

TITLE

Aerodynamic device for a vehicle

TECHNICAL FIELD

5 The invention relates to an aerodynamic device arranged for mounting to a vehicle or a trailer for reducing the wind resistance of the vehicle/trailer comprising a cargo space. The aerodynamic device comprises at least one sheet material, each sheet material being arranged to be mounted to the vehicle/trailer such that each sheet material is associated with a
10 corresponding wall portion. Each wall portion has an outer surface and an inner surface, the inner surface facing the cargo space. The wall portion extends towards the rear of the vehicle/trailer, where, in a deployed first state, each sheet material is arranged to at least partly extend beyond a rearmost position of said wall portion.

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The invention also relates to a vehicle or a trailer comprising said aerodynamic device.

BACKGROUND

20 In recent years, there has been an increased interest in improving the aerodynamic properties of vehicles in general. A major reason for this is the increased fuel costs and improving the aerodynamic properties of vehicles may reduce the fuel consumption and thus the fuel costs. In particular, professional companies in the transport and load carrying business feel an
25 urge to keep down the fuel costs, therefore there is a desire among producers of load carrying vehicles to provide vehicles having a low fuel consumption. Many of the load carrying vehicles have a box shape such that its load compartment or trailer is essentially box shaped. There are certain benefits of this shape, in particular it is a suitable shape for managing to load
30 as much as possible in the load compartment. However, the rear end of the load compartment will thus comprise right-angled edges, which results in that the rear end of the load compartment is not aerodynamically adapted.

- In order to improve the aerodynamic properties and achieve a reduction of the wind resistance, the rear end of a trailer or load compartment has previously been modified in different ways. The use of rigid structures, e.g.
- 5 air foils or the like devices, which are permanently mounted in order to improve the aerodynamic properties of a vehicle, are well known in the art. However, such structures are usually not convenient for trucks or trailers since they probably will get in the way for the doors to the loading compartment, which normally are arranged at the rear end of the load
- 10 compartment. Hence, there would most probably be a need for such a structure to be easily detachable or to be mounted such that it does not interfere with the access to the load compartment through the door, e.g. by being mounted only to the doors.
- 15 However, these kinds of structures would add some length to the trailer/truck, and in many countries there are restrictions regarding the length of the vehicle such that the addition of an air foil may either make the vehicle too long or the load compartment itself smaller, i.e. shorter.
- 20 US 4142755 discloses an assembly of air deflector shields surrounding the space between the tractor and the trailer, and a streamlined drag reducer shield at the rear end of the trailer whereby air drag in those regions is substantially decreased. The shields are removable to provide access to the trailer.
- 25 However, the shields have to be removed, and this is time-consumable, and requires direct handling of the large and probably dirty shields.
- US 4818015 discloses collapsible airfoils which reduce wind resistance for a
- 30 vehicle in their operational positions, both at the front and at the rear of the vehicle. The airfoils may be moved to and from storing positions on the sides

of the vehicle. Slide mechanisms for the folding of resilient airfoil sections are provided on the vehicle side walls.

5 However, when the rear airfoils are positioned at the storing positions on the sides at the rear of the vehicle, the vehicle width is affected, and furthermore the door opening capacity is reduced, normally the desired door opening angle is about 270°.

10 There is thus a desire to provide an aerodynamic device for a vehicle or a trailer, where the aerodynamic device is easily removed and re-installed without adding additional width to the vehicle, and without affecting the loading conditions i.e. not affecting the normal opening of the rear doors.

SUMMARY

15 It is an object of the present invention to provide an aerodynamic device for a vehicle or a trailer, where the aerodynamic device is easily removed and re-installed without adding additional width to the vehicle, and without affecting the loading conditions i.e. not affecting the normal opening of the rear doors.

20 This object is achieved by means of an aerodynamic device arranged for mounting to a vehicle or a trailer.

This object is also achieved by means of an aerodynamic device arranged for mounting to a vehicle or a trailer and by a vehicle or a trailer comprising an
25 aerodynamic device

The aerodynamic device arranged for reducing the wind resistance of the vehicle/trailer, which comprises a cargo space. The aerodynamic device comprises at least one sheet material, each sheet material being arranged to
30 be mounted to the vehicle/trailer such that each sheet material is associated with a corresponding wall portion of the vehicle/trailer. Each wall portion has an outer surface and an inner surface, the inner surface facing the cargo

space. The wall portion extends towards the rear of the vehicle/trailer, where, in a deployed first state, each sheet material is arranged to at least partly extend beyond a rearmost position of said wall portion.

In a stored second state, each sheet material is arranged to be inserted such
5 that it faces towards the inner surface.

According to an example, the aerodynamic device comprises a first sheet material and a second sheet material. Each sheet material is arranged to be mounted to the vehicle/trailer such that the first sheet material is associated
10 with a first wall portion of the vehicle and the second sheet material is associated with a second wall portion of the vehicle. The wall portions are mutually parallel, where the outer surfaces face away from each other and the inner surfaces face towards each other.

15 According to another example, the first sheet material comprises an outer edge, an inner edge, an upper edge and a lower edge. Furthermore, the second sheet material comprises an outer edge, an inner edge, an upper edge and a lower edge. The edges constitute borders of said sheet materials, where, in the deployed first state, the outer edges are closer to each other
20 than the inner edges.

According to another example, the aerodynamic device comprises an upper sheet material which is arranged to be mounted to the vehicle/trailer such that it is associated with an upper wall portion which constitutes a roof.
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According to another example, each sheet material comprises a first sub-sheet and a second sub-sheet. The first sub-sheet is closer to the corresponding wall portion than the second sub-sheet, and the first sub-sheet and the second sub-sheet are connected to each other at the outer edge.
30 The first sub-sheet is arranged to travel a longer distance than the second sub-sheet when said sheet material is moved from the stored second state to the deployed first state.

According to another example, the sheet materials follow a curved shape in the deployed first state, constituting a mainly continuous extension of the corresponding first wall portion, second wall portion and upper wall portion.

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According to another example, each sheet material is arranged to be inserted between the corresponding wall portion and a corresponding inner wall portion.

- 10 A number of advantages are provided by means of the present invention. For example, a versatile aerodynamic device for a vehicle or a trailer, which is storable in such a way that the outer dimensions of the vehicle/trailer, and its normal workings such as cargo room door opening angles, are not affected.

15 BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described more in detail with reference to the appended drawings, where

- 20 Figure 1 shows a partial perspective view of the rear end of a truck without any aerodynamic device;

- Figure 2 shows a schematic partial top view of the rear end of a truck without any aerodynamic device, where air streams are schematically indicated;

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- Figure 3 shows a schematic partial top view of the rear end of a truck with a typical aerodynamic device, where air streams are schematically indicated;

- 30 Figure 4 shows a partial perspective view of the rear end of a truck with a aerodynamic device according to the present invention;

- Figure 5 shows a partial top view of the rear end of a truck with an aerodynamic device according to the present invention in a stored second state;
- 5 Figure 6 shows a partial top view of the rear end of a truck with an aerodynamic device according to the present invention in a deployed first state;
- 10 Figure 7a shows a partial top view of a part of a first wall portion with a first example of a sheet material of the aerodynamic device according to the present invention in a stored second state;
- 15 Figure 7b shows a partial top view of a part of a first wall portion with a first example of a sheet material of the aerodynamic device according to the present invention in a deployed first state;
- 20 Figure 8a shows a partial top view of a part of a first wall portion with a second example of a sheet material of the aerodynamic device according to the present invention in a stored second state;
- 25 Figure 8b shows a partial top view of a part of a first wall portion with a second example of a sheet material of the aerodynamic device according to the present invention in a deployed first state;
- 30 Figure 9 shows an alternative shape of a sheet material of the aerodynamic device according to the present invention; and
- Figure 10 shows a partial perspective view of the rear end of a truck with a aerodynamic device according to the present invention using the alternative shape shown in Figure 9.

DETAILED DESCRIPTION

Figure 1 shows a box-shaped rear end of an ordinary truck or a trailer 4, in the following the term truck will be used.

- 5 The truck 4 comprises a first wall portion 13, a second wall portion 14 and an upper wall portion 26, the first wall portion 13 and second wall portion 14 constituting side walls and the upper wall portion 26 constituting a roof. The wall portions 13, 14, 26 confine a cargo space S. The first wall portion 13 has an outer surface 15, an inner surface 17 and a rearmost edge portion 20; the
- 10 second wall portion 14 has an outer surface 16, an inner surface 18 and a rearmost edge portion 21; and the upper wall portion 26 has an outer surface 27, an inner surface 28 and a rearmost edge portion 29. The first wall portion 13 and the second wall portion 14, constituting side walls, are mutually parallel where the outer surfaces 15, 16 face away from each other and the
- 15 inner surfaces 17, 18 face each other.

The edge portions 20, 21, 29 define sharp edges with right angles towards a door portion D, which sharp edges affect the airflow. Figure 2 and Figure 3 are used in the following general discussion regarding air flow or turbulence

20 of air around the rear end of a truck, and how a typical aerodynamic device affects said air flow or turbulence of air.

Figure 2 schematically shows a top view of the air flow or turbulence of air around the rear end of the truck 4 without any aerodynamic devices, when it is moving in a forward direction. The lengths of the arrows A1, A2 are intended to be proportional to the drag resistance influencing the truck 4 when it is moving. The long arrows A1, A2 behind the rear end 19 of the truck 4 indicate a rather large drag resistance. The sharp edges 20, 21, 29 will result in sudden detachment of the air streaming along the first wall portion

25 13 and the second wall portion 14, and there will thus be a vacuum or a significant lower pressure at the rear end 19 of the truck 4 such that a large drag resistance is produced.

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In Figure 3, such a sudden detachment of the airstream along the first wall portion 13 and the second wall portion 14 is avoided by an aerodynamic device C of a common type. The aerodynamic device C will contribute to a better streamlining of the truck 4 at the rear end 19. Hence, there will be less vacuum or a not so significant lower pressure at the rear end of the truck and the air streaming along the first wall portion 13 and the second wall portion 14 of the truck 4 will more smoothly detach from the truck 4, as indicated by the shorter arrows A1', A2' corresponding to a lower drag resistance.

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With reference to Figure 4, an aerodynamic device according to the present invention will be described. The aerodynamic device comprises a first sheet material 1, a second sheet material 2, and an upper sheet material 3. Each sheet material 1, 2, 3 is mounted to the truck 4 such that the first sheet material 1 is associated with the first wall portion 13, the second sheet material 2 is associated with the second wall portion 14 and the upper sheet material 3 is associated with the upper wall portion 26.

The first sheet material 1 comprises an outer edge 5, an inner edge 6, an upper edge 7 and a lower edge 8; the second sheet material 2 comprises an outer edge 9, an inner edge 10, an upper edge 11 and a lower edge 12; and the upper sheet material 3 comprises an outer edge 22, an inner edge 23, a first side edge 24 and a second side edge 25. The edges 5, 6, 7, 8; 9, 10, 11, 12; 22, 23, 24, 25 constitute borders of said sheet materials 1, 2, 3.

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In a deployed first state S1, as shown for the first sheet material 1 and the second sheet material 2 in Figure 5, each sheet material 1, 2, 3 is arranged to at least partly extend beyond the rearmost position 20, 21, 29 of the wall portions 13, 14, 26. For the first sheet material 1 and the second sheet material, in the deployed first state S1, the outer edges 5, 9 are closer to each other than the inner edges 6, 10. As shown in Figure 5 for the first sheet material 1 and the second sheet material 2, the sheet materials 1, 2, 3 follow

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a curved shape in the deployed first state (S1), constituting a mainly continuous extension of the corresponding first wall portion 13, the second wall portion 14 and the upper wall portion 26. The relatively small discontinuous step remaining at the edge portions 20, 21, 29 is disregarded, being considered to be too small to be of relevance.

According to the present invention, in a stored second state S2, as shown for the first sheet material 1 and the second sheet material 2 in Figure 6, each sheet material 1, 2, 3 is arranged to be inserted such that its faces the corresponding inner surface 17, 18, 28. All sheet materials 1, 2, 3 are thus slid inside the truck 4, such that at least a corresponding major part of the sheet materials 1, 2, 3 is positioned within the confinement of the wall portions 13, 14, 26.

In this way, the sheet materials 1, 2, 3 may be removed in an efficient and easily handled manner. Furthermore, no width is added to the truck 4.

Preferably, as shown for the first sheet material 1 and the second sheet material 2 in Figure 5 and Figure 6, there are corresponding inner wall portions 30, 31 arranged such that each sheet material 1, 2 is arranged to be inserted between the corresponding wall portion 13, 14 and a corresponding inner wall portion 30, 31, which inner wall portions 30, 31 have a supporting function. Although not shown, a similar arrangement with an inner wall may be applicable for the upper sheet material 3 as well. Of course, alternative supporting means may be used, such as for example beams or wires.

Figure 7a, Figure 7b, Figure 8a and Figure 8b show an enlarged portion E indicated with dotted lines in Figure 5. This enlarged portion shows examples of arrangements for the first sheet material 1, but the examples are of course applicable for all sheet materials 1, 2, 3.

With reference to Figure 7a and Figure 7b, the first sheet material is shifted between the deployed first state S1 as shown in Figure 7a and the stored second state S2 as shown in Figure 7b.

- 5 In this example, the first sheet material 1 is provided with a rigidity, for example by means of rigid structures, which makes it form a desired shape when it is in its deployed first state S1. The first sheet material 1 may thus take the curved shape shown in the deployed first state S1, but can be flattened to such an extent that it can be inserted to its stored second state
10 S2.

- With reference to Figure 8a and Figure 8b, the first sheet material 1' comprises a first sub-sheet 1a and a second sub-sheet 1b, the sub-sheets 1a, 1b being arranged in a parallel manner and fastened to each other at the
15 outer edge 5' by means of a suitable fastening device 32. The first sub-sheet 1a is arranged to face the first wall portion 13. When the first sheet material 1' is retracted from its stored second state S2 as shown in Figure 8b to its deployed first state S1 as shown in Figure 8a, the first sub-sheet 1a is arranged to travel a longer distance than the second sub-sheet 1b. In this
20 way, the first sheet material 1' will take the curved shape shown in the deployed first state S1 in Figure 8b.

- The invention is not limited to the examples described, but may vary freely within the scope of the appended claims. For example, the sheet materials 1,
25 2, 3 may take the desired curved shape in the deployed first state S1 by means of attaching the outer edges to fixing points.

- The sheet materials 1, 2, 3 have been described to have a rectangular shape, but other shapes are of course conceivable. With reference to Figure 9,
30 the first sheet material 1'' is shown having a triangular shape, comprising an inner edge 6, a first outer edge 33 and a second outer edge 34, where the outer edges are inclined with respect to the inner edge 6.

With all sheet materials having suitable triangular shapes as shown in Figure 10, the first sheet material 1", the second sheet material 2" and the upper sheet material 3" may be retracted to the deployed first state S1 such that adjacent outer edges 33, 35; 36, 37 at least partly may be brought into contact, although this is not explicitly shown in Figure 10 for reasons of clarity. In this way, a more coherent aerodynamic device is obtained. In order to improve the clarity in Figure 10, the sheet materials 1", 2", 3" are shown transparent, denoted with dashed lines.

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In order to achieve the above, one of two adjacent outer edges 33, 35; 36, 37 has to be slightly outwardly curved, but with the main triangular shape maintained, as can easily be understood. Although none of the outer edges 33, 34 in Figure 9 is shown as curved, it should be understood that both these edges could be outwardly curved.

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The truck may be any type of suitable vehicle.

The inner wall portions 30, 31 may have a limited extension with regard to the corresponding wall portions 13, 14 as shown in Figure 5 and Figure 6. It is also conceivable that each inner wall portion 30, 31 mainly have the same extension as the corresponding wall portion 13, 14, each inner wall portion 30, 31 and corresponding wall portion 13, 14 forming a double wall portion. This is of course applicable for the upper wall portion 26 as well, although no inner wall is shown for the upper wall portion in the Figures.

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CLAIMS

1. An aerodynamic device arranged for mounting to a vehicle or a
5 trailer (4) for reducing the wind resistance of the vehicle/trailer (4) comprising
a cargo space (S), the aerodynamic device comprising at least one sheet
material (1, 2, 3), each sheet material (1, 2, 3) being arranged to be mounted
to the vehicle/trailer (4) such that each sheet material (1, 2, 3) is associated
with a corresponding wall portion (13, 14, 26) of the vehicle/trailer (4), each
10 wall portion (13, 14, 26) having an outer surface (15, 16, 27) and an inner
surface (17, 18, 28), the inner surface (17, 18, 28) facing the cargo space
(S), said wall portion (13, 14, 26) furthermore extending towards the rear (19)
of the vehicle/trailer, where, in a deployed first state (S1), each sheet material
(1, 2, 3) is arranged to at least partly extend beyond a rearmost position (20,
15 21, 29) of said wall portion (13, 14, 26) **characterized in** that in a stored
second state (S2), each sheet material (1, 2, 3) is arranged to be inserted
such that it faces towards the inner surface (17, 18, 28).

2. An aerodynamic device according to claim 1, **characterized in**
20 that the aerodynamic device comprises a first sheet material (1) and a
second sheet material (2), each sheet material (1, 2) being arranged to be
mounted to the vehicle/trailer (4) such that the first sheet material (1) is
associated with a first wall portion (13) of the vehicle/trailer (4), and the
second sheet material (2) is associated with a second wall portion (14) of the
25 vehicle/trailer (4), the wall portions (13, 14) being mutually parallel, the outer
surfaces (15, 16) facing away from each other and the inner surfaces (17, 18)
facing towards each other.

3. An aerodynamic device according to claim 2, **characterized in**
30 that the first sheet material (1) comprises an outer edge (5), an inner edge (6)
an upper edge (7) and a lower edge (8), and that the second sheet material
(2) comprises an outer edge (9), an inner edge (10), an upper edge (11) and

a lower edge (12), the edges (5, 6, 7, 8; 9, 10, 11, 12) constituting borders of said sheet materials (1, 2), where, in the deployed first state (S1), the outer edges (5, 9) are closer to each other than the inner edges (6, 10).

- 5 4. An aerodynamic device according to any one of the previous claims, **characterized in** that the aerodynamic device comprises an upper sheet material (3), the upper sheet material (3) being arranged to be mounted to the vehicle/trailer (4) such that it is associated with an upper wall portion (26) which constitutes a roof.

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5. An aerodynamic device according to claim 4, **characterized in** that the upper sheet material (3) comprises an outer edge (22), an inner edge (23), a first side edge (24) and a second side edge (25), the edges (22, 23, 24, 25) constituting borders of the upper sheet material (3).

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6. An aerodynamic device according to any one of the claims 1 or 2, **characterized in** that each sheet material (1') is of a main triangular shape, comprising an inner edge (6), a first outer edge (33) and a second outer edge (34).

20

7. An aerodynamic device according to any one of the previous claims, **characterized in** that each sheet material (1, 2, 3) is provided with rigid structures which make each flexible sheet material (1, 2, 3) form a desired shape when it is in its deployed state.

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8. An aerodynamic device according to any one of the claims 2-6, **characterized in** that each sheet material (1, 2, 3) comprises a first sub-sheet (1a) and a second sub-sheet (1b), where the first sub-sheet sheet (1a) is closer to the corresponding wall portion (13) than the second sub-sheet (1b), and where the first sub-sheet (1a) and the second sub-sheet (1b) are connected to each other at the outer edge (5'), where furthermore the first sub-sheet (1a) is arranged to travel a longer distance than the second sub-
- 30

sheet (1b) when said sheet material is moved from the stored second state (S2) to the deployed first state (S1).

9. An aerodynamic device according to any one of the previous
5 claims, **characterized in** that said sheet material (1, 2, 3) in the deployed first state (S1) follows a curved shape, constituting a mainly continuous extension of the corresponding wall portion (13, 14, 26).

10. An aerodynamic device according to any one of the previous
10 claims, **characterized in** that each sheet material (1, 2, 3) is arranged to be inserted between the corresponding wall portion (13, 14) and a corresponding inner wall portion (30, 31).

11. A vehicle or a trailer (4) comprising an aerodynamic device for
15 reducing the wind resistance of the vehicle/trailer (4), the vehicle/trailer (4) comprising a cargo space (S), the aerodynamic device (1, 2, 3) comprising at least one sheet material (1, 2, 3), each sheet material (1, 2, 3) being mounted to the vehicle/trailer (4) such that each sheet material (1, 2, 3) is associated with a corresponding wall portion (13, 14, 26) of the vehicle/trailer (4), each
20 wall portion (13, 14, 26) having an outer surface (15, 16, 27) and an inner surface (17, 18, 28), the inner surface (17, 18, 28) facing the cargo space (S), said wall portion (13, 14, 26) furthermore extending towards the rear (19) of the vehicle/trailer (4), where, in a deployed first state (S1), each sheet material (1, 2, 3) is arranged to at least partly extend beyond a rearmost
25 position (20, 21, 29) of said wall portion (13, 14, 26) **characterized in** that in a stored second state (S2), each sheet material (1, 2, 3) is arranged to be inserted such that it faces towards the inner surface (17, 18, 28).

12. A vehicle/trailer (4) according to claim 11, **characterized in** that
30 the aerodynamic device comprises a first sheet material (1) and a second sheet material (2), each sheet material (1, 2) being arranged to be mounted to the vehicle/trailer (4) such that the first sheet material (1) is associated with

a first wall portion (13) of the vehicle/trailer (4), and the second sheet material (2) is associated with a second wall portion (14) of the vehicle/trailer (4), the wall portions (13, 14) being mutually parallel, the outer surfaces (15, 16) facing away from each other and the inner surfaces (17, 18) facing towards
5 each other.

13. A vehicle/trailer (4) according to claim 12, **characterized in** that the first sheet material (1) comprises an outer edge (5), an inner edge (6) an upper edge (7) and a lower edge (8), and that the second sheet material (2)
10 comprises an outer edge (9), an inner edge (10), an upper edge (11) and a lower edge (12), the edges (5, 6, 7, 8; 9, 10, 11, 12) constituting borders of said sheet materials (1, 2), where, in the deployed first state (S1), the outer edges (5, 9) are closer to each other than the inner edges (6, 10).

15 14. A vehicle/trailer (4) according to any one of the claims 11-13, **characterized in** that the aerodynamic device comprises an upper sheet material (3), the upper sheet material (3) being arranged to be mounted to the vehicle/trailer (4) such that it is associated with an upper wall portion (26) which constitutes a roof.

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15. A vehicle/trailer (4) according to claim 14, **characterized in** that the upper sheet material (3) comprises an outer edge (22), an inner edge (23), a first side edge (24) and a second side edge (25), the edges (22, 23, 24, 25) constituting borders of the upper sheet material (3).

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16. A vehicle/trailer (4) according to any one of the claims 11-15, **characterized in** that each sheet material (1, 2, 3) comprises a first sub-sheet (1a) and a second sub-sheet (1b), where the first sub-sheet sheet (1a) is closer to the corresponding wall portion (13) than the second sub-sheet (1b), and where the first sub-sheet (1a) and the second sub-sheet (1b) are
30 connected to each other at the outer edge (5'), where furthermore the first sub-sheet (1a) is arranged to travel a longer distance than the second sub-

sheet (1b) when said sheet material is moved from the stored second state (S2) to the deployed first state (S1).

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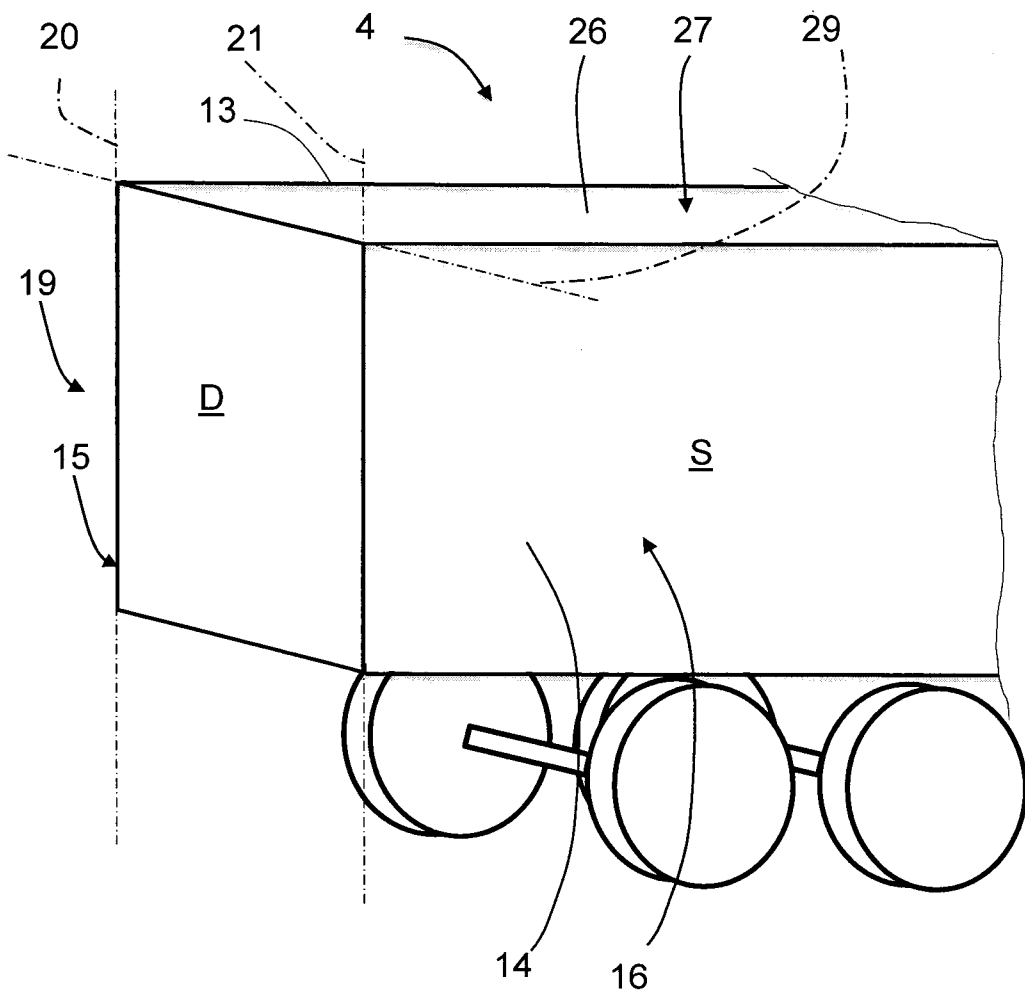


FIG. 1

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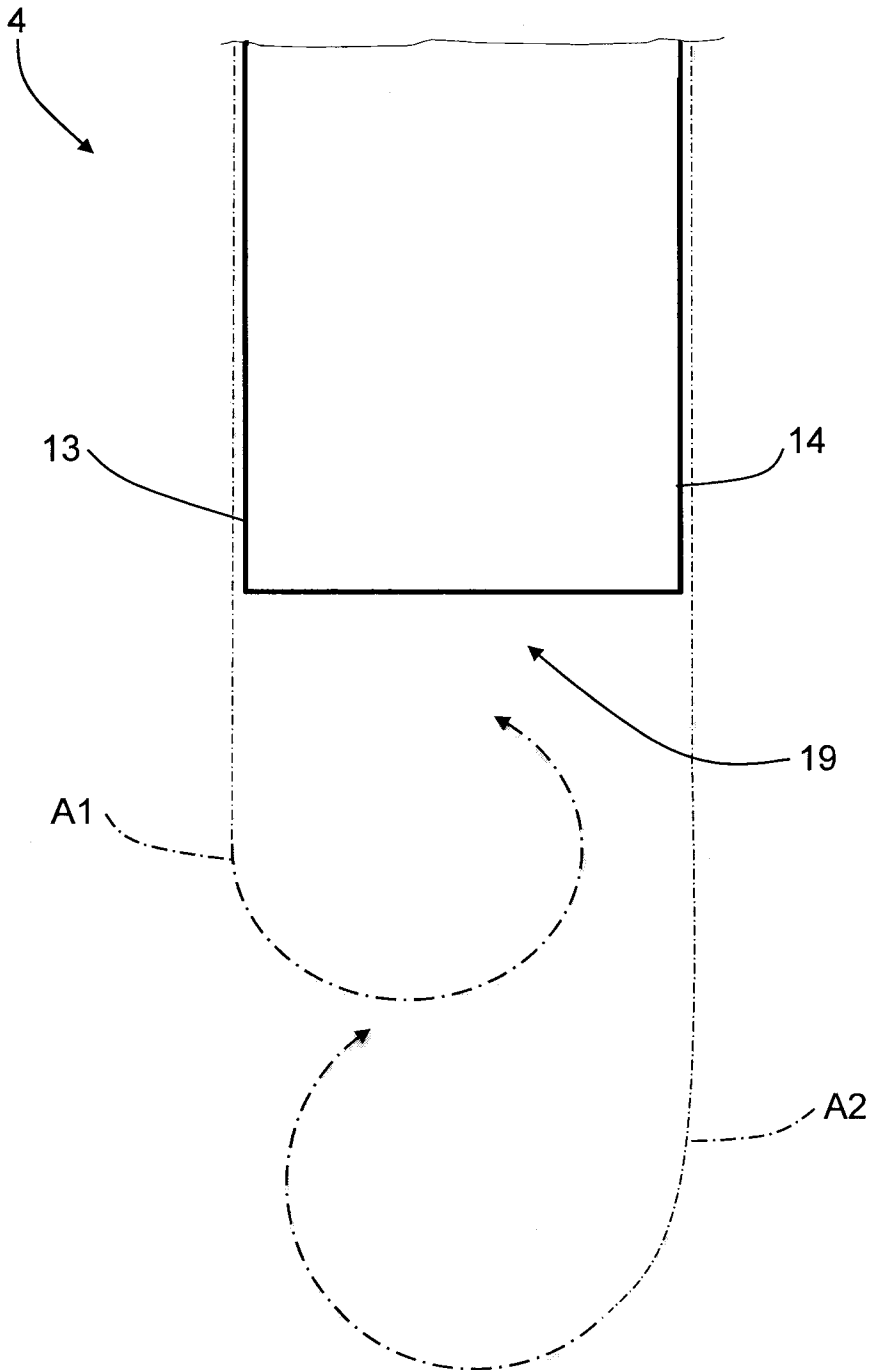


FIG. 2

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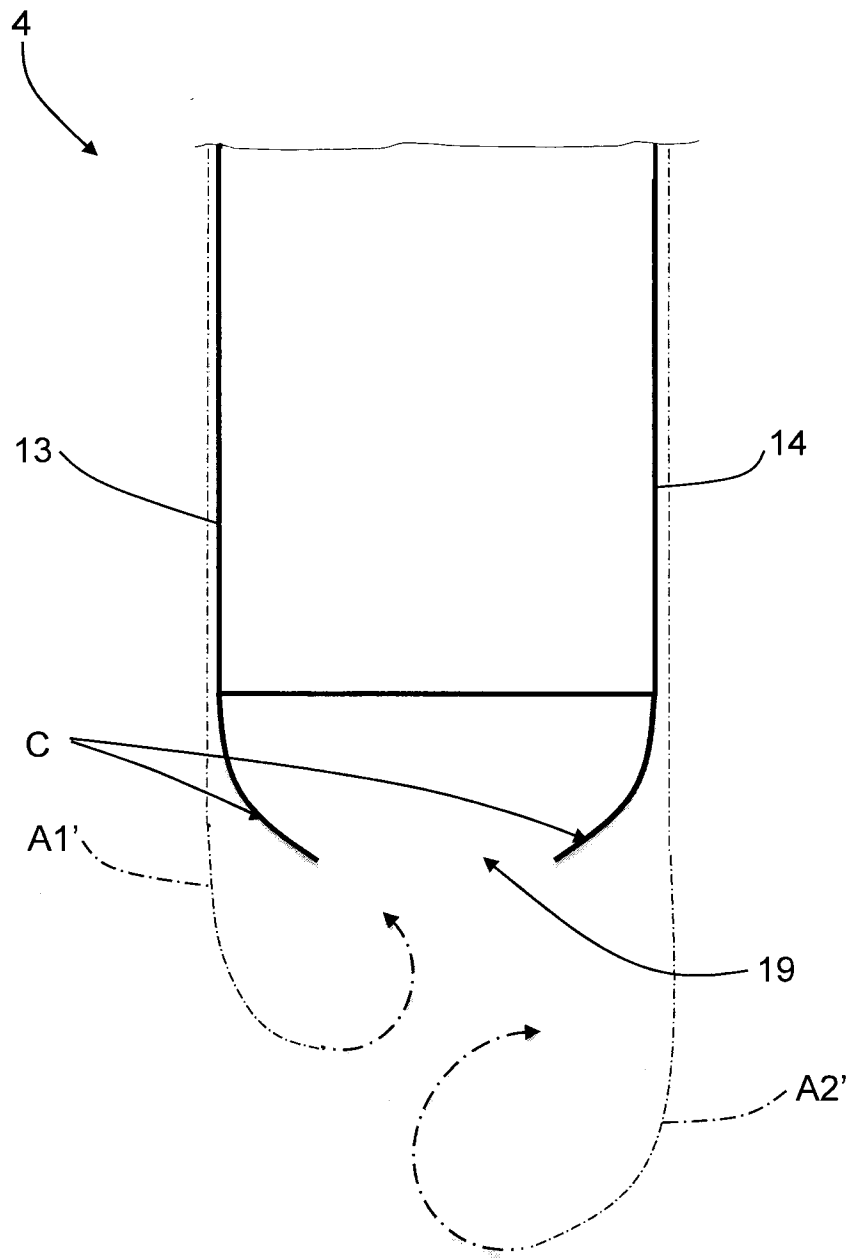
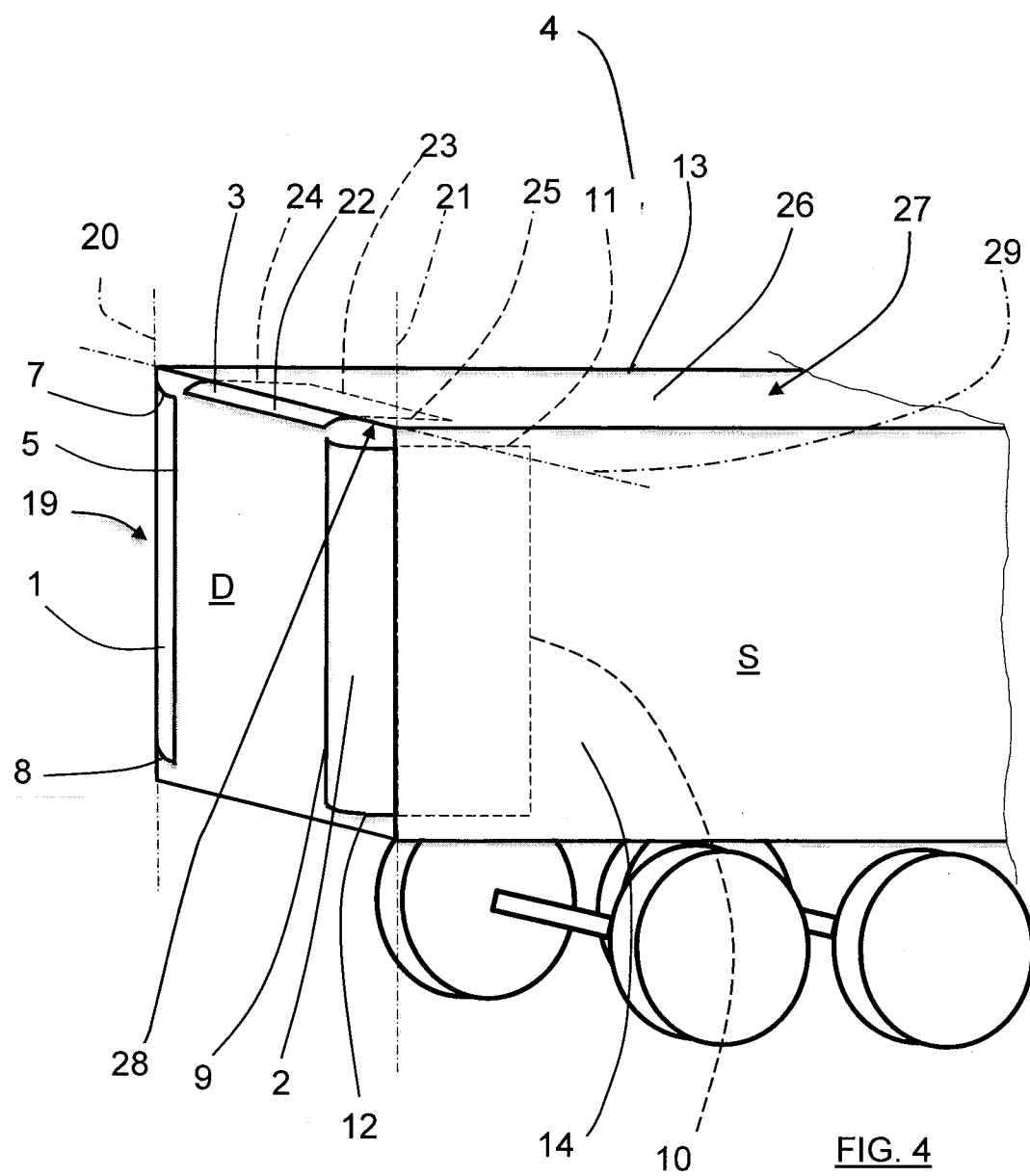


FIG. 3



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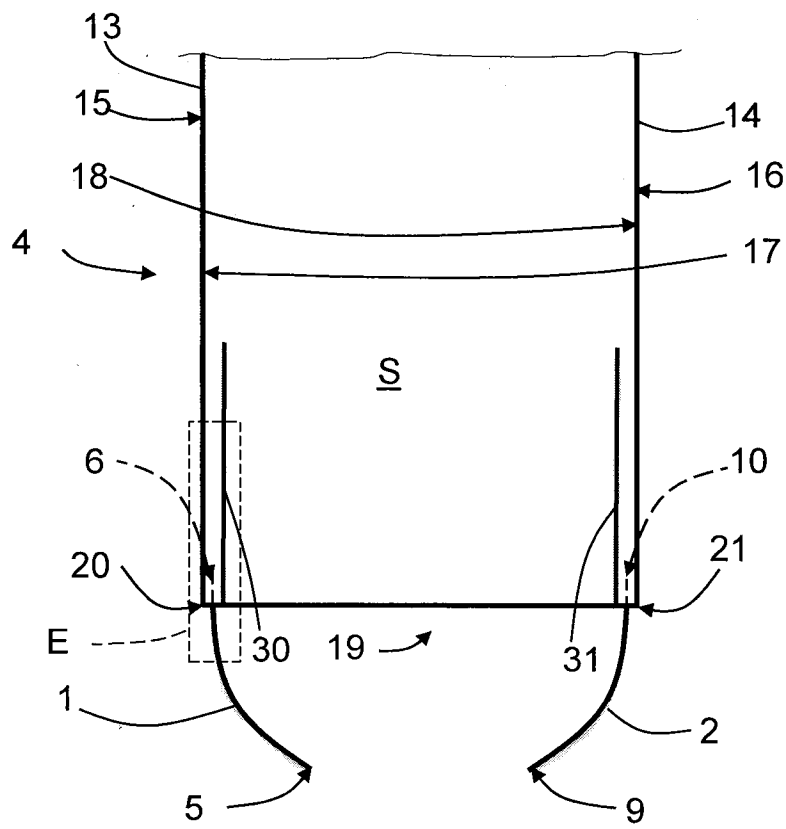


FIG. 5

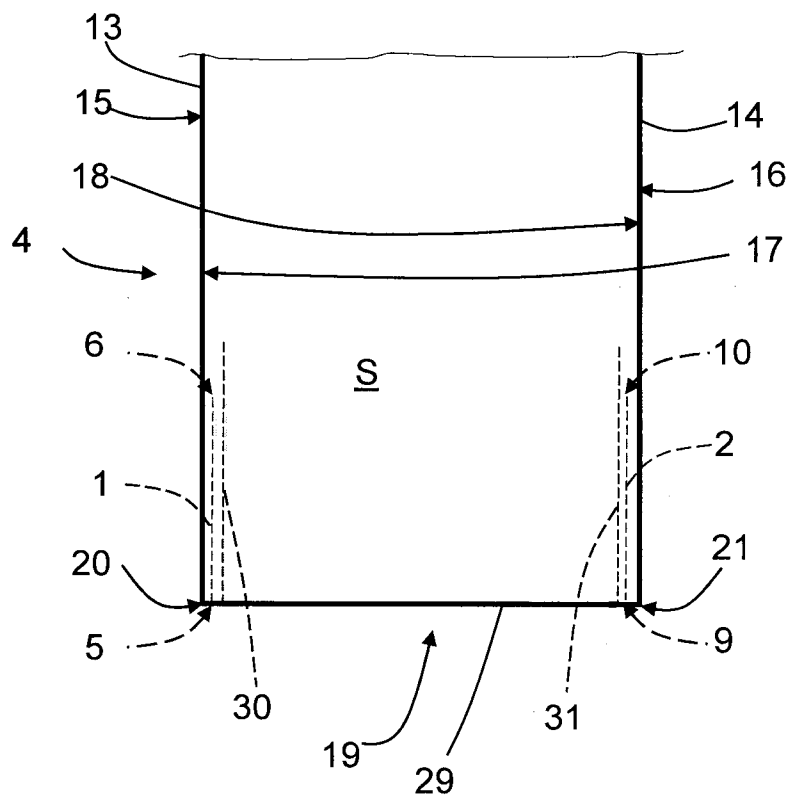


FIG. 6

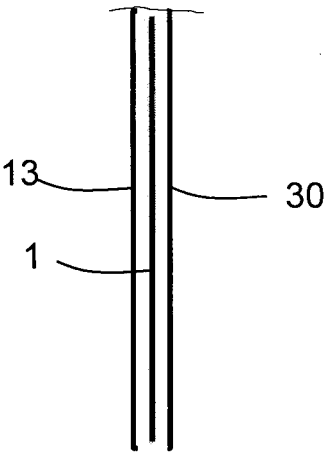


FIG. 7a

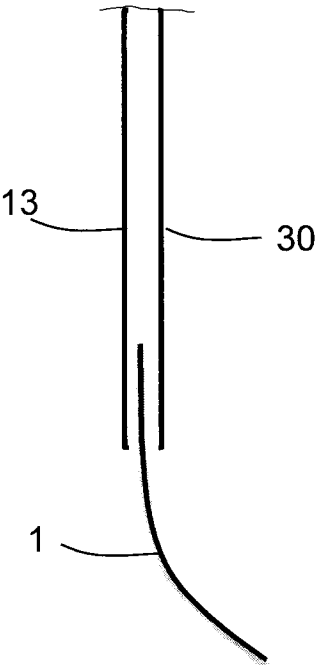


FIG. 7b

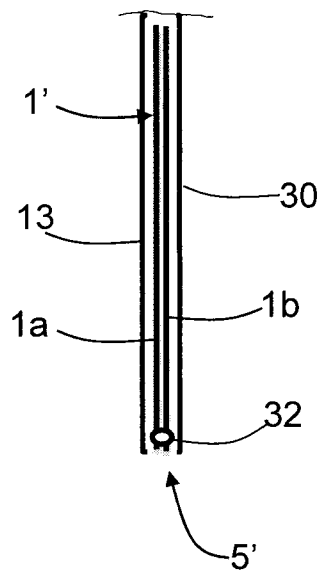


FIG. 8a

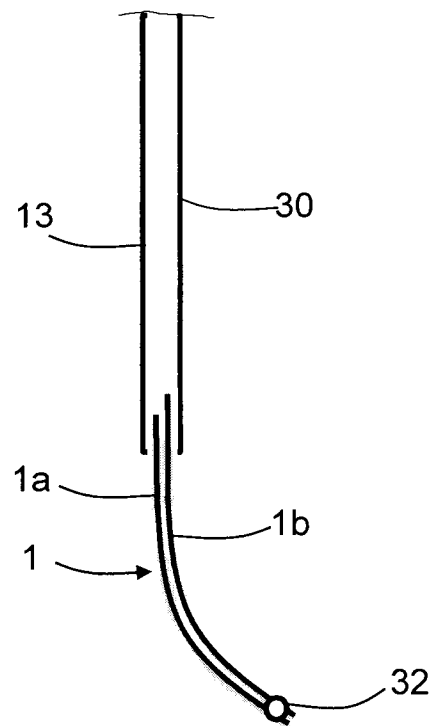


FIG. 8b

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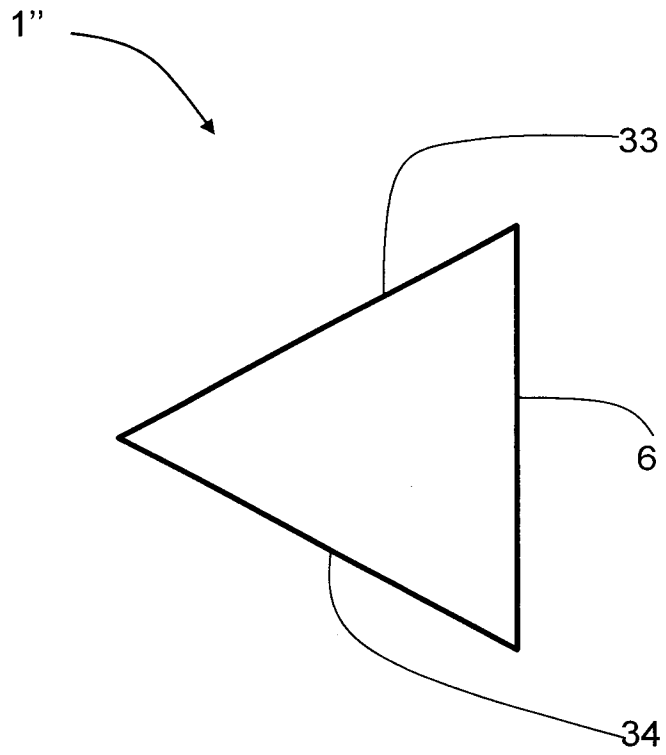


FIG. 9

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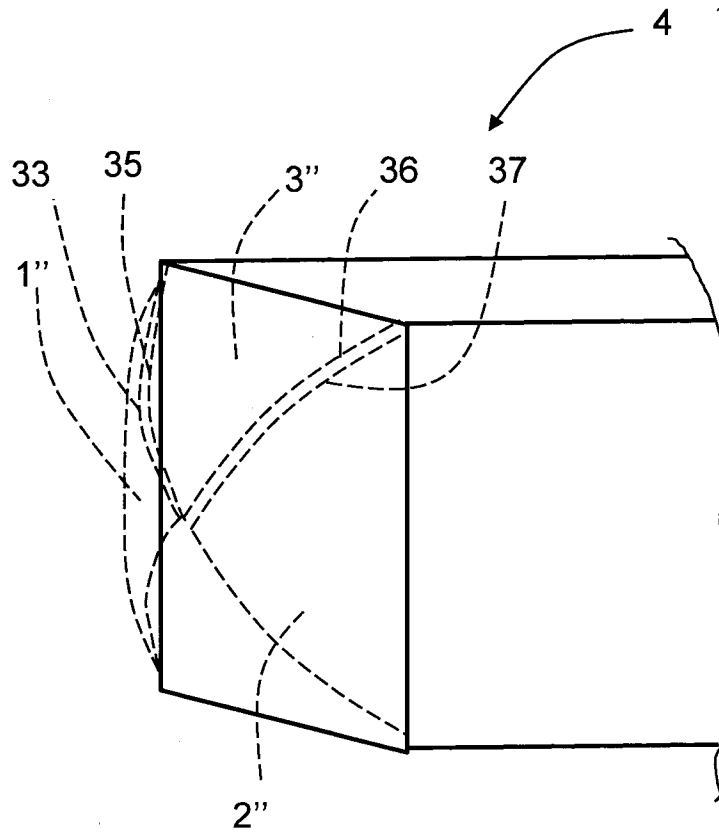


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/000108

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B61D, B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010148508 A1 (VISENTIN FRANK), 29 December 2010 (2010-12-29); abstract; paragraphs [0014]-[0015], [0042]; figures --	1-16
X	DE 202010004371 U1 (OENGUENER EMIR), 15 July 2010 (2010-07-15); abstract; figures --	1-16
A	US 4257641 A (KEEDY EDGAR L), 24 March 1981 (1981-03-24); whole document --	1-16
A	US 4818015 A (SCANLON BARRY F), 4 April 1989 (1989-04-04); whole document --	1-16



Further documents are listed in the continuation of Box C.



See patent family annex.

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“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

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International application No.
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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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B61D 17/02 (2006.01)

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