

[0023] Figures 1 and 2 show a first embodiment of a sealing element 10 with a flexible body 12 surrounded by a coating 14.

[0024] The body 12 has a trapezoid cross section with a height H and a width W as well as a length L the body 12 extends in, perpendicular to its cross section along the horizontal axis A.

[0025] The thickness of the coating 14 is only a small fraction of the dimensions of the body 12, i.e. the coating 14 is so thin that for all intends and purposes the height H and width W of the body 12 correspond to the height H and width W of the sealing element 10.

[0026] The sealing element 10 is designed to seal a flute 16 of a fluted metal deck 18 (see figure 4) extending along the horizontal axis A (see also figure 7) that is perpendicular to the drawing plane in figure 4. The cross section 20 of the flute 16 perpendicular to the horizontal axis A is generally trapezoidal with a depth h and a width w (see also figure 2 where the cross section 20 of the flute 16 is illustrated by the dashed line).

[0027] The height H and the width W of the body 12 is larger than the depth h and the width w of the flute 16 respectively (see figure 2). Thus, the cross sectional area of the sealing element 10 is larger than the cross sectional area 20 of the flute 16 which means that the body 12 is oversized in comparison to the flute 16.

[0028] The embodiment of the body 12 shown in figures 1 and 2 has a cross section with a shape that corresponds to the shape of the cross section 20 of the flute 16 as both cross sections are trapezoidal with a similar shape.

[0029] Because the body 12 is flexible, the shape of the body's 12 cross section can also be rectangular, have rounded edges or basically can have any other shape as long as its cross section guarantees a secure seal of the flute 16 the sealing element 10 is designed to seal.

[0030] The length L of the body 12 is defined by firestop requirements and is usually equal to or smaller than the track width T (see figure 7) of a top track 28 of a wall configuration.

[0031] In a different embodiment the length L of the body 12 is larger than the track width T of a top track 28, in particular the length of the body 12 can correspond to the width of a top track seal 30 (see figure 4) of a wall configuration.

[0032] In this way, the body 12 has a predefined geometry to seal the flute 16.

[0033] The body 12 is made of multiple layers 22 of mineral wool forming a stack (see figure 3). The layers 22 are identical and run parallel to each other. The cross section of each layer 22 is perpendicular to the horizontal axis A, i.e. the cross section of each layer 22 corresponds to the cross section of the body 12.

[0034] The multiple layers 22 forming the body 12 are separate layers 22 of mineral wool. In a different embodiment the body 12 can be made of a single block of mineral wool that has an internal layered structure, i.e. the layers 22 are integral to the block of mineral wool.

[0035] In a further different embodiment the body 12 can be made of a single block or can be composed from multiple blocks, especially layers, in any kind of way.

[0036] The body 12 is made of a formaldehyde-free mineral wool.

[0037] In a different embodiment the body 12 can be made a different suitable material, especially any kind of mineral wool.

[0038] The body 12 is pre-portioned so that it comprises enough material to ensure a tight seal of the flute 16 the sealing element 10 is designed to seal. In this way, the sealing element 10 is adapted to seal the flute 16 by its predefined shape and size.

[0039] The coating 14 is made of a flexible and stretchable plastic foil, like a shrink foil, that tightly surrounds the body 12 on all sides. Thus, the body 12 is completely enclosed by the coating 14 with minimal to no air pockets

between the body 12 and the coating 14. In an alternative embodiment, the coating 14 only partially surrounds the body 12, especially along a circumference of the body12.

[0040] The body 12 is sealed air tight by the coating 14.

[0041] In an alternative embodiment, the coating 14 is not air tight so that air can pass from the inside of the sealing element 10 to its outside and vice versa. To this effect the coating 14 can comprise ventilation holes 24 (see figure 6) or a seam through which air can pass. In addition or in the alternative, the coating 14 may be made of a porous or air permeable material, e.g. a foil with micro-perforation.

[0042] Figure 4 shows the sealing element 10 inserted in the flute 16 between the metal deck 18 and a ceiling runner 26 with a top track 28 and a top track seal 30.

[0043] To seal the flute 16 the sealing element 10 is pushed into the flute 16 perpendicular to the metal deck 18 with the narrow side 32 (see figure 1) of the sealing element 10 facing the flute 16 with enough pressure so that the sealing element 10 is deformed and adapts the shape and size of the flute 16. Afterwards, the sealing element 10 is pushed along the horizontal axis A (see figure 7) in the opening between the metal deck 18 and the ceiling runner 26.

[0044] Thereby the sealing element 10 is compressed such that the height H and width W of the sealing element 10 corresponds to the height h and width w of the flute 16 which results in the sealing element 10 completely filing the cross section 20 of the flute 16 and sealing the flute 16 tight.

[0045] In the example shown in figure 4 the metal deck 18 has a corrugation 34 in the form of an indentation that extends into the flute 16 and that runs along the flute axis A. The sealing element 10 is designed to tightly seal flutes 16 with or without corrugations 34.

[0046] When the sealing element 10 is inserted into a flute 16 with a corrugation 34, the sealing element 10 adapts the shape of the flute 16 including the corrugation 34 as shown in figure 4.

[0047] In figure 4 a dashed line indicates a faulty state in which the tension of the narrow side 32 of the sealing element 10 creates small pockets 36 or openings between the sealing element 10 and the metal deck 18 which can reduce the sealing quality of the seal. To prevent these pockets 36 from forming, the rigidity of the coating 14 is lower than the rigidity of the body 12 which results in the coating 14 being more easily deformed than the body 12 so that the tension of the coating 14 on the body 12 is reduced.

[0048] To further ensure a tight seal, the body 12 is elastic so that the coating 14 is pushed by the body 12 against the metal deck 18 which also prevents pockets 36 from forming. This has the additional advantage that the sealing element 10 keeps its shape even when deformed prior to its use.

[0049] In a further embodiment of the invention, the elasticity of the body 12 is very low or non-existent.

[0050] A second embodiment of the sealing element is shown in figures 5 and 6. Apart from the different coating 14, the sealing element 40 corresponds to the sealing element 10 described above. The same reference symbols are used for the components that are known from the first embodiment and reference is made to the previous explanations in this respect.

[0051] In this embodiment of the invention, the coating 14 of the sealing element 40 is not tightly wrapped around the body 12 but is provided in the form of a bag 42 which contains the body 12.

[0052] The bag 42 is oversized, i.e. the volume the bag 42 can contain is larger than the volume of the body 12. The drawing in figure 5 is not to scale and the size difference between the body 12 and the bag 42 is for illustrative purposes only.

[0053] Basically, the ratio of the volume of the bag 42 to the volume of the body 12 is greater than 1. Preferably the ratio is less than 1.3, more preferably less than 1.2, especially less than 1.1.

[0054] Figure 7 shows a fluted metal deck 18 with a top track 28 of a wall configuration installed below. To seal the flute 16, the sealing element 40 is pushed in direction P into the opening 44 between the metal deck 18 and the top track 28, wherein the body 12 is oriented in a way that its cross section corresponds to the cross section of the flute 16 so that the sealing element 40 fits tight into the opening 44.

[0055] To prevent air blisters 46 (indicated by the dashed line in figure 7) from forming when the sealing element 40 is used to seal a flute 16, the bag 42 has ventilation holes 24 (see figure 6) that allow the air to escape and the blisters 46 to depressurize.

[0056] In the embodiment shown in figure 6, the ventilation holes 24 are located on the narrow side 32 of the sealing element 40. In an alternative embodiment, the ventilation holes 24 can be located anywhere in the coating 14, especially on the sides 48, 50 that face in direction of the flute axis A.

[0057] In a further embodiment of the invention, the volume of the bag 42 not taken up by the body 12 is only partially filled with air. Preferably there is only a minimal amount of air between the body 12 and the coating 14, especially when the coating 14 is air tight, to minimize or prevent air blisters 46.

[0058] The sealing elements 10, 40 improve the sealing of flutes 16 of a fluted metal deck 18 in the following ways:

The flutes 16 can be tightly sealed in a short amount of time without the need of additional tools.

[0059] The sealing elements 10, 40 can be installed during the installation of the ceiling runner 26, the top track 28 and/or a top track seal 30. In this way, the flutes 16 are easily accessible and no additional "ladder climbing" is required.

[0060] The sealing of the flutes 16 is failure proof as the pre-manufactured sealing elements 10, 40 ensure that the necessary material required for a tight seal is installed by comprising a pre-proportioned body 12.

[0061] Further, the sealing of the flutes 16 requires no curing time because the material, the sealing elements 10, 40 are made of, is already cured.

Claims

1. A sealing element (10, 40) for sealing a flute (16) of a fluted metal deck (18), comprising a body (12) and a coating (14) surrounding the body (12), wherein the body (12) has a predefined geometry adapted to seal the flute (16), wherein the body (12) is flexible and the cross sectional area of the body (12) in a direction perpendicular to the flute axis (A) is larger than the cross sectional area (20) of the flute (16) the sealing element (10, 40) is designed to seal.

2. The sealing element according to claim 1, **characterized in that** the shape of the cross section of the body (12) corresponds to the shape of the cross section (20) of the flute (16).

3. The sealing element according to any preceding claim, **characterized in that** the body (12) is made of mineral wool, especially a formaldehyde-free mineral wool.

4. The sealing element according to claim 3, **characterized in that** the body (12) is made of multiple layers (22) of mineral wool, especially wherein the layers (22) are oriented parallel to the cross sectional area of the body (12).

5. The sealing element according to any preceding claim, **characterized in that** the coating (14) is made of a thin plastic film.

6. The sealing element according to any preceding claim, **characterized in that** the coating (14) is stretchable.

7. The sealing element according to any preceding claim, **characterized in that** the rigidity of the coating (14) is lower than the rigidity of the body (12).

8. The sealing element according to any preceding claim, **characterized in that** the body (12) is tightly enveloped by the coating (14).

9. The sealing element according to any one of claims 1 to 7, **characterized in that** the coating (14) is provided in the form of a bag (42), wherein the volume of the bag (42) is larger than the volume of the body (12).

10. The sealing element according to claim 9, **characterized in that** the coating (14) is not air tight.

Fig. 1

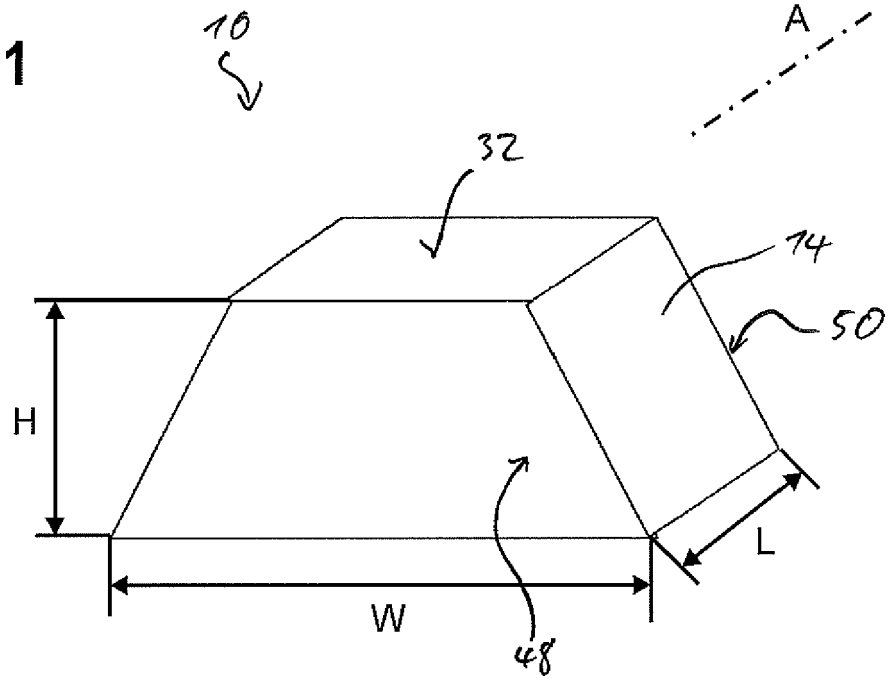


Fig. 2

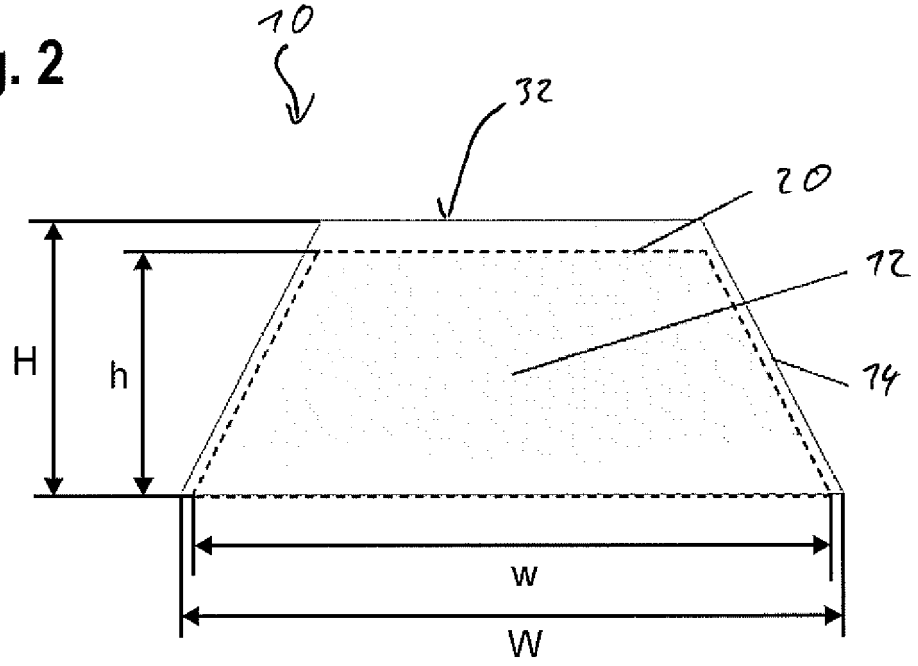


Fig. 3

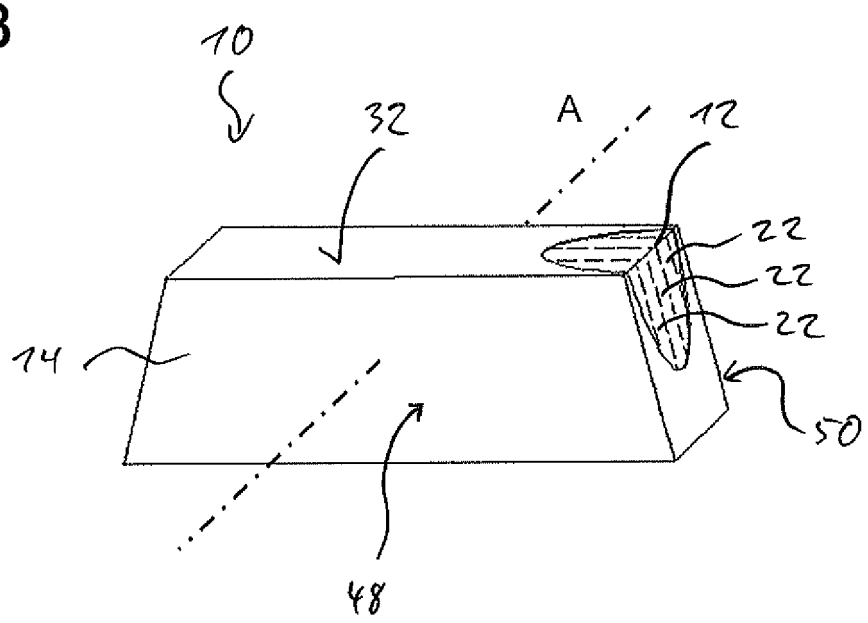


Fig. 4

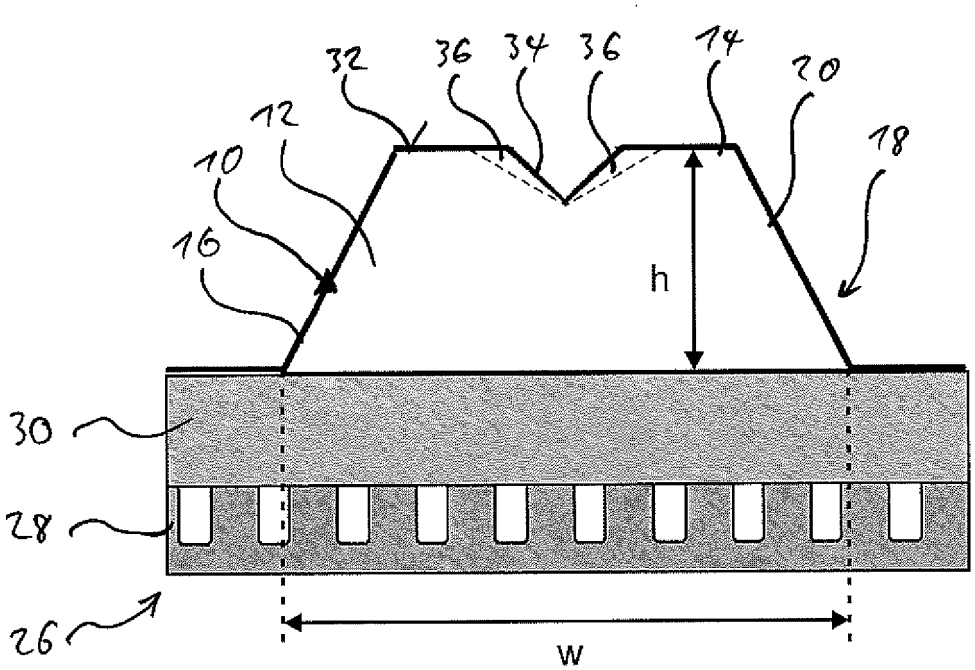


Fig. 5

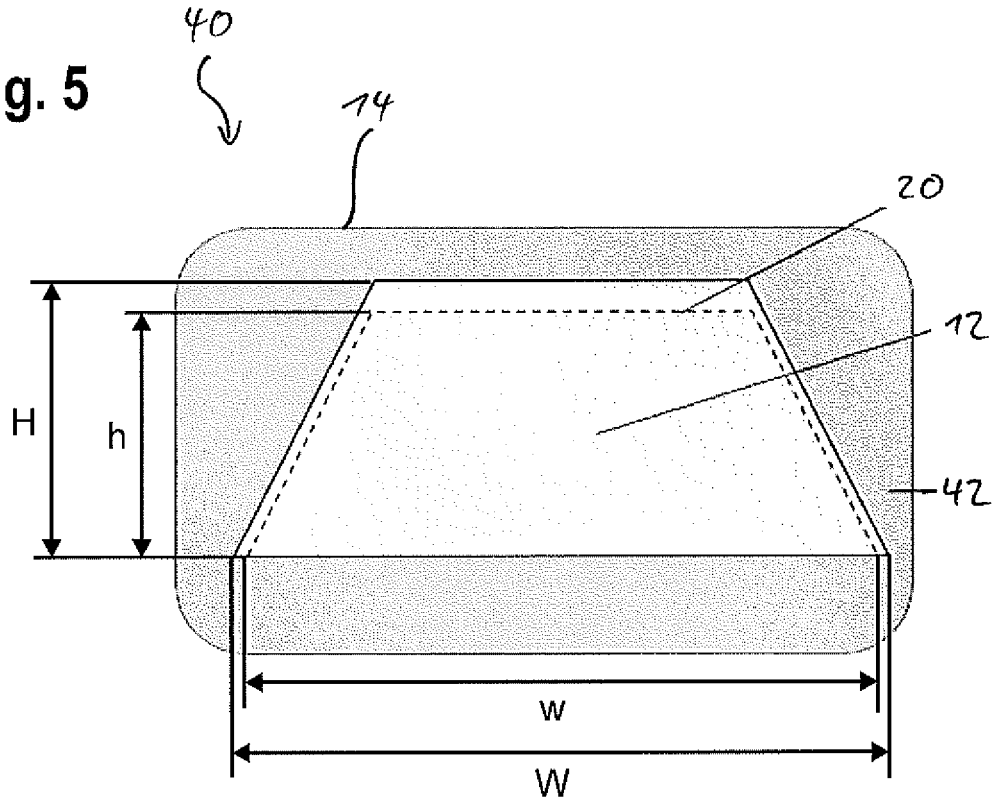
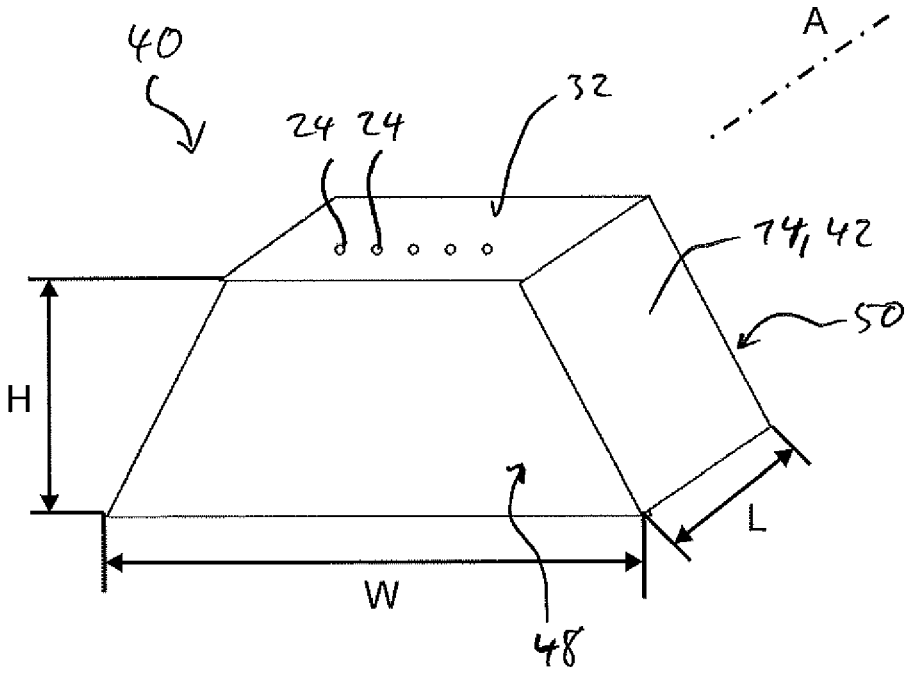


Fig. 6



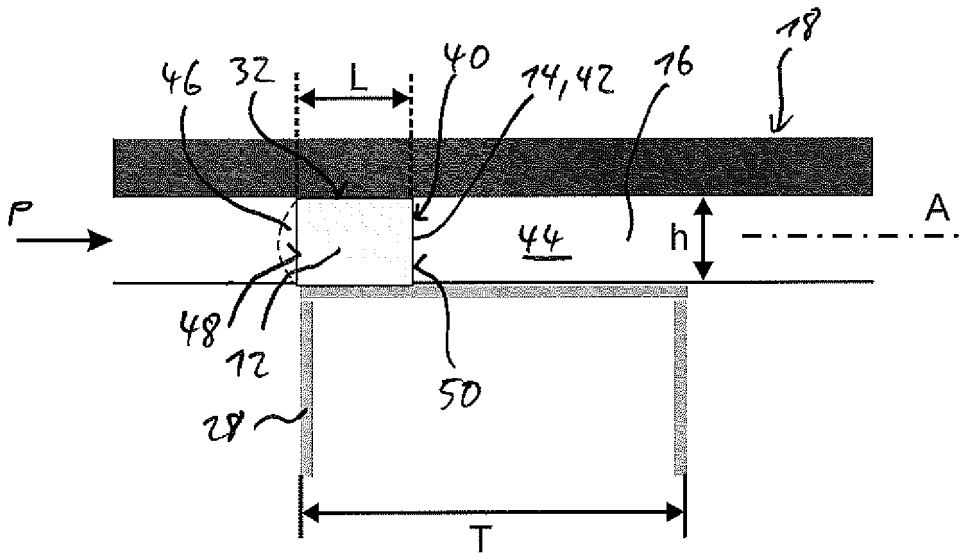


Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 17 1971

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 2016/201319 A1 (PILZ DON A [US]) 14 July 2016 (2016-07-14) * paragraph [0136] - paragraph [0137]; figures 19,20 *	1-10	INV. E04B1/94
X	WO 2009/026464 A2 (CALIFORNIA EXPANDED METAL PROD [US]; PILZ DON [US]; POLIQUIN RAYMOND E) 26 February 2009 (2009-02-26)	1-4	
A	* paragraph [0067] - paragraph [0068]; figures 11,12a *	5-10	
A	DE 20 2017 106075 U1 (HILTI AG [LI]) 9 November 2017 (2017-11-09) * the whole document *	1-10	
A	WO 2005/000496 A1 (BLUESCOPE STEEL LTD [AU]; BRAUN ADRIAN [AU]) 6 January 2005 (2005-01-06) * the whole document *	1-10	
A	JP H06 42090 A (KANEGAFUCHI CHEMICAL IND; NIPPON KOKAN LIGHT STEEL KK) 15 February 1994 (1994-02-15) * the whole document *	1-10	TECHNICAL FIELDS SEARCHED (IPC) E04B
A	JP H07 4620 U ([JP]) 24 January 1995 (1995-01-24) * the whole document *	1-10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 November 2018	Lopes, Claudia

CATEGORY OF CITED DOCUMENTS

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 17 1971

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-11-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016201319 A1	14-07-2016	NONE	
WO 2009026464 A2	26-02-2009	CA 2697295 A1	26-02-2009
		CA 2827183 A1	26-02-2009
		US 2009049777 A1	26-02-2009
		US 2010126092 A1	27-05-2010
		WO 2009026464 A2	26-02-2009
DE 202017106075 U1	09-11-2017	NONE	
WO 2005000496 A1	06-01-2005	NONE	
JP H0642090 A	15-02-1994	NONE	
JP H074620 U	24-01-1995	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82