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

(11) Publication number: **0 575 705 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **93104919.1**

(51) Int. Cl.5: **E01F 15/00**

(22) Date of filing: **25.03.93**

(30) Priority: **14.04.92 IT UD920013 U**

(43) Date of publication of application:
29.12.93 Bulletin 93/52

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE LI LU MC NL PT SE

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(54) Metallic safety barrier.

(57) Metallic safety barrier of the type of EP-A-0428097, which comprises a plurality of modular metallic elements (11) and consists of a frontal absorption panel (12), lengthwise reinforcing elements (13), uprights or stiffening ribs (14) and compartments (25) for the fixture of anchorage bolts (29) to the ground (28), means being included for connecting the modular metallic elements (11) together, the frontal absorption panel (12) extending from an upper front position with an upper portion (35) to a lower intermediate base position, lengthwise reinforcing elements (13) being at least one in number and extending along the length of the frontal absorption panel (12), the uprights or stiffening ribs (14) being equidistant from each other and at least two in number per modular metallic element (11) and having their rear substantially vertical and being sconformed as an "L" and their front portion anchored to the rear of the frontal absorption panel (12) and to the lengthwise reinforcing elements (13), the compartments (25) cooperating with a supporting base (19) of the stiffening ribs (14) and with a base segment (26) of the frontal absorption panel (12).

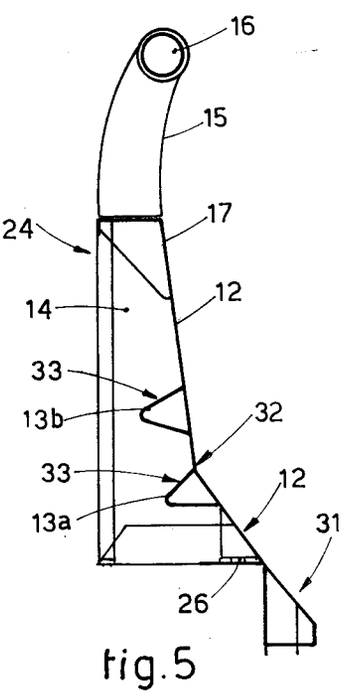

fig.5

EP 0 575 705 A1

This invention concerns a metallic safety barrier especially suitable for bridges and viaducts and of the type disclosed in EP-A-0428097.

To be more exact, the invention concerns a barrier structurally suitable to meet the strictest safety standards and having at the same time weight characteristics compatible with the usual type of beam employed for roadway constructions, particularly at bridges and viaducts.

The barrier of the invention can be employed on bridges and viaducts as a central traffic dividing strip or as a rigid lateral edge but can also be used in any other employment requiring safety means having a low weight and a great retaining capability.

The state of the art includes several apparatuses intended to improve driving safety on modern roads and motorways. Amongst these apparatuses a role of primary importance is played by the so-called guardrails.

As is known, these products perform the twofold task of showing a motorist his path clearly and of preventing a motor vehicle leaving its carriageway in the event of an accidental steering mistake.

In particular, the guardrails have to enable the following objectives to be attained:

- a great structural strength to retain and reject heavy and light motor vehicles;
- a great capacity of preventing roll-over (overturning onto the other carriageway);
- a great capacity of absorption of energy (resilience).

In addition to the above, further effects are required such as functional decoration, (longlasting green hedges), surface drainage of the carriageways, etc.

Good results have been achieved by using barriers consisting of prefabricated reinforced-concrete elements having a known profile and called "New Jersey".

These barriers, which have been in use now for some years in many countries, have a surface inclined at its base and suitable to act directly on the steering equipment of motor vehicles on a collision course, thus returning the motor vehicle to its own carriageway as required.

Moreover, trials have been made to avoid the natural rigidity of this type of barrier by employing systems to anchor barriers of a resilient type to the ground.

In other words, the barriers are permitted to undergo deformations and residual displacements which enable the decelerations induced in the motor vehicle to be reduced to a minimum, thus achieving acceptable rebound trajectories together with minimum damage.

The above has overcome a great part of the problems on normal stretches of road but not at bridges or viaducts.

In fact, the heavy structure of the New Jersey type concrete barriers is not compatible with the loads which can be withstood by the frameworks normally employed.

At the present time the usual guardrails made of steel strip are employed on bridges and viaducts and entail the well known limits made still more evident by the absolute need to prevent motor vehicles leaving their carriageway at the above parts of the roads.

EP-A-0428097 discloses a safety barrier consisting of a modular metallic element which can be connected to equal elements arranged next to it; this element has sidewalls, in one or more reciprocally connected elements, and frontal walls.

This element is substantially hollow within and comprises lengthwise stiffening means and means for connection to adjacent elements, together with means for fixture to the ground.

EP-A-0428097, however, teaches the obtaining of a metallic barrier which, so as to achieve the required capacity of absorption and structural stability, requires weights and components that impair the barrier in terms of weight and rigidity and therefore have an unfavourable effect on the frameworks and on drivers in the event of an accident.

To overcome the shortcomings of the state of the art and to achieve further advantages, the present applicants have designed, tested and embodied this invention.

This invention is set forth and characterized in the main claim, while the dependent claims describe variants of the main idea of the embodiment.

The purpose of this invention is to provide a metallic safety barrier which is lighter, but stronger and safer, than that disclosed in EP-A-0428097.

A further purpose of this invention is to provide a quick and safe system to connect together the adjacent metallic elements composing the barrier.

The barrier according to the invention consists of modular metallic elements which can be coupled to equal adjacent elements to form the safety barrier.

Each of these modular elements consists substantially of a frontal metallic absorption panel which is stiffened lengthwise and crosswise by at least one reinforcing element.

The frontal absorption panel has a known profile of the New Jersey type, which is formed as a double trapezium becoming larger towards its bottom and includes in its lower half a change of inclination to enlarge the supporting base of the modular element and to act in a differentiated manner against the tyres of a motor vehicle.

The frontal absorption panel according to the invention is bent advantageously backwards at its lower end along its supporting base and for a portion of the same.

The modular elements are open at their rear so as to be lighter.

The barrier according to the invention weighs about 120 to 140 kgs. per linear metre as against the 800 to 1100 kgs. per linear metre of the normal New Jersey type concrete barriers and against the 160 kgs. per linear metre of the barriers according to EP-A-0428097.

The modular elements of the barrier according to the invention include at their upper end supporting means with which there cooperates at least one suitable lengthwise bar to provide further retention.

This lengthwise retention bar has the purpose of further stiffening and reinforcing the safety barrier in the lengthwise and vertical directions and plays a special part in retaining a motor vehicle on its own carriageway so as to prevent the motor vehicle climbing over the safety barrier.

According to a variant two or more lengthwise retention bars are included.

Substantially in correspondence with, or in the neighbourhood of, the supporting means of the retention bar the frontal absorption panel contains within its upper part a stiffening bracket to distribute the loads so as to distribute better the stresses which the retention bar imparts to the absorption panel at the time of an impact.

According to the invention, so as to improve the stiffness and reinforcement, the points of connection of one retention bar to another are displaced advantageously away from the connecting ends of adjacent modular elements composing the safety barrier.

The remaining metallic structure of the barrier according to the invention has been devised to make possible an improved safety performance, particularly as regards absorption of kinetic energy, by converting that energy at the moment of impact into a greater action of deformation of the structure thus hit.

Moreover, this better structure includes improved stiffening ribs, or reinforcing uprights, and new lengthwise reinforcing elements; furthermore, the structure is fixed advantageously with specific anchorage bolts.

The damage to persons in the motor vehicle and to the motor vehicle itself is lessened considerably in this way and the rebound of the motor vehicle towards the middle of its own carriageway is limited at the same time.

According to a variant the supporting means with which the retention bar cooperates are positioned in correspondence with the stiffening ribs, and in this case the stiffening brackets which distribute the loads are eliminated.

The barrier according to the invention gives excellent results in retaining a motor vehicle weighing thirty tonnes hurled at a speed of 65 kms. per hour at an angle of incidence of 30°.

In the above example the zone of plastic deformation is restricted substantially to the neighbourhood of the point of impact of the motor vehicle against the safety barrier.

According to a variant a covering panel secured, for instance, by rivets or other means may be fixed to the rear outer face of the frontal absorption panels for mere aesthetic and non-structural reasons.

According to another variant the modular metallic element includes in its lower front portion a connecting shoe in the event that the safety barrier is fixed to a slab raised above the roadbed.

The modular metallic elements according to the invention are butt-jointed together with a reciprocal connection at their ends by means of suitable connecting means so as to form a barrier without any break of continuity.

According to a variant the connecting means consist of a horizontal plate fitted to the upper end of the frontal absorption panels and firmly secured, by bolts and nuts for instance, to the two modular metallic elements to be connected.

According to another variant the means which connect the modular metallic elements consist of a double hinge, the eyelets of which are solidly fixed to the terminal reinforcing uprights.

A connecting plate with mating connecting eyelets cooperates with those eyelets.

The installation and successive connection of adjacent modular metallic elements equipped according to this variant are carried out by positioning the connecting plate between two adjacent modular metallic elements with its eyelets on the same axis as the eyelets on those two adjacent modular metallic elements and threading therethrough from above two pins which cooperate with the relative eyelets.

According to another variant the double hinge extends only partly, advantageously along the upper part of the modular metallic elements.

The modular metallic elements according to the invention may also include specific hooks for connection to preexisting modular metallic elements of another type.

Each modular metallic element comprises means for anchorage to the ground; these anchorage means are advantageously of a resilient type pre-loaded to provide a required resilient resistance to the stresses resulting from the impact of a motor vehicle.

The means for anchorage of the modular metallic elements to the ground consist of a plurality

of anchorage bolts which cooperate with appropriate seatings machined in the lower part of the modular metallic elements and which are anchored in the slab of the carriageway. These seatings cooperate directly with the structural elements providing vertical stiffening and consisting of stiffening ribs or uprights

According to a variant, where bridges are made of steel, the anchorage means consist of anchorage bolts cooperating with tubes or sheaths secured firmly to the inside of the metallic structure of which the bridge consists.

The stiffening ribs, which are at least two for each modular metallic element, are connected solidly to the inner surface of the frontal absorption panel so as to form one single body.

The lengthwise reinforcing element, which is suitably shaped, for instance, substantially as a "V" with its broad sides anchored firmly to the back of the frontal absorption panel, is substantially as long as the modular metallic element and is positioned at a height between 0.3 and 0.6 times, substantially 0.45 times, the height of the frontal absorption panel of the metallic barrier according to the invention.

According to a variant the lengthwise reinforcing element consists of an inner "V-shaped" bent element, or advantageously a dovetail-shaped element, formed in the frontal absorption panel.

In this case vertical spaced connecting bridges may be included in correspondence with the horizontal lips of the inner bend.

According to a further variant two or more lengthwise reinforcing elements cooperate with the frontal absorption panel.Where there are two lengthwise reinforcing elements, the upper of the two is positioned at a height from the ground between 0.3 and 0.6 times, advantageously 0.45 times, the height of the frontal absorption panel, whereas the lower of the two cooperates advantageously by means of one of its sides with the vertex of the change of inclination of the frontal absorption panel.

The stiffening ribs have an L-shaped cross-section, the long side of which has a variable length so as to be adapted to the conformation of the frontal absorption panel.

To be more exact, the long side of the "L" has an increasing development in a downward direction so as to be anchored with its free end to the rear surface of the frontal absorption panel to which it is firmly secured.

The orientation of the rear, vertically positioned, short side of the stiffening ribs is turned away from the side of the arrival of vehicles passing by.

Substantially V-shaped grooves are machined in the long side of the stiffening ribs in a number corresponding to the number of lengthwise reinforcing elements; these grooves enable the lengthwise reinforcing elements to pass and be positioned against the rear surface of the frontal absorption panel.

The stiffening ribs are bent at their lower end to form a supporting base which cooperates terminally with the advantageously bent lower edge of the frontal absorption panel.

The attached figures, which are given as a non-restrictive example, show some preferred embodiments of the invention as follows:

Fig.1
is a frontal three-dimensional diagram of a structure with metallic safety barriers according to the invention;

Fig.2
is a rear view of a metallic barrier according to the invention;

Fig.3
is a lengthwise section of the metallic barrier along the line D-D of Fig.4 together with an enlarged detail of the type of connection between adjacent elements;

Fig.4
is a cross-section of the metallic barrier along the line A-A of Fig.2;

Fig.5
shows a cross-section of a variant of the metallic barrier of Fig.4;

Fig.6
shows a cross-section of a type of anchorage of the metallic barrier of Fig.4 to the ground;

Fig.7
shows in an enlarged scale a cross-section of a stiffening rib according to a horizontal plane along the line B-B of Fig.2;

Fig.8
shows a vertical lengthwise section of the stiffening rib along the line C-C of Fig.7;

Figs.9 to 13
show cross-sections of some forms of embodiment of the metallic barrier according to the invention;

Fig.14
is a rear view of another form of embodiment of the metallic barrier according to the invention;

Fig.15
is a rear view of a metallic barrier according to the invention, which shows a different type of connection of the various elements;

Fig.16
is a horizontal section of the metallic barrier of Fig.15 along the line E-E;

Figs.17 and 18
are cross-sections of two types of anchorage of the metallic barrier according to the invention to a metallic structure.

Fig.1 is a diagram of a safety barrier 10 consisting of a plurality of modular metallic elements 11 positioned adjacent to each other and connected together; the modular metallic elements 11 include means 30 for their fixture to the ground 28.

The frontal conformation of the modular metallic elements 11 is like that of the New Jersey type and comprises the well-tried advantageous features of the same.

The modular metallic element 11 includes a shaped frontal absorption panel 12, which has in its lower part a vertex 32 coinciding with a change of the inclination of the frontal absorption panel 12.

In the examples of Figs.2, 4, 5 and 8 the frontal absorption panel 12 includes two reinforcing elements 13 arranged lengthwise along its rear surface and having substantially the same length as the modular metallic element 11.

The first lower reinforcing element 13a is fitted with one side in the vicinity of the vertex 32 of the change of inclination of the frontal absorption panel 12 and extends downwards, whereas the second higher lengthwise reinforcing element 13b is located at a height from the ground 28 between 0.3 and 0.6 times, advantageously 0.45 times, the height of the frontal absorption panel 12 of the metallic barrier 10 according to the invention.

According to a variant (Figs.9, 10, 11, 12 and 13) the frontal absorption panel 12 comprises only one reinforcing element 13b, which is arranged along the rear of the panel 12 and has substantially the same length as the modular metallic element 11.

According to a variant the reinforcing element 13b is obtained with an internal V-shaped bend of the frontal absorption panel (Fig.12) or with an internal dovetailled bend of the frontal absorption panel (Fig.11).

Next, the frontal absorption panel 12 includes a plurality of substantially vertical stiffening ribs 14, which are at least two in number on each modular metallic element 11 and are spaced regularly apart and secured to the frontal absorption panel 12 and to the reinforcing elements 13.

In the example of Fig.2 a metallic barrier 10 is shown in which each modular metallic element 11 includes six stiffening ribs 14.

The stiffening ribs 14 have an L-shaped cross-section along a horizontal plane (Fig.7); the long side 14a of the "L" has a variable length which mates with the profile of the frontal absorption panel 12 to which the ribs 14 are firmly secured.

Substantially V-shaped grooves 33 are also machined in the long side 14a of the stiffening ribs 14 and have a form and position coordinated with the lengthwise reinforcing elements 13a-13b.

Where there is only reinforcing element 13b (Figs.9, 10, 11, 12 and 13), the stiffening ribs 14 include only one groove 33, which has a form and position coordinated with the lengthwise reinforcing element 13b.

The stiffening ribs 14 are bent at their lower portion so as to form a supporting base 19, which cooperates terminally with the frontal absorption panel 12, which is bent backwards to form a base 26, and with the ground 28.

Supports 15 which protrude above the frontal absorption panel 12 are comprised in cooperation with the upper part 35 of the panels 12 and with the vertical stiffening ribs 14; with these supports 15 there cooperates a retention bar 16, which extends along the whole length of the safety barrier 10.

The supports 15 are bent forwards so as to place the retention bar 16 in cooperation with the projection of the almost vertical upper surface of the frontal absorption panel 12.

In correspondence with the supports 15 the frontal absorption panel 12 includes within its upper portion a V-shaped stiffening and stress-distribution bracket 17, which has the purpose of containing and distributing the stresses caused by the retention bar 16 on the frontal absorption panel 12 at the moment of impact of a motor vehicle.

According to a variant (Fig.14) the supports 15 are positioned in correspondence with the vertical stiffening ribs 14, and in this case the stiffening and stress-distribution brackets 17 are omitted.

According to another variant (Fig.14) the supports 15 are positioned at least in correspondence with the end stiffening ribs 14 and act also as an attachment means 20.

The retention bars 16 are advantageously connected to each other by connecting sleeves 18, in which the ends of adjacent retention bars 16 are secured.

According to a variant (Fig.13) the frontal absorption panel 12 has a reduced height, which is between 0.5 and 0.8 times its normal height, and the retention bars 16 are two or more in number.

The stiffening ribs 14 positioned at the end of the modular metallic element 11 comprises reciprocal attachment means 20, which have the purpose of connecting two adjacent metallic elements 11 together.

These reciprocal attachment means 20, in the examples of Figs.2 and 3, consist of a hinge comprising a plurality of eyelets 21 arranged on the stiffening ribs 14 and of a connecting plate 22, which too comprises at each of its sides a plurality of eyelets 23 in coordinated positions.

The reciprocal connection of two adjacent modular metallic elements 11 is achieved by making each of two pins 24 cooperate with eyelets 21 of the respective stiffening rib 14 and with the corresponding eyelets 23 of the connecting plate

22, which are suitably aligned with the eyelets 21 of the rib 14.

To make the drawing of Fig.2 clear, the pins 24 are shown as being only partly threaded into the respective eyelets 21-23.

In the event of bends in the roads or other types of deviations it is enough to change suitably the dimensions and/or shape of the connecting plate 22 so that the adjacent modular metallic elements 11 can be connected together.

According to a variant (Fig.14) the hinge extends only partly along the stiffening ribs 14 of the metallic barrier 10 according to the invention.

According to another variant (Figs.15 and 16) the reciprocal attachment means 20 consist of a horizontal plate 36 rested on the upper side 35 of the frontal absorption panel 12 of two adjacent modular metallic elements 11 and fixed to the elements 11 by suitable bolts and nuts 37.

By coupling together and fixing in counterpart positions the rear surfaces of two modular metallic elements 11 it is possible to produce the central fender strip.

For merely aesthetic reasons it is possible to fit to the rear side of the modular metallic element 11 a panel which covers the lengthwise reinforcing elements 13 and the stiffening ribs 14; the surface of this panel can be used for the display of advertising posters, for instance.

Fig.6 shows a form of embodiment of means 30 for the resilient anchorage of the modular metallic element 11 to the ground 28. Each modular metallic element 11 includes in its lower portion a plurality of compartments 25, which are made in correspondence with the base 26; each compartment 25 contains a reinforcing plate 34.

Holes 27 are machined in the base 26 in correspondence with the compartments 25, and anchorage bolts 29 are inserted through the holes 27. These anchorage bolts 29 are tightened advantageously with a dynamometric key or with screwers calibrated to provide the desired value of preloading. The reinforcing plate 34 is rested on the supporting base 19 and the latter is rested on the base 26.

This has the effect that the resilient clamping of the anchorage bolts 29 cooperates with the safety barrier 10 without creating localized points of discharge of the energy of impact.

Where the safety barrier 10 is secured to a slab raised above the roadbed 28, the modular metallic element 11 comprises at its lower end a connecting shoe 31 (Figs.5, 10 and 18).

According to a variant, where a bridge is made wholly of steel, the anchorage means 30 consist of anchorage bolts 29 which cooperate with tubes or sheaths 38 fitted inside between an upper plate 40a and lower plate 40b of the metallic structure forming the base 39 of the steel bridge.

In the examples of Figs.17 and 18 strengthening ribs 42 are fitted below the upper plate 40a.

The tube 38, which is substantially coaxial with the anchorage bolt 29, is firmly secured to the upper plate 40a constituting the base 39 of the steel bridge and contains in its bottom 44 a hole 41 with which the anchorage bolt 29 cooperates.

In the example of Fig.18 the metallic bridge comprises a slab 43, which is raised higher than the roadbed 28 and with which there cooperates the connecting shoe 31 comprised at the lower end of the modular metallic element 11.

In this example the tube 38 is solidly fixed to the slab 43 and to the upper plate 40a, through which the tube 38 passes.

Claims

1. Metallic safety barrier of the type of EP-A-0428097, which comprises a plurality of modular metallic elements (11) and consists of a frontal absorption panel (12), lengthwise reinforcing elements (13), uprights or stiffening ribs (14) and compartments (25) for the fixture of anchorage bolts (29) to the ground (28), means being included for connecting the modular metallic elements (11) together, the barrier being characterized in that the frontal absorption panel (12) extends from an upper front position with an upper portion (35) to a lower intermediate base position, and in that the lengthwise reinforcing elements (13) are at least one in number and extend along the length of the frontal absorption panel (12), and in that the uprights or stiffening ribs (14) are equidistant from each other and at least two in number per modular metallic element (11) and have their rear substantially vertical and are conformed as an "L" and have their front portion anchored to the rear of the frontal absorption panel (12) and to the lengthwise reinforcing elements (13), and in that the compartments (25) cooperate with a supporting base (19) of the stiffening ribs (14) and with a base segment (26) of the frontal absorption panel (12).

2. Barrier as in Claim 1, in which the lengthwise reinforcing element (13) is conformed as a "V" with its sides opening apart towards the frontal absorption panel (12).

3. Barrier as in Claim 1 or 2, in which the lengthwise reinforcing element (13) extends along the rear of the frontal absorption panel (12) and is continuously in contact with the frontal absorption panel (12) (Figs.11 and 12).

4. Barrier as in any claim hereinbefore, in which on the upper portion (35) of the frontal absorption panel (12), there are supports (15) bearing at least one retention bar (16) positioned along and above the modular metallic elements (11).

5. Barrier as in any claim hereinbefore, in which the retention bar (16) is displaced forwards and cooperates with the projection of the upper almost vertical surface of the frontal absorption panel (12).

6. Barrier as in any claim hereinbefore, in which a stiffening bracket (17) to distribute stresses is included in cooperation with each support (15) and is positioned on the inner upper part of the frontal absorption panel (12).

7. Barrier as in any claim hereinbefore, in which each support (15) is positioned in cooperation with a stiffening rib (14).

8. Barrier as in any claim hereinbefore, in which a support (15) having also the function of an attachment means (20) (Fig.14) is included in correspondence with the end stiffening rib (14).

9. Barrier as in any claim hereinbefore, in which a first lower lengthwise reinforcing element (13a) has the edge of one of its sides in cooperation with the vertex (32) of the frontal absorption panel (12) and is fitted to the lower almost vertical surface of that panel (12).

10. Barrier as in any claim hereinbefore, in which a second higher reinforcing element (13b) is positioned at a height above the ground between 0.3 and 0.6 times the height of the frontal absorption panel (12).

11. Barrier as in any claim hereinbefore, in which the L-shaped rear of the stiffening ribs (14) extends in the opposite direction to the direction of driving of the motor vehicle and comprises a stiffening appendix.

12. Barrier as in any claim hereinbefore, in which the compartments (25) include a reinforcing plate (34) and sidewalls providing stiffening and connection.

13. Barrier as in any claim hereinbefore, in which attachment means (20) are conformed as a vertical plate (22) cooperating with connecting pins (24), the vertical plate (22) extending vertically by at least part of the height of the end reinforcing rib (14) (Fig.14).

14. Barrier as in any of Claims 1 to 12 inclusive, in which the attachment means (20) are conformed as a horizontal plate (36) cooperating by means of bolts and nuts (37) with the upper ends of two modular metallic elements (11) placed side by side (Figs.15 and 16).

15. Barrier as in any claim hereinbefore, in which the frontal absorption panel (12) has a reduced height between 0.5 and 0.8 times its normal height (Fig.13).

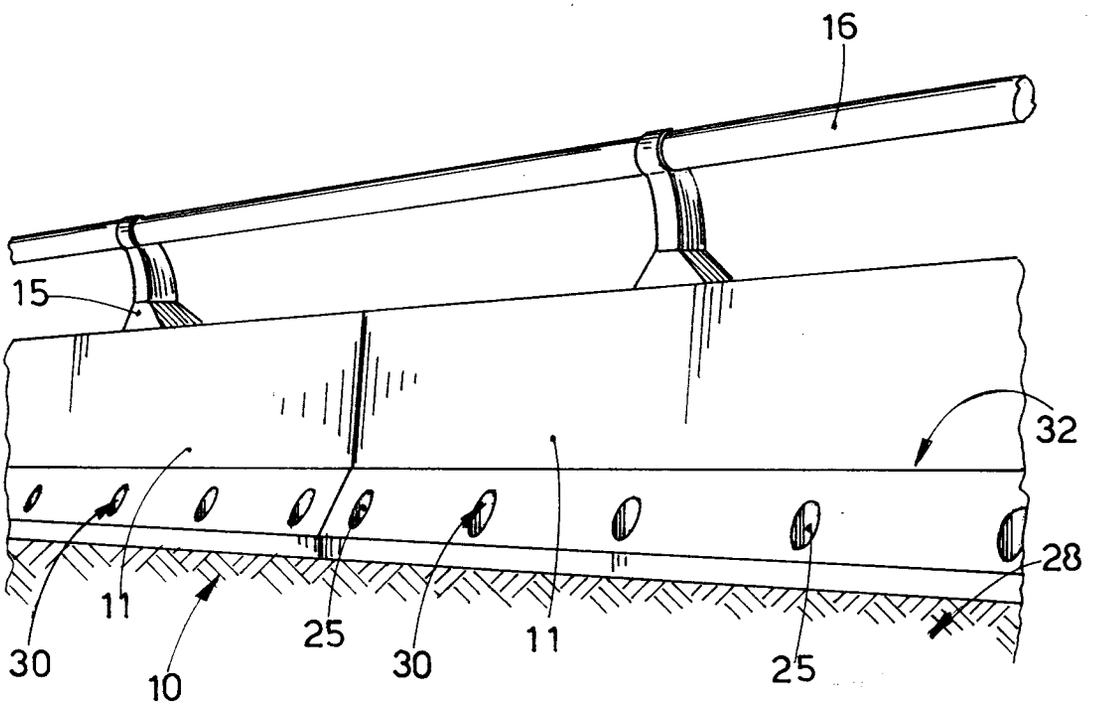
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fig.1

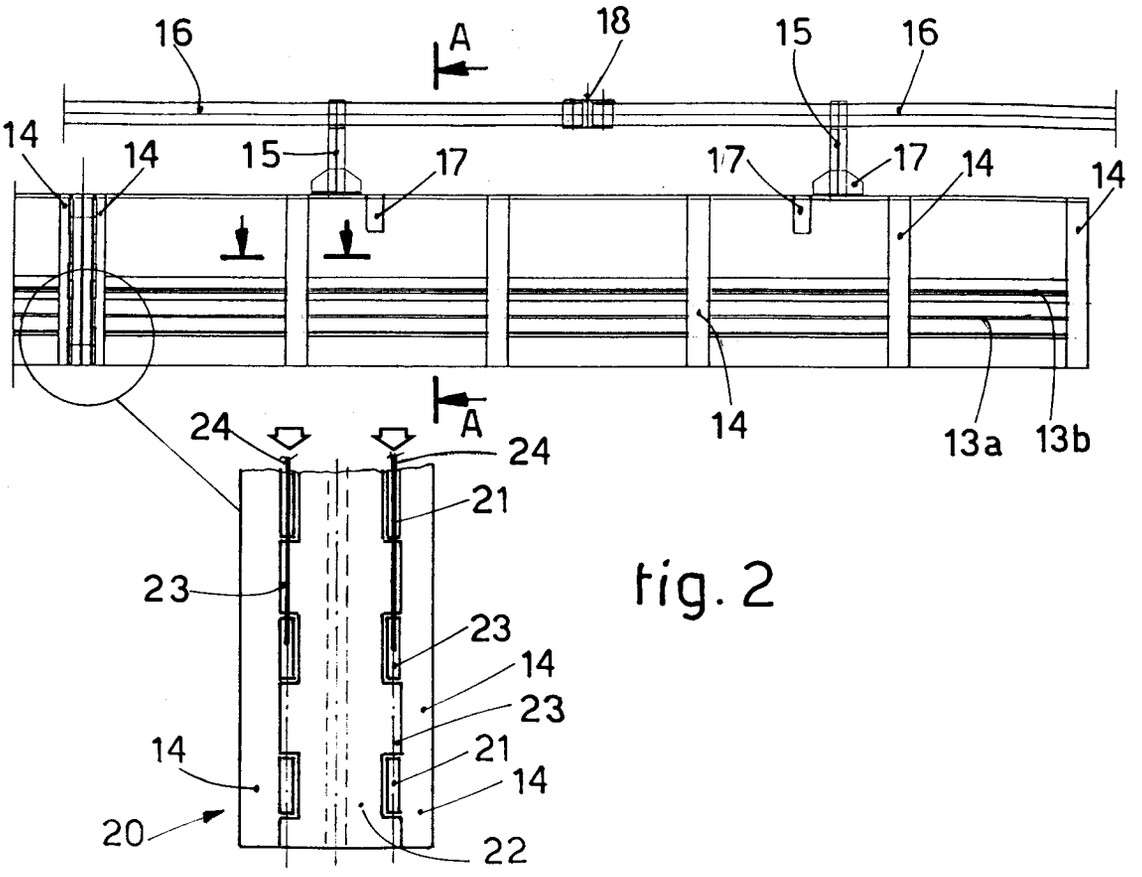
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fig. 2

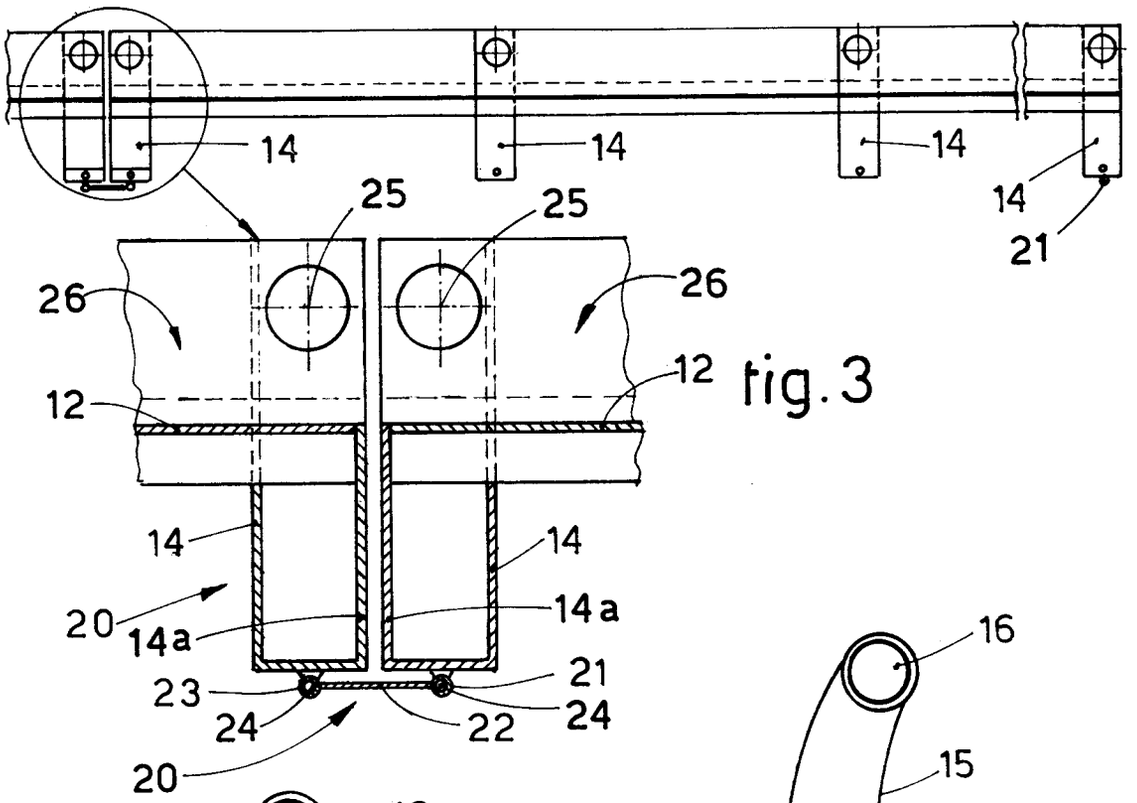


fig.3

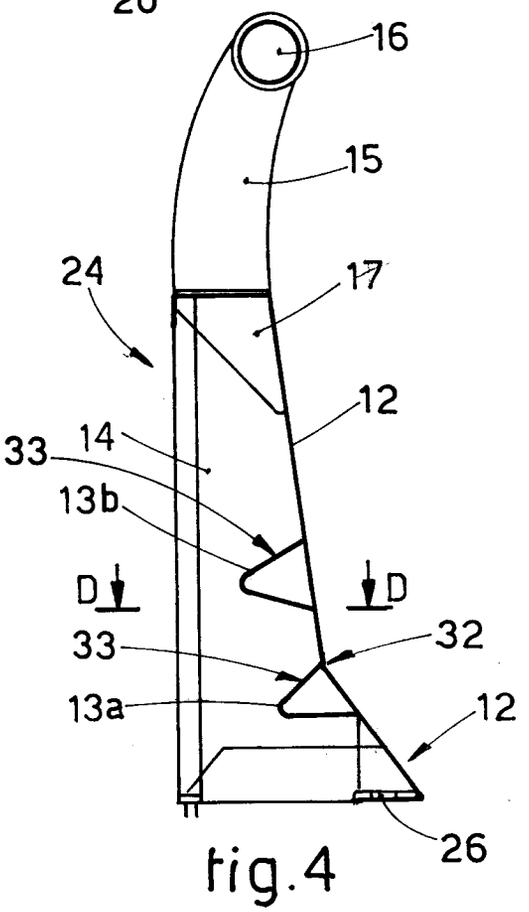


fig.4

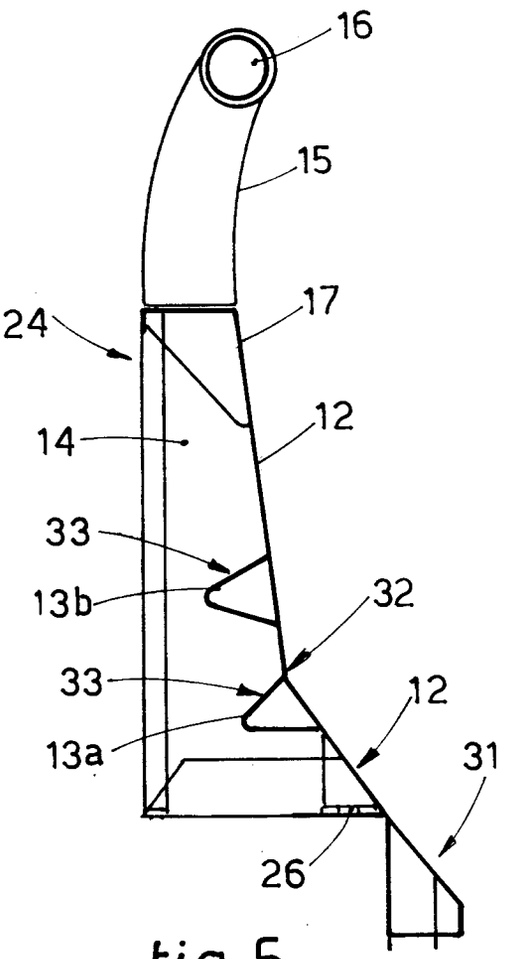


fig.5

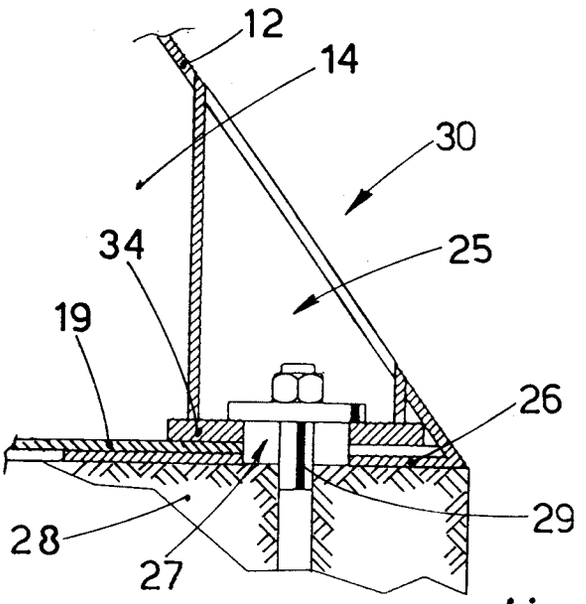


fig.6

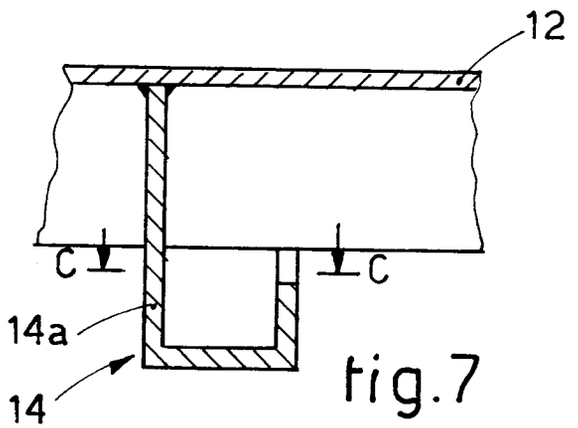


fig.7

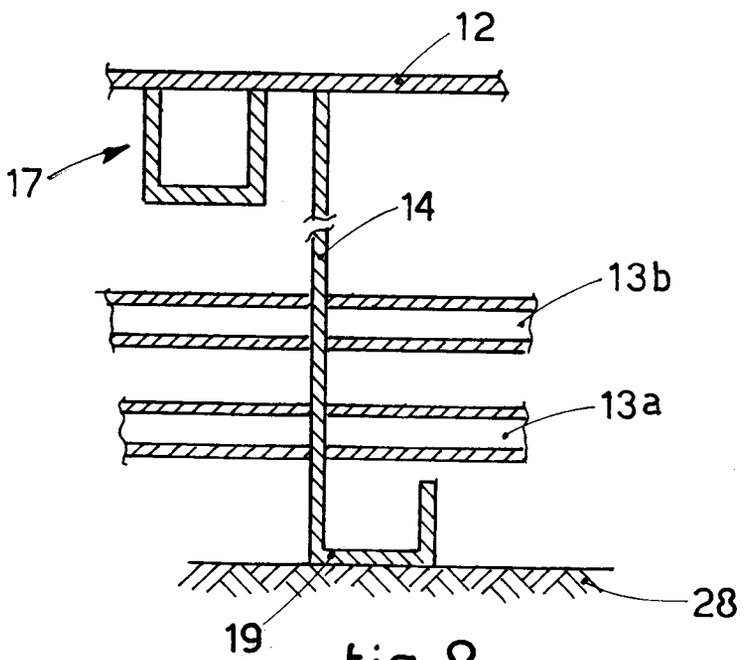


fig.8

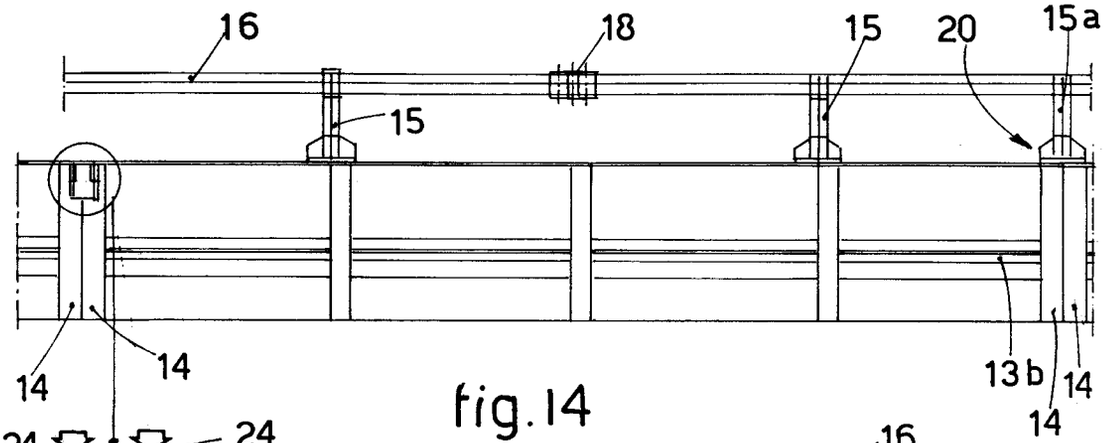
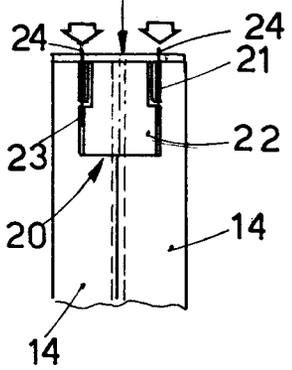


fig.14



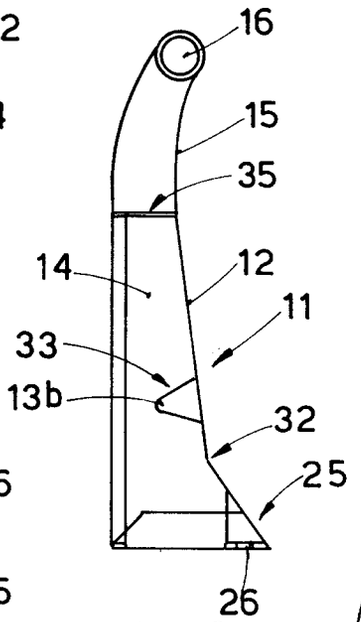


fig.9

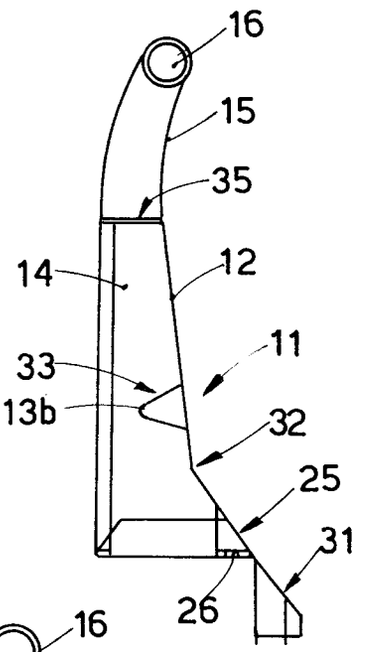


fig.10

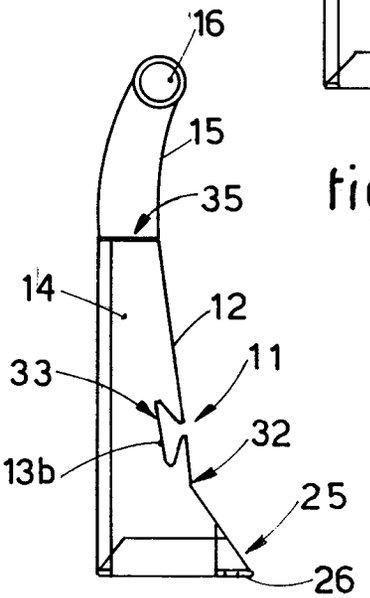


fig.11

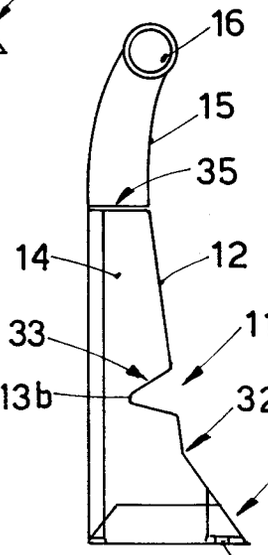


fig.12

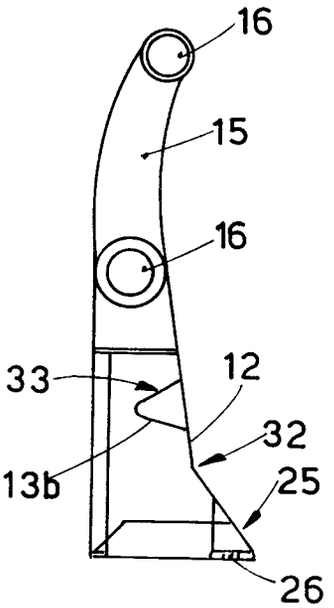


fig.13

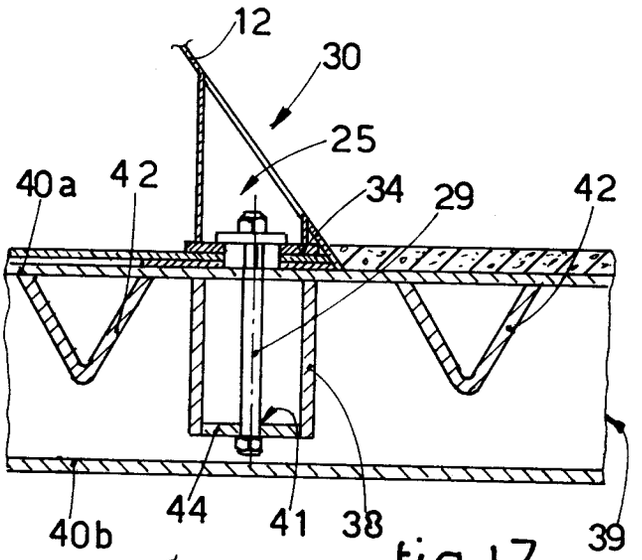


fig.17

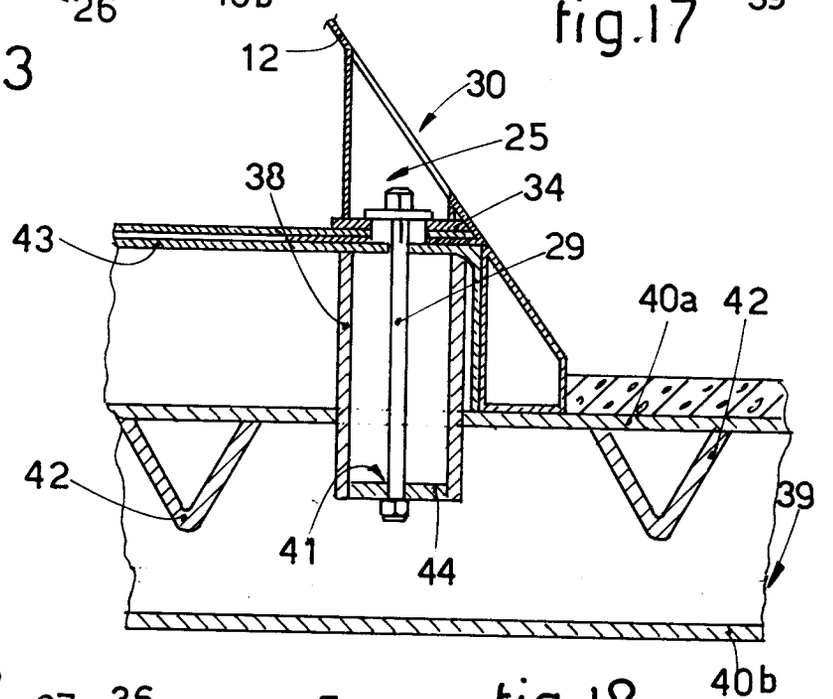


fig.18

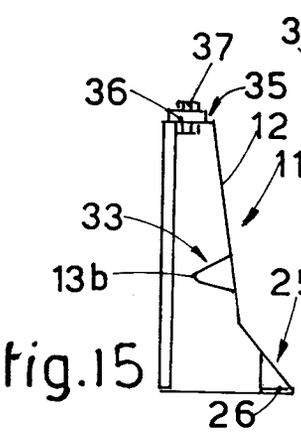


fig.15

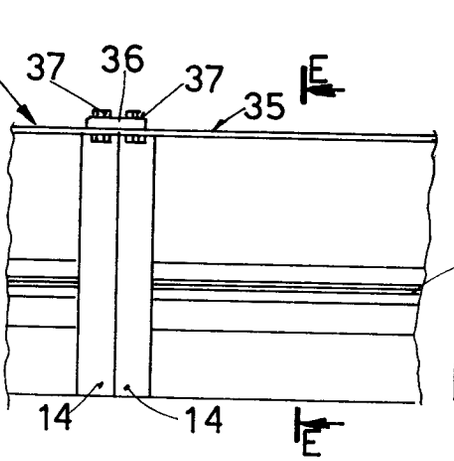


fig.16

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 10 4919

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	EP-A-0 428 097 (F. BATTISTELLA) * the whole document *	1	E01F15/00
A	EP-A-0 216 712 (L'EQUIPEMENT ROUTIER) * figure 3 *	1	
A	US-A-4 681 302 (M.L. THOMPSON) * figure 51 *	1,2	
A	DE-U-8 903 821 (SPS) * figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E01F
E01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 JULY 1993	VERVEER D.

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