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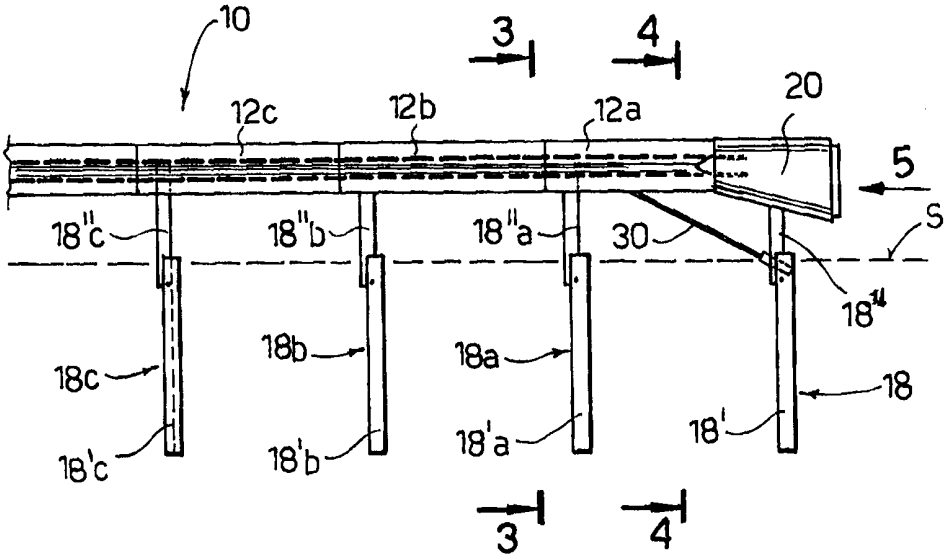
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(54) Title: SAFETY BARRIER TERMINAL FOR MOTORWAY GUARD–RAIL



(57) Abstract

A safety terminal (10) comprises a number of longitudinal segments (12a, 12b, 12c...) provided with elongated slots and fastened together in such a way as to be capable of sliding longitudinally over one another, with consequent absorption of energy, each segment being supported by an upright or post (18a, 18b,...) made up of two half–posts connected together by breakable means having a preset breaking strength, the bottom half–post being burried in the ground; the said terminal moreover comprises a cable (30) between the bottom half–post (18') of the end post (18) and the top half–post (18") of the adjacent post, the said cable (30) comprising a breakable plate having a preset breaking strength. Preferably the headpiece of the terminal comprises a restraining frame extended from a plate orthogonal to the longitudinal extent of the terminal. The new terminal enables good absorption of impact energy of a possible vehicle, whilst at the same time requiring reasonable costs for restoring.

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SAFETY BARRIER TERMINAL FOR MOTORWAY GUARD-RAIL

DESCRIPTION

This invention refers to the field of safety barriers, or guard-rails, for use on roads or motorways. Safety barriers of the "guard-rail" type are currently known, which comprise a horizontal, longitudinal member, or stringer, which may consist of a strip of corrugated sheet iron mounted on uprights or posts. These safety barriers present quite safe and predictable results in the event of impact of a vehicle at angles of trajectory which are not too wide with respect to the longitudinal extent of the barrier. However, for reasons of convenient access to the roadway or for other reasons, it is unthinkable to build a continuous guard-rail all along a road between the points of start and arrival of the road itself. Consequently, the guard-rail will inevitably be built in more or less long stretches that have end portions. Whilst statistics have shown a rather satisfactory behaviour of the guard-rail in the case of impact against an intermediate portion thereof, they have also shown an increasing incidence of impact of vehicles against the end parts, or terminals, of the barrier, having consequences that are almost always serious or tragic because the stiffness of the barrier is high in its longitudinal direction, and because of the very high kinetic energy, due to the whole speed of the vehicle. In addition, the height of the ends may be dangerous.

Consequently, in more recent times, attention has been directed to the problem of shock absorption in the case of head-on impact against a safety barrier.

A widely adopted solution consists in setting the terminal segment of the barrier inclined downwards to the ground; this prevents a head-on collision of a vehicle with an end of the barrier at a dangerous height, but may cause the vehicle to leave the ground and even reach dangerous heights.

Other currently known solutions involve barrier terminals that are able to absorb energy by means of telescoping, said terminals comprising various barrier segments which are fastened to one another in longitudinal succession by means of calibrated bolts engaged

in slots in the segments; the barrier is double at least at the terminal portion, and each couple of parallel segments of the guard-rail are supported by a wooden post, which has a through hole at a certain height so as to be able to withstand impacts that are transverse to the barrier but to break under an impact of preset magnitude that is longitudinal to the barrier. The impact of a vehicle against the terminal causes the screws and posts to break, and the sections to telescope one over another. The known terminals of this type are widely used in some states of the United States, however, they have the drawback that, since a particularly high-priced type of wood must be used, the cost of such barriers is relatively high already when the wood is locally available; if they were to be transported as they are to other areas, the cost of the posts would be prohibitive, also considering that it is not possible to restore them after impact. In addition, the stiffness of the posts is anyway excessive and relatively dangerous.

The state of the art also includes a safety barrier for motorways made of a single strip of curved section on the end of which is mounted a widened headpiece provided with a system of rollers. In the event of collision of a vehicle against the end, i.e., against the headpiece, of the terminal, this headpiece slides along the metal strip, flattening it out as it goes; the absorption of energy is provided by the deformation of the metal strip.

A variant of this system comprises a terminal with headpiece equipped with particular knives, which, in the event of impact of a vehicle, runs along the strip of the guard-rail so that the knives cut the guard-rail up into thin slices. In this case, the absorption of energy is provided by the longitudinal cutting of the strip.

These latter two systems present the drawback that they are difficult to calibrate, and anyway costly.

The state of the art also comprises so-called shock-attenuators. These are devices that are set to protect a particular object, which is considered to be dangerous or to be in a dangerous position for traffic. Shock-attenuators differ from terminals in that they present better performance and higher costs. In fact, a terminal functions only in so far as it is connected to a safety barrier, whereas a shock-attenuator may function even when it

is isolated, protecting a dangerous but relatively narrow obstacle, such as the pier of a bridge or the end of a low wall.

The aim of this invention is to make a terminal for road safety barriers which enables good absorption of energy in the event of impact, good retention of the vehicle, and hence provides a good level of safety, and at the same time may be made and restored at acceptable costs.

These aims have been achieved with a terminal as described in Claim 1 attached. Further new and advantageous characteristics are described in the subsequent claims.

The new terminal comprises a longitudinally extended strip made up of a number of barrier segments provided with elongated slots in which screws for joining the segments together are screwed at a calibrated tightening torque; it further comprises a headpiece of the terminal applied on an outermost segment; each segment is mounted on an upright or post, which is made up of two half-posts, the bottom one of which is driven into the ground for a substantial portion of its height, and the top one is mounted on the bottom one by means of a predictably breakable transverse pin, i.e. a pin having a preset breaking strength, and preferably presenting a groove which engages with a peg of the bottom half-post. According to a further characteristic of the invention, at least between the bottom half-post, which supports the end segment and/or the headpiece, and the adjacent top half-post a tie rod is mounted, which comprises in its length a weakened section with a predictable or preset breaking strength.

According to a further characteristic, the headpiece comprises a plate which is set transverse to the longitudinal extension of the barrier and is provided with a protruding frame for retention of the vehicle, so as to prevent a vehicle that hits the terminal from sliding sideways without being able to exploit the absorption of energy provided by the terminal.

According to a further aspect of this invention, the breakable upright or post made up of two half-posts, the bottom one of which is driven into the ground for a substantial portion of its height, and the top one of which is mounted to the bottom one by means of a

predictably releasing restraint, can be used in a wide variety of road safety barriers, including highway guardrails of any suitable design. Thus, the breakable post of this invention is not restricted to use with a particular guardrail shown in the attached drawings.

The new terminal enables a good absorption of energy, and hence a considerable degree of safety, for a vehicle in the event of impact of the latter against the terminal with a substantial component of force parallel to the longitudinal extent of the barrier or guard-rail. In addition, it has relatively reasonable production and installation costs, and it may be restored rapidly and at reasonable costs.

An exemplary explanatory unrestrictive embodiment of the invention will be described in below, with reference to the attached drawings, in which:

Figure 1 is a broken-away side view, in reduced scale, of a motorway safety barrier terminal according to the present invention;

Figure 2 is a top plan view with respect to Figure 1;

Figure 3 is a sectional view according to a plane indicated by 3-3 in Figure 1;

Figure 4 is a sectional view according to a plane indicated by 4-4 in Figure 1;

Figure 5 is a view of an end headpiece according to arrow referenced 5 in Figure 1.

Figure 6 shows enlarged a detail of Figure 1;

Figure 7 is a sectional view according to a plane indicated by 7-7 in Figure 6;

Figure 8 is a sectional view according to a plane indicated by 8-8 in Figure 6;

Figure 9 is a full-size scale representation of a predictably breakable plate, i.e. a plate having a preset breaking strength, of a tie rod of the barrier;

Figure 10 is a top plan view with respect to Figure 9;

Figure 11 is an enlarged side view of a terminal headpiece mounted on a barrier end segment;

Figure 12 is a top plan view with respect to Figure 11.

A safety terminal for road safety barriers is indicated as a whole by reference 10 in the figures and is suitable for being applied to the ends of road safety barriers of the guard-rail type, which comprise one or more strips of corrugated sheet metal supported by

uprights or posts.

The terminal 10 basically comprises a number of segments 12 of elastic metal strip, each of which is referenced 12a, 12b, 12c, . . . respectively, starting from the outermost segment 12a.

Each of the segments 12a, 12b, 12c, . . ., as may be seen in Figures 3, 11 and 12, comprises a corrugated metal strip with double corrugation, with longitudinal slits or slots aligned in two parallel rows, referenced 13 and 14 respectively. According to a characteristic of this invention, the slots 13 of one row and the slots 14 of the other row are mutually staggered in a longitudinal direction. In the area where edge parts of the segments are overlapping, the segments of corrugated section bar, 12a, 12b, 12c are fastened together, in a per se known way, by means of bolts 15. The bolts are tightened with a calibrated tightening torque, whilst the sheet metal bridges between each slot and the next one are sized so as to collapse at a preset applied force when the bolts pass through them. At each segment, 12a, 12b, 12c, etc., a supporting upright or post is provided, respectively referenced 18a, 18b, 18c, etc., whilst the reference 18 indicates an end upright which supports a headpiece 20 applied to the end segment 12a. Each upright or post comprises a bottom half-post and a top half-post, respectively referenced 18' and 18" for the post 18, 18'a and 18"a for the post 18a, and likewise 18'b and 18"b for the post 18b, and 18'c and 18"c for the post 18c. The bottom half-posts have a bottom retaining rod or peg 16 and, set at the top, a predictably breakable pin 17, i.e. a pin having a preset breaking strength, upon which the top half-post engages. In particular, the pin 17 passes through registering holes of the bottom half-post and in the top half-post, whilst rod 16 is engaged in a recess 16' of the top half-post. In the embodiment shown, the bottom half-post is made of I-section and the top half-post of channel section, whilst reinforcements 19 are provided along the flanges of the metal section which forms the top half-post.

Between the first upright 18 and the second upright 18a a tie rod 30 is stretched which is anchored with one end thereof on the bottom half-post 18' of 18 and with the other end thereof on the top half-post 18"a. The tie rod 30 generally comprises a cable portion, a

tensioning device which is per se known, and preferably comprises a predictably breakable plate 32, i.e. a plate having a preset breaking strength, generally consisting, as may be seen from Figures 9 and 10, of a metal plate with one narrow portion 33.

The head or headpiece 20 (Figures 5, 11 and 12) comprises an end plate, referenced 22, which is substantially orthogonal to the longitudinal extent of the barrier and fastened to the end of the end segment of metal section 12a by means of a bottom bracket 24 and an oblique arm 25. The plate 22 comprises a restraining projection 26 set around the perimeter of the plate close to the latter's periphery. The said restraining projection has the purpose of restraining a vehicle which collides against the headpiece so as to prevent any lateral displacements of the vehicle that might cause it to swerve and thus fail to exploit the possibilities of absorption of energy of the safety terminal, with consequent greater risks.

The restraining projection generally consists of a bent metal sheet welded to the base plate 22.

As has been said, the new terminal for guard-rails or road safety barriers is mounted with the uprights driven into the ground almost up to the full height of the bottom half-posts 18', 18'a, etc., as is indicated by the dashed line S in Figures 1, 3 and 4. When a vehicle hits the terminal with a component of force that is substantially longitudinal to the barrier, the energy of impact is substantially dissipated by the frictional force between the elements 12a, 12b, etc., by the breaking of the bridges that separate the slots of the said elements; by the breaking of the breakable plate 32; and by the breaking of the pegs 17 of the uprights.

After impact, the terminal may be restored relatively easily by replacing the barrier elements 12, 12a, etc. that have been deformed, by replacing the tie-rod element 30, by replacing the calibrated pins 17, and by restoring the top half-posts on them.

Of course, many variations and modifications are possible. For example, the breakaway post described above can be used with guardrails having other types of segments and

other types of headpieces. The top half-post can be formed with any suitable geometry, including a solid cross section or a rectangular channel cross section. The bottom half-post can also be formed with any suitable geometry, including a C-channel cross section, or a solid cross section defining a slot for the top half-post. The restraint can include a breakaway pin as described above, which may be formed of stainless steel, and which may use conventional retainers such as an enlarged head and a cotter pin to hold the pin in place. Other types of restraints can be used, as long as they allow the top half-post to move out of the slot in the bottom half-post when an excessive rearward load is imposed. For example, a breakable or bendable latch may be mounted to or formed on the flanges of the bottom half-post to secure the top half-post releasably in its vertical orientation.

The disclosed system is easy to install because the bottom half-post can be driven into the ground quickly and easily, and then the top half-post can be assembled in place simply by placing it on the peg and then installing the breakaway pin. The breakaway posts are readily refurbished after a collision. Often, nothing is more required than to reposition the top half-post in its vertical position on the peg of the lower half-post, and then to install a new breakaway pin.

The foregoing description should be regarded as an illustration of selected preferred embodiments of this invention, and not as a definition of the invention. It is only the following claims, including all equivalents, that are intended to define the scope of this invention.

CLAIMS

1. A terminal for road safety barrier comprising:
barrier segments (12a, 12b, 12c, . . .) provided with slots set one longitudinally with respect to the other in a double row (13, 14), separated in each row by predictably breakable bridges, the said barrier segments being connected together by means of bolts (15) passing in said slots, the said segments being supported on breakable uprights in such a way that, for an impact against said terminal having a force or a component of force or a level of energy higher than a preset threshold, the said segments may slide over one another, thus dissipating energy, and the said uprights may break;
characterized in that
each of said breakable uprights (18, 18a, 18b, 18c, . . .) comprises a bottom half-post and a top half-post (18", 18"a, 18"b, 18"c . . .), of which the top half-post is constrained to the bottom one by means of a breakable system (16, 17), and in that the endmost segment (12a) carries a headpiece (20).

2. A terminal for road safety barrier according to Claim 1, characterized in that the said breakable system comprises a breakable through-pin (17).

3. A terminal for road safety barrier according to Claim 2, characterized in that the said breakable system further comprises a peg and a peg-engaging surface on opposed half-posts.

4. A terminal according to Claim 1, characterized in that the bottom half-posts are buried for a substantial part of their height in the ground.

5. A terminal for road safety barrier according to Claim 1, characterized in that in said barrier segments the slots are not continuous but are interrupted by breakable bridges having a preset breaking strength.

6. A terminal for road safety barrier according to Claim 1, characterized in that in said barrier segments the slots (13) of one row and the slots (14) of the other row are

longitudinally staggered with respect to one another.

7. A terminal for road safety barrier according to Claim 1, characterized in that at least between one bottom half-post (18') of one upright (18) and one top half-post (18"a) of the adjacent upright (18a) a breakable tie-rod (30) is stretched having a preset breaking strength.

8. A terminal for road safety barrier according to Claim 7, characterized in that the said tie-rod (30) comprises a cable portion and a breakable plate (32) having a preset breaking strength.

9. A terminal for road safety barrier according to Claim 1, characterized in that the said headpiece (20) comprises an end plate (22) that is set substantially transverse to the longitudinal extent of the barrier and is equipped with a vehicle restraining projection or protruding edge (26).

10. A terminal for road safety barrier according to Claim 9, characterized in that the said restraining edge (26) is extended around the perimeter of the plate (22) at a short distance therefrom.

11. A terminal for a road safety barrier comprising:
a plurality of barrier segments; and
a plurality of uprights supporting the barrier segments;
characterized in that
at least one of the uprights comprises a bottom half-post, a top half-post, and a breakable system that releasably secures the top half-post to the bottom half-post.

12. A road safety barrier breakable upright comprising:
a bottom half-post;
a top half-post; and
a breakable system that releasably secures the top half-post to the bottom half-post.

13. The invention of Claim 11 or 12 wherein the breakable system comprises a breakable through-pin.

14. The invention of Claim 11 or 12 wherein the breakable system comprises a peg on one of the half-posts and a peg-engaging surface on the other of the half-posts.

15. The invention of Claim 11 or 12 wherein the bottom half-post is buried for a substantial part of its height in the ground.

16. The invention of Claim 11 or 12 wherein the bottom half-post comprises an I-beam element, wherein the top half-post comprises a C-channel element, and wherein the C-channel element is received in a slot formed by the I-beam element.

17. A roadside guardrail comprising a plurality of the support posts of Claim 11 or 12 and at least one barrier segment supported by the top half-posts.

18. A road safety barrier support post comprising:
a lower post portion;
an upper post portion mounted to the upper post portion; and
a restraint releasably holding the upper post in a selected initial position with respect to the lower post position.

19. The invention of Claim 18 wherein the restraint comprises a breakable pin.

20. The invention of Claim 18 wherein the lower post portion comprises a slot that receives the upper post portion, and wherein the lower post portion comprises a pivot oriented transverse to the slot, said slot opening to one side of the lower post portion to allow part of the upper post portion to move out of the slot.

21. The invention of Claim 20 wherein the lower post portion comprises a web and two spaced parallel flanges that bound the slot, wherein the web braces the upper post portion against pivoting toward the web.

22. The invention of Claim 20 where the restraint comprises a breakable through pin that extends across the slot and the upper post portion.

23. The invention of Claim 20 wherein the pivot comprises a peg extending across the slot, and wherein the lower post portion comprises a peg-engaging surface.

24. The invention of Claim 18 wherein the lower post portion comprises an I-beam element, wherein the upper post portion comprises a C-channel element, and wherein the C-channel element is received in a slot formed by the I-beam element.

25. A roadside guardrail comprising a plurality of the support posts of Claim 18 or 20 and at least one barrier supported by the upper post portions.

26. The invention of Claim 18 or 20 wherein the lower post portions are buried in the ground for at least a substantial part of their height.

FIG.1

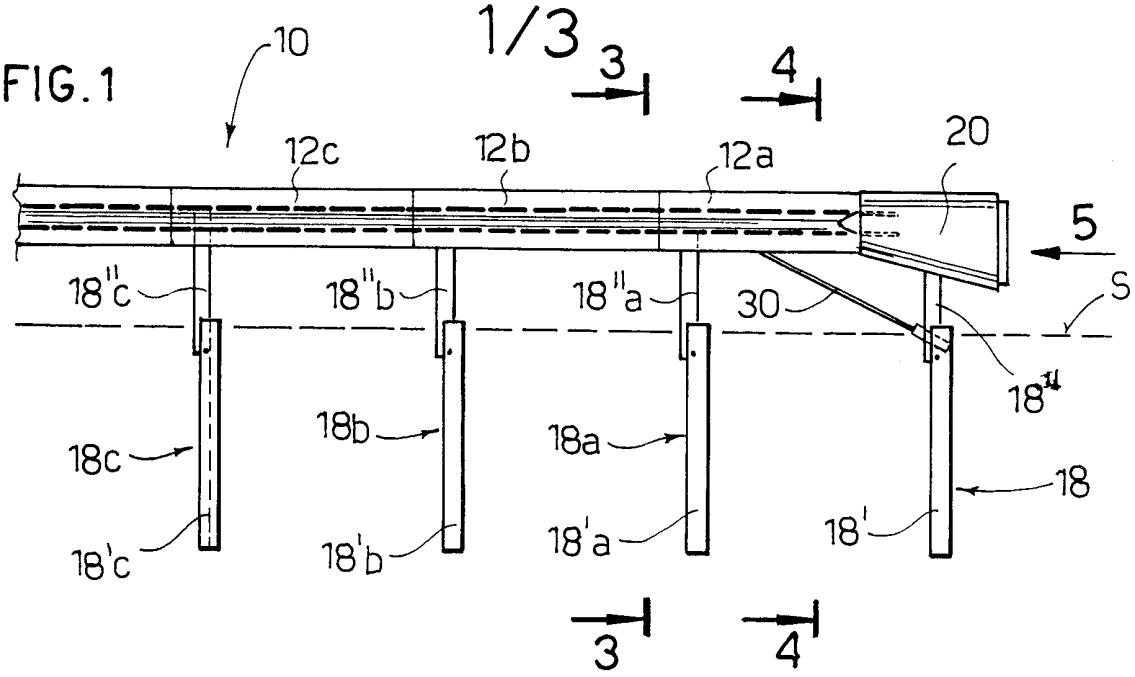
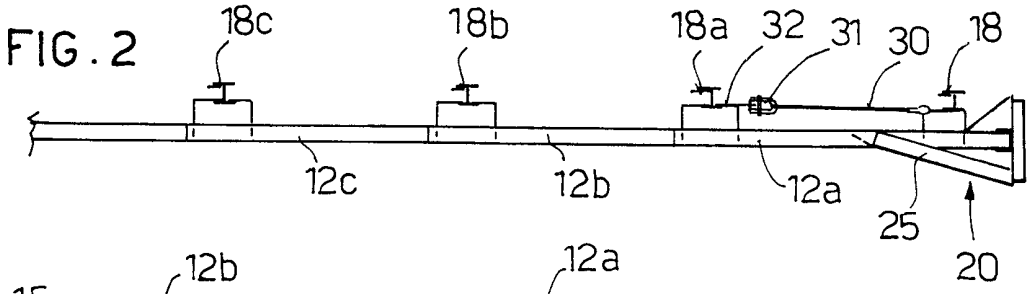


FIG.2



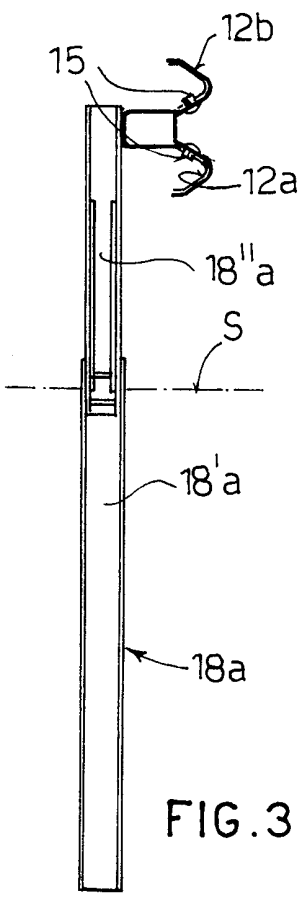


FIG.3

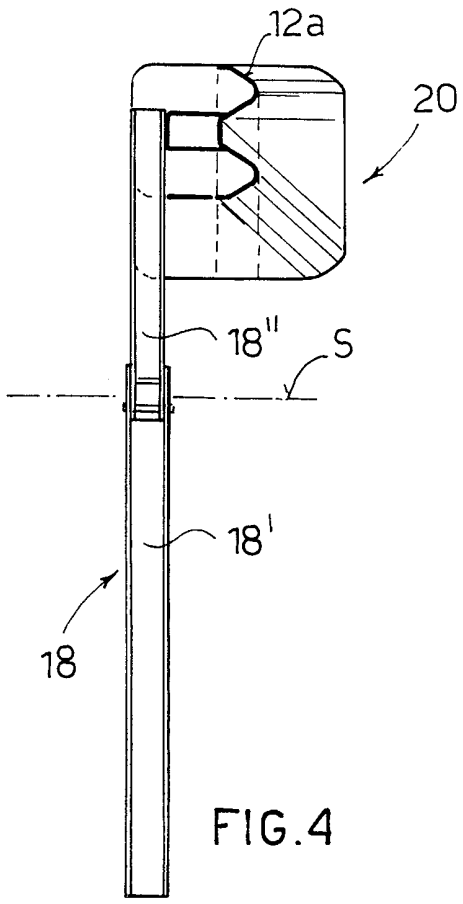


FIG.4

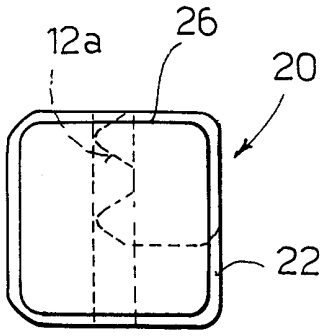


FIG.5

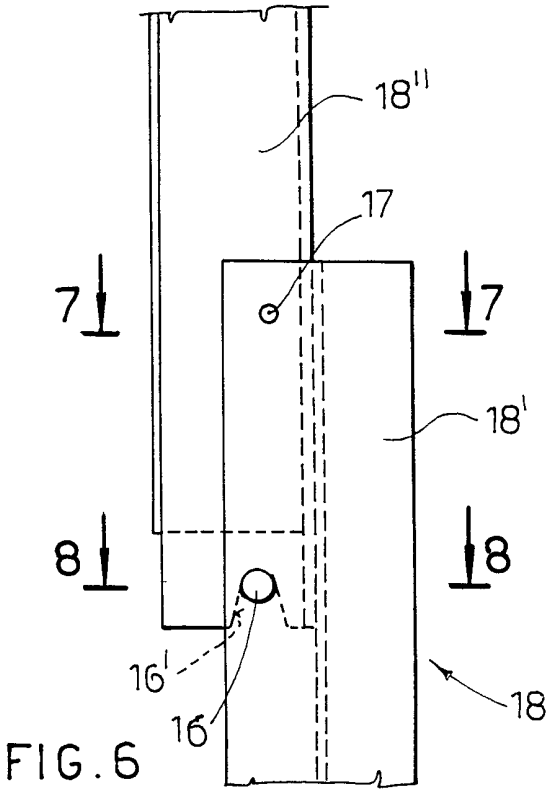
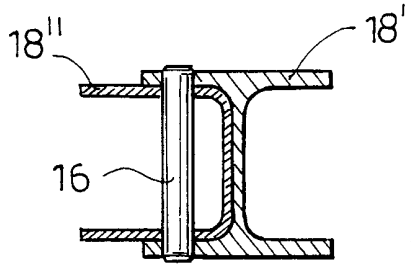


FIG.6

FIG.8



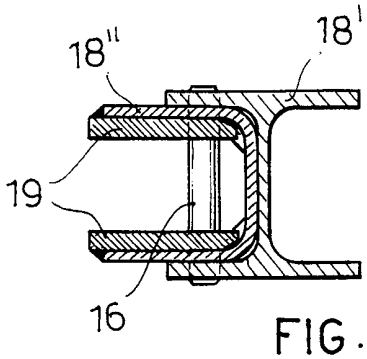


FIG.7

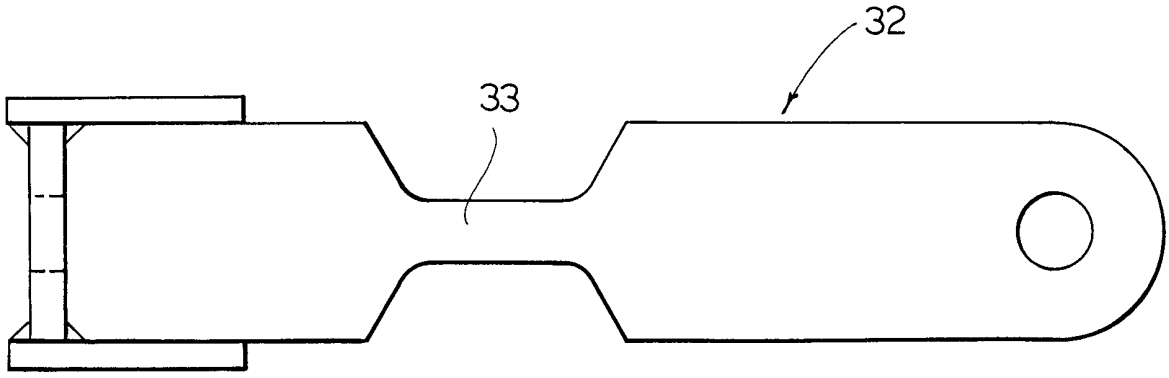


FIG.9

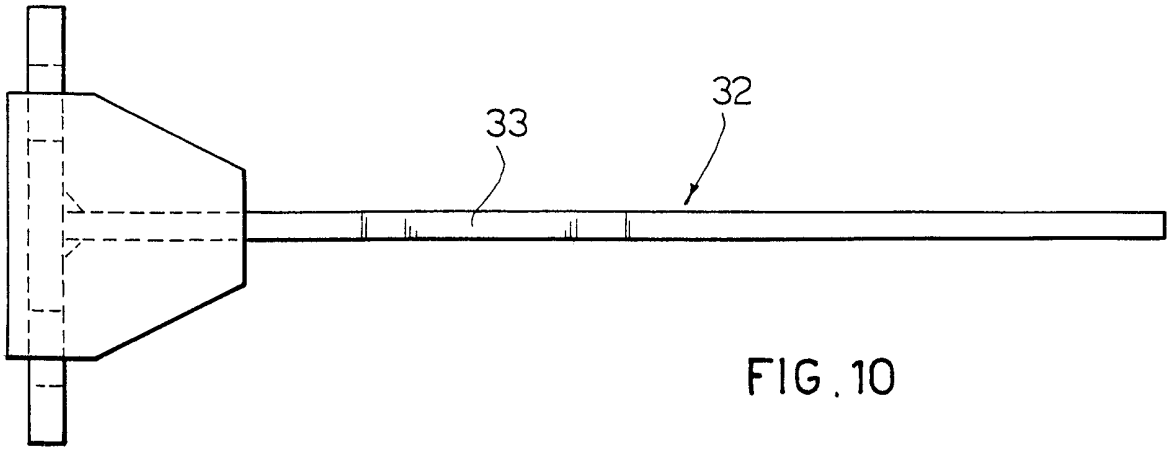


FIG.10

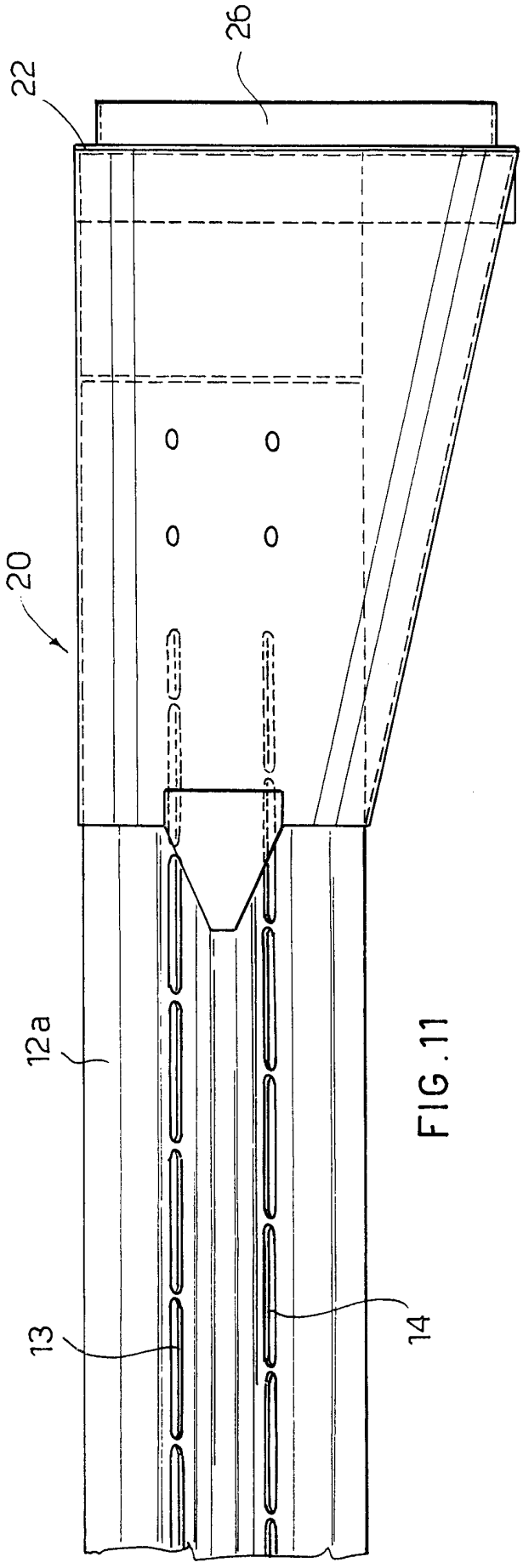


FIG. 11

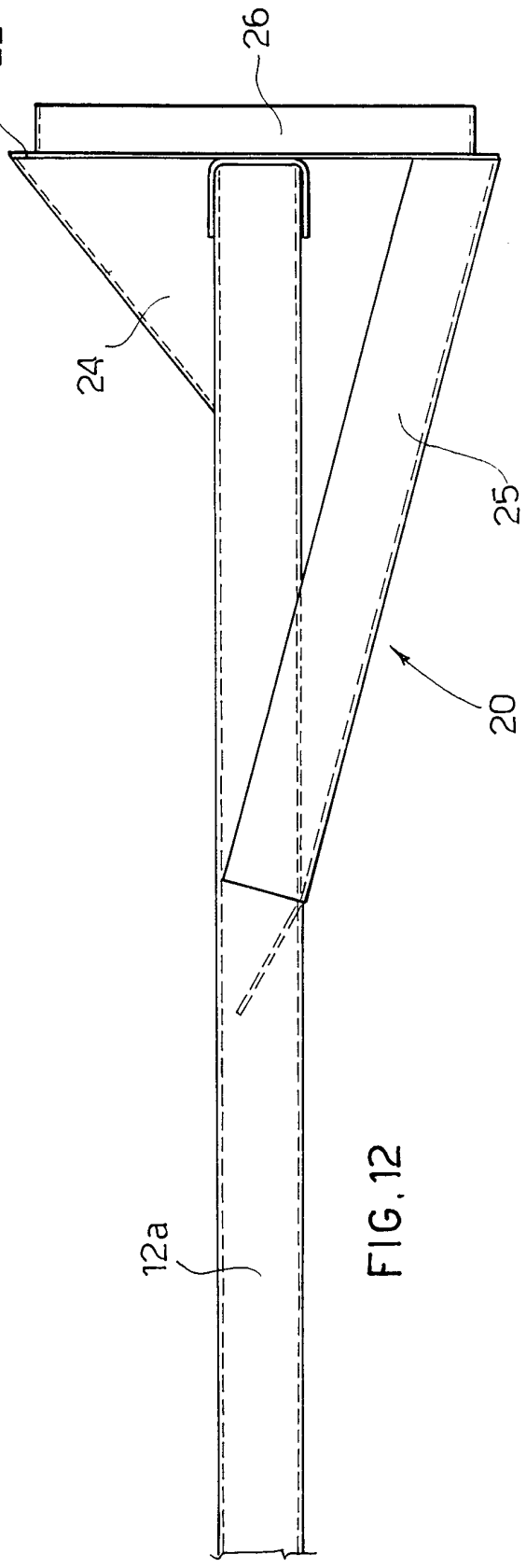


FIG. 12

INTERNATIONAL SEARCH REPORT

Interna al Application No
PCT/EP 98/08325

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E01F15/04 E01F15/14 E01F9/018

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 6 E01F

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 4 838 523 A (W.P. HUMBLE) 13 June 1989 see column 2, line 59 - column 3, line 62; figures ---	1,4,5, 11-13 2,3,7,9, 10
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 March 1999	13/04/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Verveer, D

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INTERNATIONAL SEARCH REPORT

Interna al Application No
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