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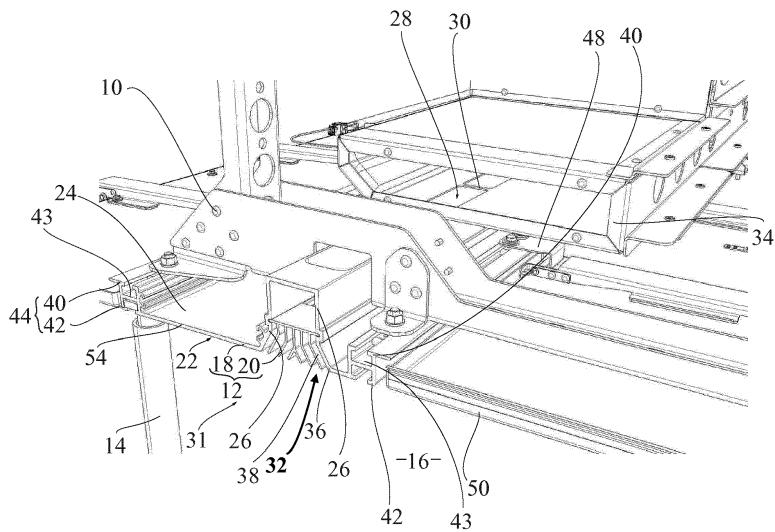
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**(54) LINEAR AIR DIFFUSER MODULE COMPRISING A MULTIFUNCTIONAL SUPPORT MEMBER FOR A CAR BODY OF A PUBLIC TRANSPORTATION VEHICLE**

(57) A linear air diffuser module (12), comprises an elongated support member (18) and a diffuser plate (20). The support member (18) including two longitudinal upright wall portions (26) facing one another and laterally enclosing a longitudinal air channel (28) provided with at least one upper opening and at least one elongated lower opening (31). The air diffuser plate (20) extends between the two longitudinal upright wall portions (26) to cover the lower opening (31) and is provided with diffusion openings (32) to direct a flow of air from the air channel

(28) to an interior space (16) of a vehicle body of a public transportation vehicle. The support member (18) is a multifunctional structural member of the vehicle body provided with at least two upper C-shaped attachment rails (40) for attaching the linear air diffuser module (12) to the ceiling structure (10) and one or more lower C-shaped attachment rails (42) for attaching interior fitments (14) of the interior space (16) of the vehicle body to the support member (18).

Fig. 1



## Description

### TECHNICAL FIELD OF THE INVENTION

**[0001]** The present invention relates to an air diffuser module in a public transportation vehicle, in particular a rail vehicle.

### BACKGROUND ART

**[0002]** A linear air diffuser for the delivery of conditioned air to the interior of a passenger vehicle such as a bus, railcar or the like is disclosed in US 4,354,323. The diffuser consists of a frame structure with a pair of open ended longitudinally extending delivery channels situated in a generally parallel side-by-side relationship. Each of the channels is turned to extend laterally outwardly in opposite directions and is provided with a curved interior surface on one wall to intercept input air so as to induce eddy current turbulence in the flow characteristics of the delivered air. The input openings to the channels are partially closed by a common longitudinal plate releasably affixed to the frame structure. The lateral peripheral edges of the plate serve to determine the width of a narrow longitudinal input orifice for each of the channels.

**[0003]** A linear air diffuser for the ventilation of a vehicle is disclosed in DE202012009059U1. The air diffuser includes a U-shaped extruded profile, and air guide elements formed as extruded profiles, which are clipped into the U-shaped profile. The air guide elements can be clipped in two positions to direct the air flow in two opposite directions. The structure of the linear air diffuser is modular in that the number of air guide elements in each direction can be varied when the air diffuser is assembled. This modularity, however, is limited insofar as the shape of the air guide elements is always the same. Moreover, the linear air diffuser is not a structural member of the vehicle, i.e. it is not possible to attach interior fitments of the vehicle e.g. grab poles or rails, to the air diffuser.

### SUMMARY OF THE INVENTION

**[0004]** The invention aims to provide an improved linear air diffuser, which has a greater versatility and modularity and can be used in various configurations in different rail vehicles and, once installed, can be easily adapted in case of refurbishing or retrofitting.

**[0005]** According to a first aspect of the invention, there is provided a linear air diffuser module, comprising:

- an elongated support member having a longitudinal direction, a lower face intended to face an interior space of a vehicle body of a public transportation vehicle and an upper face intended to face a ceiling structure of the vehicle body, the support member including two longitudinal upright wall portions facing

one another and laterally enclosing a longitudinal air channel provided with at least one upper opening and at least one elongated lower opening;

5 - a diffuser plate extending between the two longitudinal upright wall portions to cover the lower opening, the diffuser plate being provided with diffusion openings to direct a flow of air from the air channel to the interior space;

10 **[0006]** The support member is a multifunctional structural member of the vehicle body provided with at least two upper C-shaped attachment rails for attaching the linear air diffuser module to the ceiling structure and one or more lower C-shaped attachment rails for attaching interior fitments of the interior space of the vehicle body to the support member, wherein the air channel is located between the two upper C-shaped attachment rails.

15 **[0007]** Because the support member is dimensioned as a structural member of the vehicle body, it can be used as interface for fixing various interior fitments, which may include grab poles, grab rails, display screens or partition walls. Because the diffuser plate is separate from the support member, its design can be postponed or altered 20 until the final stage of the design process without having to redesign other parts of the car body or interior trim, in particular the support member or the interior fitments interfaced via the support member to the ceiling structure.

25 **[0008]** Preferably, at least one, and preferably each of 30 one or more lower C-shaped attachment rails has a common bottom wall with a respective one of the at least two upper C-shaped attachment rails. The lower C-shaped attachment rail and the respective upper C-shaped attachment rail form together a particularly rigid H-shaped rail, which contributes to the rigidity of the structural member and constitutes an interface to direct forces from the interior fitments directly to the ceiling structure.

35 **[0009]** According to a preferred embodiment, at least 40 one of the two longitudinal upright wall portions is provided with a protruding and/or recessed attachment profile and the diffuser plate is provided with a matched attachment portion for attaching the diffuser plate to the support member. Advantageously, the matched attachment portion of the diffuser plate is in sliding engagement

45 with protruding and/or recessed attachment profile. Alternatively, the matched attachment portion of the diffuser plate is clipped into or onto the protruding and/or recessed attachment profile. These embodiments enable a delayed differentiation during the design and the assembly process, i.e. the actual shape of the diffuser plate 50 can be defined at the last minute without involving a complex redesign of the structural member or surrounding parts.

**[0010]** Other attachment means can be envisaged. In 55 particular, the diffuser plate can be fixed to the support member by means of one or more bolts or screws.

**[0011]** According to various embodiments:

- The support member can be an extruded profile.
- The air channel can be provided with only one elongated lower opening.
- The support member can include one or more lighting openings for inserting one or more lighting modules.
- The two longitudinal upright wall portions can have diverging lower end portions defining at least one lower opening, and parallel upper end portions leading to at least one upper opening.
- The one or more lower C-shaped attachment rails can include at least two lower C-shaped attachment rails, in which case the air channel is preferably located between the two lower C-shaped attachment rails.
- The diffusion openings can include perforated holes and elongate slots.
- The diffuser plate is preferably an extruded profile.

**[0012]** According to a preferred embodiment, the support member includes at least one flat portion extending between the air channel and one of the upper C-shaped attachment rails. Advantageously, the diffuser plate is flush with the flat portion of the support member. Alternatively, the diffuser plate can be recessed with respect to the flat portion of the support member.

**[0013]** According to one embodiment, the support member is made of aluminium. Alternatively, the support member can be made of a glass reinforced plastic or a high-pressure laminate.

**[0014]** According to another aspect of the invention there is provided a vehicle body of a public transportation vehicle, comprising a ceiling structure and the linear air diffuser module as described above, wherein the linear air diffuser module is located between the ceiling structure and an interior space of the vehicle body, a lower face of the support member of the linear air diffuser module faces the interior space of the vehicle body, the upper face of the support member faces the ceiling structure, the linear air diffuser module is attached to the ceiling structure via mounting brackets inserted in the at least two upper C-shaped attachment rails and at least one interior fitment of the interior space of the vehicle body inserted in and secured to the at least one of the one or more lower C-shaped attachment rails. In particular, the interior fitment can be a grab pole, a grab rail, a draught screen, a partition wall or a passenger counter.

#### BRIEF DESCRIPTION OF THE FIGURES

**[0015]** Other advantages and features of the invention will then become more clearly apparent from the following

description of a specific embodiment of the invention given as non-restrictive examples only and represented in the accompanying drawings in which:

- 5 - Figure 1 is an isometric view of a ceiling region of a car body of a public transportation vehicle including a linear air diffuser module according to one embodiment of the invention;
- 10 - Figure 2 is an isometric view of a linear air diffuser module according to a second embodiment of the invention;
- 15 - Figure 3 is an isometric view of a linear air diffuser module according to a third embodiment of the invention;
- 20 - Figure 4 is an isometric view of a linear air diffuser module according to a third embodiment of the invention;
- 25 - Figure 5 is an across-sectional view of a linear air diffuser module according to a third embodiment of the invention;

**[0016]** Corresponding reference numerals refer to the same or corresponding parts in each of the figures.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0017]** With reference to Figure 1, a vehicle body of a public transportation vehicle comprises a ceiling structure **10**, a linear air diffuser module **12** fixed to the ceiling structure **10** and an interior fitment **14** such as a grab pole, a grab rail, a draught screen, a partition wall or a passenger counter located in an interior space **16** of the vehicle body and fixed to the air diffuser module **12**.

**[0018]** The linear air diffuser module **12** comprises an elongated support member **18** and a diffuser plate **20**. The elongated support member **18** is an extruded profile made of aluminium and has a longitudinal direction perpendicular to the plane of Figure 1, which can be aligned with or perpendicular to the longitudinal direction of the vehicle body. The elongated support member **18** has a lower face **22** that faces the interior space **16** of the vehicle body and an upper face **24** that faces the ceiling structure **10**. The support member **18** includes two longitudinal upright wall portions **26** facing one another, which laterally enclose a longitudinal air channel **28** provided with a plurality of upper openings **30** towards the ceiling structure **10** and a single elongated lower opening **31** towards the interior space **16**. The two longitudinal upright wall portions **26** have diverging lower end portions, which form the lower opening **31**, and parallel upper end portions, which lead to the upper openings **30**.

**[0019]** The diffuser plate **20** is an extruded profile, which extends between the two longitudinal upright wall

portions **26** to cover the lower opening **31**. The diffuser plate **20** is provided with diffusion openings **32**. A secondary air duct **34** derived from a main air duct (not shown) of the vehicle body extends directly on top of the support member **18** and is connected to the longitudinal air channel **28** to direct an air flow from the secondary air duct **34** to the longitudinal air channel **28** and from there to the interior space **16** through the diffusion openings **32** of the diffuser plate **20**.

**[0020]** In the embodiments illustrated in Figures 1, 2 and 3, the longitudinal upright wall portions **26** can each be provided with a longitudinal slot **36** that forms an attachment profile for an attachment portion **38** of matching shape of the diffuser plate **20**, for attaching the diffuser plate **20** to the support member **18**. The diffuser plate **20** is inserted at one end of the elongated support member **18** and can slide into place.

**[0021]** In the alternative embodiment of Figure 4, the longitudinal upright portions can be provided each with a continuous longitudinal rib **136** and the diffuser plate **20** is provided with a projecting elastic tab **138** of matching shape for holding the diffuser plate **20** in place. This clip attachment can be reversible or not.

**[0022]** According to another alternative embodiment illustrated in Figure 5, the diffuser plate **20** is provided with an angled mounting bracket **238** fixed to the one of the longitudinal upright wall portions **26** via a bolt or screw **236**.

**[0023]** The support member **18** is a multifunctional structural member of the vehicle body provided with at least two upper C-shaped attachment rails **40** and one or more lower C-shaped attachment rails **42** for attaching interior fitments **14** of the interior space **16** of the vehicle body to the support member **18**. In the illustrated embodiments, two lower C-shaped attachment rails **42** are provided and the air channel **28** is located between the two lower C-shaped attachment rails **42** and between the upper C-shaped attachment rails **40**. Each lower C-shaped attachment rail **42** has a common bottom wall **43** with a respective one of the upper C-shaped attachment rails **40**, to form a stiffened H-shaped profile portion **44**, which provides a high strength to the support member **18**.

**[0024]** The linear air diffuser module **12** is attached to the ceiling structure **10** via mounting bolts **46** inserted in the two upper C-shaped attachment rails **40**. The lower C-shaped attachment rails **42** can be used to attach an upper end of an interior fitment **14** of the interior space **16** of the vehicle body. The upper C-shaped attachment rails **40** or lower C-shaped attachment rails **42** can be used to secure mounting brackets **48** (see Fig. 1) for mounting suspended ceiling panels **50**. Alternatively, an angled profile section **52** can protrude from the H-shaped profile portion **44** as shown in Fig. 4 to support the suspended ceiling panels **50**.

**[0025]** The support member **18** may include a flat portion **54** extending between the air channel **28** and one of the upper C-shaped attachment rails **40**. This flat portion **54** can be provided with lighting openings **56** for inserting

lighting modules **58**. The diffuser plate **20** can be flush with the flat portion **54** of the support member **18** as illustrated in Figs. 1 to 3 and 5 or recessed into the longitudinal air channel **28** as shown in Fig. 4. The diffusion openings **32** can be elongated slots formed between orientation blades as illustrated in Figs. 1, 2 and 5 or perforated holes as illustrated in Figs. 3 and 4.

**[0026]** As a variant, the support member **18** can be made of a glass reinforced plastic or a high-pressure laminate.

## Claims

15. 1. A linear air diffuser module (12), comprising:

- an elongated support member (18) having a longitudinal direction, a lower face (22) intended to face an interior space (16) of a vehicle body of a public transportation vehicle and an upper face (24) intended to face a ceiling structure (10) of the vehicle body, the support member (18) including two longitudinal upright wall portions (26) facing one another and laterally enclosing a longitudinal air channel (28) provided with at least one upper opening and at least one elongated lower opening (31);  
- a diffuser plate (20) extending between the two longitudinal upright wall portions (26) to cover the lower opening (31), the diffuser plate (20) being provided with diffusion openings (32) to direct a flow of air from the air channel (28) to the interior space (16);

**characterised in that** the support member (18) is a multifunctional structural member of the vehicle body provided with at least two upper C-shaped attachment rails (40) for attaching the linear air diffuser module (12) to the ceiling structure (10) and one or more lower C-shaped attachment rails (42) for attaching interior fitments (14) of the interior space (16) of the vehicle body to the support member (18), wherein the air channel (28) is located between the two upper C-shaped attachment rails (40).

2. The linear air diffuser module (12) of claim 1, **characterised in that** at least one, and preferably each of the one or more lower C-shaped attachment rails (42) has a common bottom wall (43) with a respective one of the at least two upper C-shaped attachment rails (40).

3. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** at least one of the two longitudinal upright wall portions (26) is provided with a protruding and/or recessed attachment profile (36) and the diffuser plate (20) is provided with a matched attachment portion (38) for at-

taching the diffuser plate (20) to the support member (18).

4. The linear air diffuser module (12) of claim 3, **characterised in that** the matched attachment portion (38) of the diffuser plate (20) is in sliding engagement with protruding and/or recessed attachment profile (36). 5

5. The linear air diffuser module (12) of claim 3, **characterised in that** the matched attachment portion (38) of the diffuser plate (20) is clipped into or onto the protruding and/or recessed attachment profile (36).

6. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the diffuser plate (20) is fixed to the support member (18) by means of one or more bolts or screws (238).

7. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the support member (18) is an extruded profile.

8. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the air channel (28) is provided with only one elongated lower opening (31). 25

9. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the support member (18) includes one or more lighting openings (56) for inserting one or more lighting modules (58). 30

10. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the support member (18) includes at least one flat portion (54) extending between the air channel (28) and one of the upper C-shaped attachment rails (40). 35

11. The linear air diffuser module (12) of claim 10, **characterised in that** the diffuser plate (20) is flush with the flat portion (54) of the support member (18). 40

12. The linear air diffuser module (12) of claim 10, **characterised in that** the diffuser plate (20) is recessed with respect to the flat portion (54) of the support member (18). 45

13. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the two longitudinal upright wall portions (26) have diverging lower end portions defining the at least one lower opening (31), and parallel upper end portions leading to the at least one upper opening. 50

14. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the one or 55

more lower C-shaped attachment rails (42) include at least two lower C-shaped attachment rails (42), wherein the air channel (28) is located between the two lower C-shaped attachment rails (42).

15. The linear air diffuser module (12) of any one of claims 1 to 14, **characterised in that** the support member (18) is made of aluminium.

16. The linear air diffuser module (12) of any one of claims 1 to 14, **characterised in that** the support member (18) is made of a glass reinforced plastic or a high-pressure laminate.

17. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the diffusion openings (32) are selected in a group consisting of perforated holes and elongate slots.

18. The linear air diffuser module (12) of any one of the preceding claims, **characterised in that** the diffuser plate (20) is an extruded profile.

19. A vehicle body of a public transportation vehicle, comprising a ceiling structure (10) and the linear air diffuser module (12) of any one of the preceding claims, wherein the linear air diffuser module (12) is located between the ceiling structure (10) and an interior space (16) of the vehicle body, a lower face (22) of the support member (18) of the linear air diffuser module (12) faces the interior space (16) of the vehicle body, the upper face (24) of the support member (18) faces the ceiling structure (10), the linear air diffuser module (12) is attached to the ceiling structure (10) via mounting brackets (36) inserted in the at least two upper C-shaped attachment rails (40) and at least one interior fitment (14) of the interior space (16) of the vehicle body inserted in and secured to the at least one of the one or more lower C-shaped attachment rails (42). 25

20. The vehicle body of claim 19, wherein the interior fitment (14) is selected in a group consisting of a grab pole, a grab rail, a draught screen, a partition wall or a passenger counter.

Fig.1

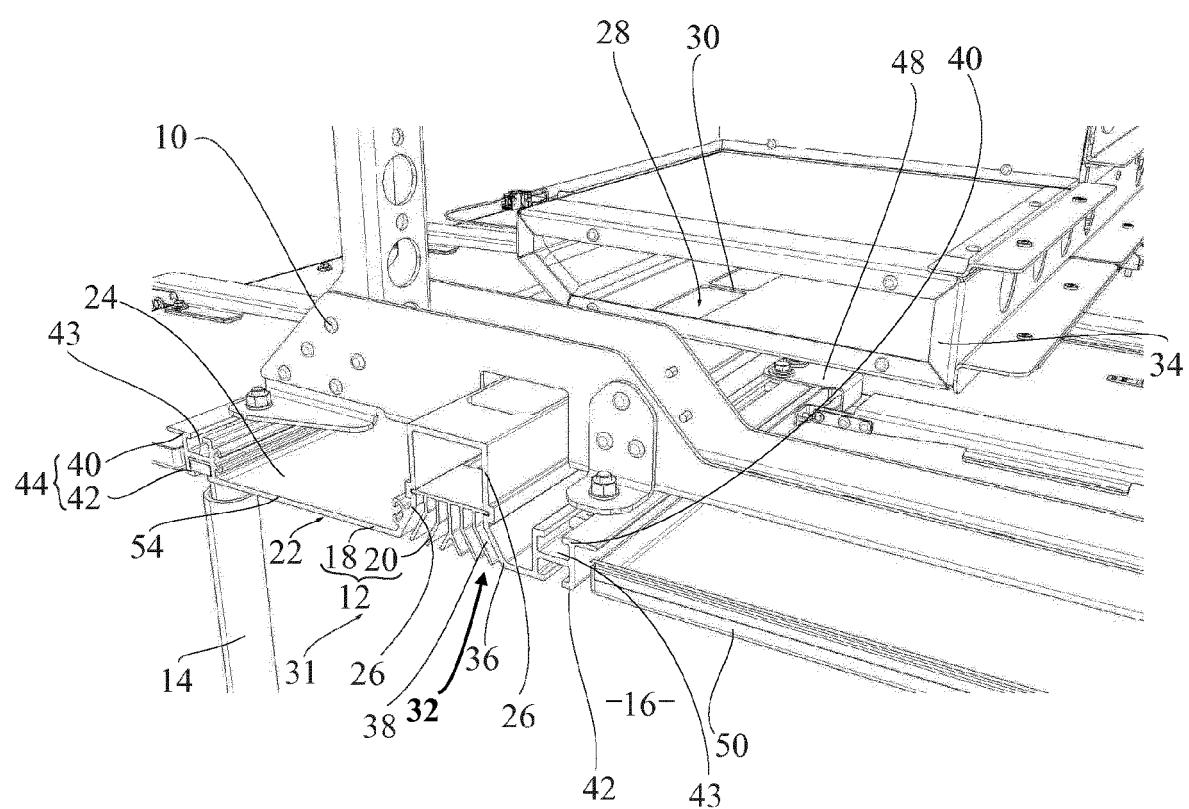


Fig.2

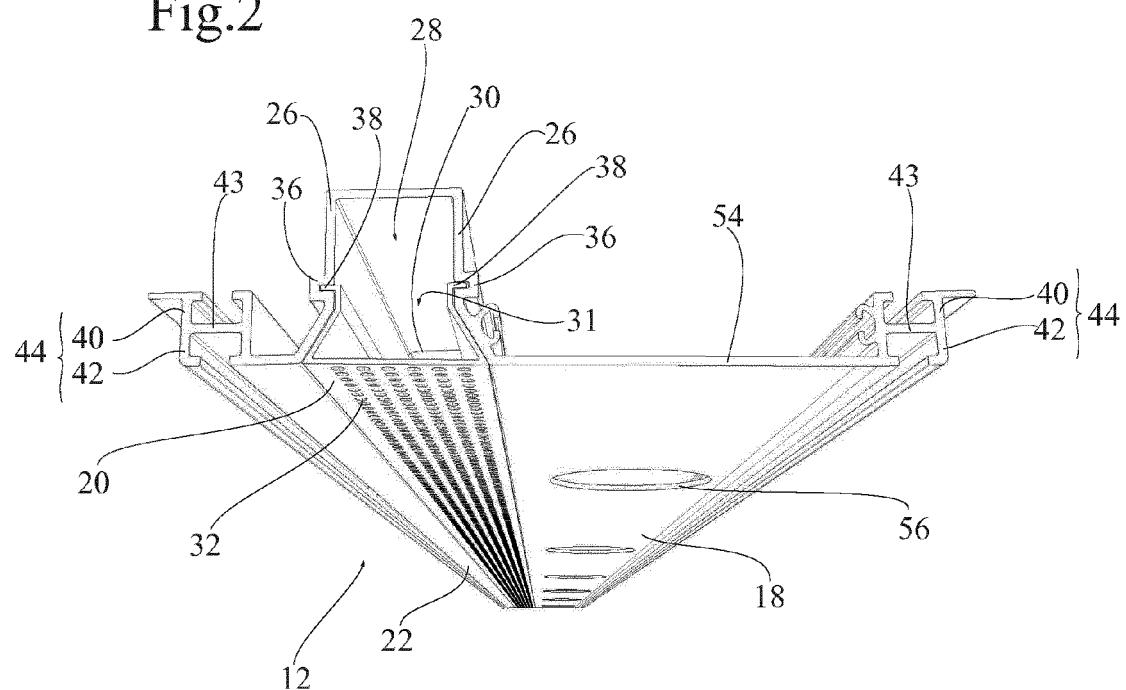


Fig.3

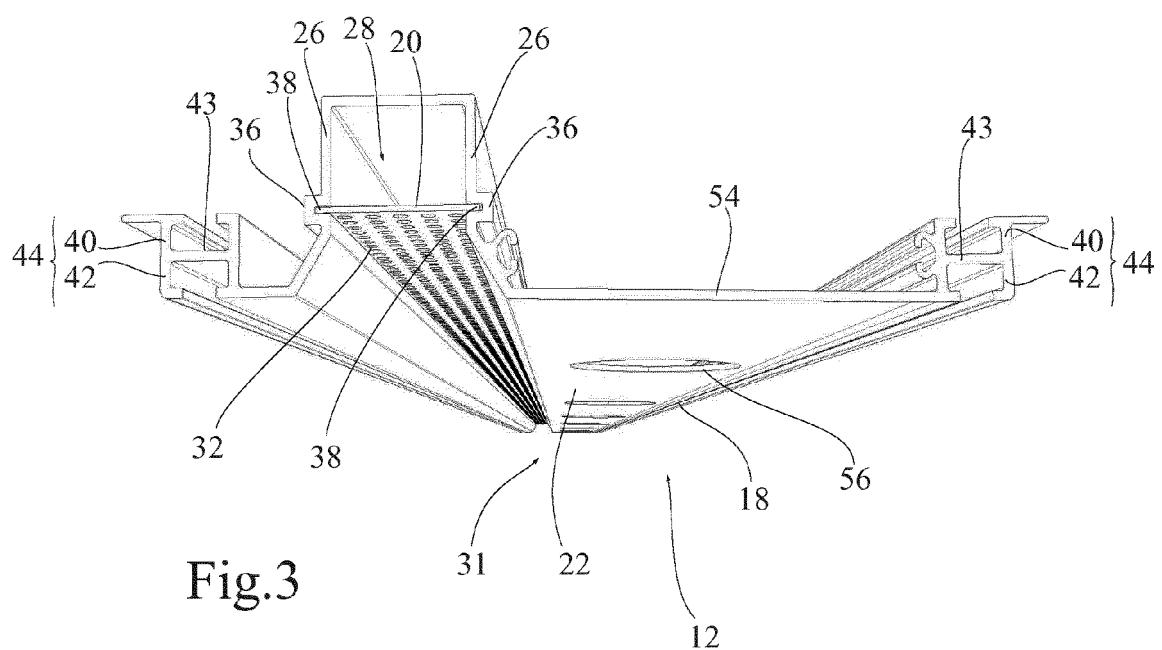


Fig.4

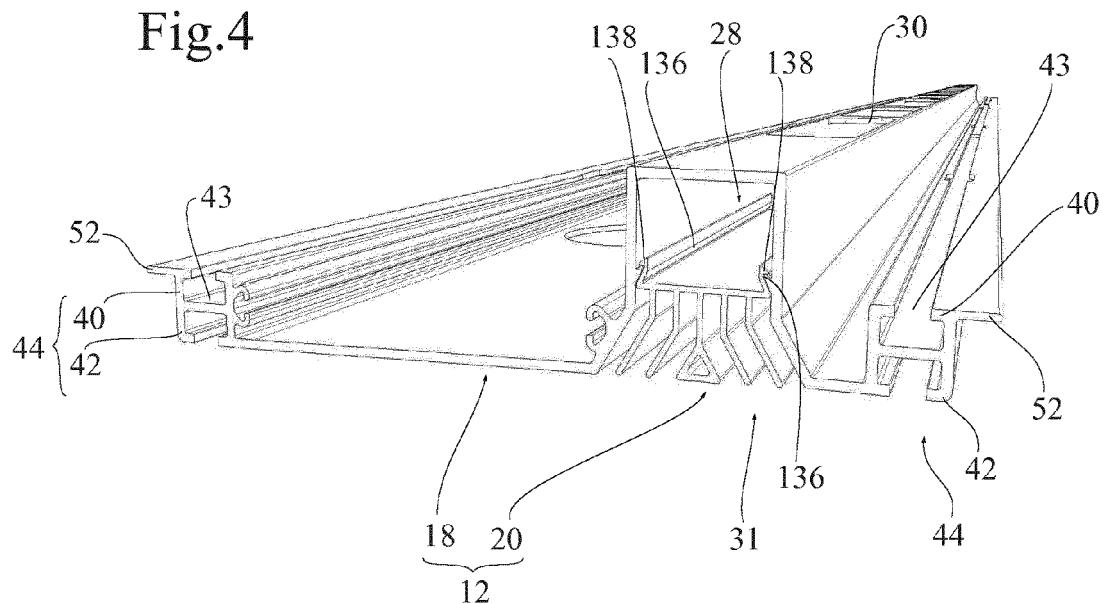


Fig.5



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