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(54) **Speed bump**

(57) A speed bump which provides a road surface (4) formed by a bent plate (1) with a transverse edge running transverse to a driving direction (7). The transverse edge rests on one or more supports (2) which are elastically deformable parallel to the driving direction. The plate and the supports have a rigidity such, for instance in that the plate is made of a sufficiently thick metal plate, that elastic deformation of the plate due to weight on the plate is converted into displacement of the transverse edge parallel to the driving direction without the plate bending. In one embodiment, the bump furthermore comprises a discrete damper (6) element arranged between a part of the plate and an underground. This damper element is designed such that increasing speed of compression of the damper element results in the increasing reaction force.

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Description

[0001] The invention relates to a deformable speed bump whose height decreases under the influence of the weight of a passing vehicle. Such a speed bump may be designed such that the height decreases significantly only when the passing vehicle observes the maximum speed, or only for vehicles with an exceptional weight (for instance trucks).

[0002] From, for instance, British patent application 2 288 419, a speed bump is known wherein the road surface is formed by a rubber sheet whose transverse edges (transverse to the driving direction) have been secured to the road and under which a liquid is provided. Under the weight of a vehicle, the rubber sheet is locally deformed so that the height of the bump decreases. The liquid is then locally pressed away. However, this only happens with low speed. With higher speeds, the liquid behaves like a rigid mass that does not allow decrease of the height. However, such a speed bump is vulnerable, in particular to vandalism, is maintenance-prone and complex to install.

[0003] From British patent application GB 2 324 326, also, a speed bump is known wherein the road surface is formed by a rubber sheet whose transverse edges (transverse to the driving direction) have been secured to the road and under which air is present. Under the weight of a vehicle, the rubber sheet is locally deformed so that the height of the bump decreases. The air is then locally pressed away through special openings. However, this only happens with low speeds. With higher speeds, the entrapped air behaves like a rigid mass, allowing no, or virtually no decrease of height. Such a speed bump is vulnerable, in particular to vandalism, maintenance-prone and complex to install.

[0004] From German patent application DE 3 132 564, a braking apparatus is known with tracks forming raised bridges for the tyres of a car. One track is connected to an electric generator. A car decelerates as it drives up the bridges and the generator then converts the generated forces into electric voltage. Viewed from a side, each track forms a trapezium-shaped elevation whose high, horizontal part, in the position of rest, is held raised with springs. A first corner point at the base of the trapezium is secured to the road surface and the second corner point at the base rests on the road surface in a displaceable manner. This second corner point is coupled to the generator. When the wheel of a car drives up the track from the side of the first corner point, the springs are compressed so that the track stretches, while the displacement of the second corner point generates current in the generator.

[0005] Although, in theory, such a device could serve as a speed bump, in practice, the installation with generators renders all this too expensive and vulnerable for general use. That is why the patent application especially describes a use for slowing down trucks on a building site, while a comparison is made with buffers as known at the end of train tracks. Furthermore, when used as speed bump (that is to say, for cars not coming to a standstill on the apparatus) there is, furthermore, a great risk that the apparatus causes much noise, because the end of the trapezium drags over the road.

[0006] It is, inter alia, an object of the invention to provide in a speed bump with a variable height, having a simple and maintenance-low construction that causes little noise.

[0007] It is, inter alia, a further object of the invention to provide in a speed bump that does not react linearly to cars driving over the bump.

[0008] The speed bump according to the invention is described in claim 1. According to the invention, the road surface of the speed bump is formed by a hard plate, preferably of metal, that is supported at one transverse edge and preferably on both transverse edges, by, only, an elastically deformable support, or supports. The rigidity of the plate and the supports is chosen such that, when loaded, the plate stretches without bending to an increasing extent (that is to say without curving locally, which decreases the degree of stretch). Here, the stretching of the plate is absorbed at the edges by deformation of the supports without the plate further contacting the underground, at least initially. That is why the plate lowers to a greater or lesser extent depending on the load, so that the speed bump remains active for lighter cars (passenger cars) but is depressed by heavier cars (for instance trucks). Noise nuisance is avoided since the plate rests only on the supports without a movement being allowed that enables the edge of the plate to make contact with the road surface next to the plate. Preferably, the combination of the supports and the plate is designed such that virtually only displacement of the edge parallel to the driving direction is allowed, while no vertical displacement of the edge is allowed that is so great that contact with the road surface next to the plate occurs.

[0009] Preferably, the speed bump contains a discrete damper element with a housing which is coupled, on the one side, to the plate and, on the other side, to an underground, and which has a damping characteristic with an increasing reaction force at increasing speed of compression of the damper element. In this manner, a behavior is realized with which the speed bump lowers with cars driving slowly, but stays upright with cars driving too fast. Preferably, the damper element is designed such that the reaction force depends mainly on the speed of compression, but further hardly, if at all, on the force of compression. Preferably, the damper element is designed such that upon increasing loading force, the reaction force saturates. In this manner, the speed bump also lowers with heavier cars driving too fast, which prevents damage to such cars or their cargo. This property results in important advantages for fire engines and ambulances which have to operate rapidly. Labour conditions of bus drivers improve as their bodies are exposed less to regular shocks. A further advantage is that vibration nuisance and/or damage to houses bordering on speed bumps are prevented.

[0010] In one embodiment, the speed bump comprises an elastically resilient surface (for instance a rubber mat) lying under the plate but, with the speed bump in a condition of rest, not making contact with the plate. Only when loaded

heavily, the plate lowers so far that it comes to rest on the rubber mat, which ensures that no hole can be formed in the road. In this manner, through the use of a resilient surface, excessive noise nuisance is prevented.

[0011] These and other objectives and advantages of the invention will become clear from the description of non-limitative exemplary embodiments, with reference to the accompanying Figures.

Fig. 1 shows a cross-section of a speed bump;
 Fig. 2 shows a depressed speed bump;
 Fig. 3 shows a speed bump with a damper; and
 Fig. 4 shows a damper characteristic.

[0012] Fig. 1 shows a cross-section of a speed bump provided on a road 4, in a condition of rest. The driving direction over the road is indicated with an arrow 7. The speed bump comprises a metal plate 1, supports 2 and a rubber mat 3. Metal plate 1 may be pre-folded such that in cross-section, metal plate 1 has the shape of the upper part of a trapezium, with a central, horizontal surface and, on both side of this central surface, obliquely ascending surfaces.

[0013] The transverse edges of the plate 1 (the edges that are transverse to the driving direction 7) at the extremities of the obliquely ascending surfaces bear on supports 2, provided in recesses in the road 4. With the speed bump in the condition of rest, supports 2 form the entire, or virtually entire support of the metal plate 1. In other respects, in the condition of rest, the plate 1 hangs completely, or virtually completely, clear.

[0014] Rubber mat 3 lies under metal plate 1 on the ground. In the condition of rest, metal plate 1 makes no or virtually no contact with rubber mat 3.

[0015] Each support 2 is for instance designed with a first metal part which is secured to metal plate 1, and second metal part secured in the recess to the road and a rubber connection, connecting the first and second metal parts, so that the two metal parts can move relative to each other while elastically deforming the rubber connection. In particular, each support 2 is designed such that the support allows at least elastic displacement of the transverse edge of metal plate 1 relative to the road parallel to the driving direction 7 (that is to say in the driving direction or counter thereto). In one embodiment, each support extends in this form, with elastic connection, almost over the entire length of a transverse edge of metal plate (perpendicular to the plane of drawing). In another embodiment, use can be made of a plurality of discrete supports along a transverse edge, supporting the transverse edge preferably over its entire length. To this end, commercially available vibration isolators may be used.

[0016] Fig. 2 shows how metal plate 1 is depressed when a car with a wheel 5 drives over metal plate 1, thereby depressing metal plate 1. As a result, the metal plate stretches, so that the distance between the transverse edges increases. This increase is elastically absorbed by supports 2. The rigidity of metal plate 1 and the rigidity of supports 2 for deformation parallel to the driving direction are chosen relative to each other such that, with increasing weight, metal plate stretches and does not bend to an increasing extent. Bending under weight is undesired, because it leads to unpredictable behavior as a result of decreasing reaction force of the speed bump upon increasing load, and possible permanent deformation of metal plate 1. Prevention of bending is a matter of combined action between the elasticity (rigidity) of supports 2 and the rigidity of metal plate 1. If supports 2 are too stiff, metal plate 1 would, under weight, sooner bend than stretch, and the same applies if metal plate 1 is not rigid enough. The rigidity of the metal plate 1 can be adjusted through selection of a suitable thickness and/or type of material, and the rigidity of supports 2 can be adjusted through selection of the weight of the rubber connection or the number of supports.

[0017] As metal plate 1 rests completely, or virtually completely, on supports 2, the noise nuisance owing to the speed bump is minimized. The transverse edges themselves of metal plate 1 do not movingly contact the road, which, otherwise, would lead to noise nuisance (unless use were to be made of carefully levelled and greased contact surfaces, which, however, would lead to high production and maintenance costs). Preferably, the rigidities of the different parts are selected such that under the weight of the wheels of relatively lighter cars (for instance ordinary passenger cars), metal plate 1 remains clear of rubber mat 3 and only under the weight of relatively heavier cars (for instance trucks or buses) lowers so much that metal plate comes into contact with rubber mat 3. The fact that, for most vehicles, under metal plate 1, except at the transverse edges, no connection at all occurs with the road, prevents noise nuisance for most cars. Even when, for heavy cars, contact is made with rubber mat 3, the noise nuisance is limited due to the properties of rubber mat 3. Rubber mat 3 ensures that above a particular weight, a strongly increasing reaction force is realized. The temporary formation of a hole in the road is thereby prevented. This prevents damage to (the cargo of) heavy vehicles and excessive noise nuisance. This property also results in important advantages for fire engines and ambulances having to do their job rapidly. Labour conditions for bus drivers improve as their bodies are exposed less to regular shocks. A further advantage is that vibration nuisance and/or damage to houses bordering on speed bumps is prevented.

[0018] Fig. 3 shows an embodiment of the speed bump in which one or more dampers 6 are added. The damper 6 is provided between a part of the metal plate 1 and the underlying ground. Damper 6 is designed such that it yields a limited reaction force against compression when compressed relatively slower, and a higher reaction force when compressed relatively faster. Such dampers are known per se and are commercially available. In one embodiment, the one

or more dampers 6 are arranged such that they receive the highest part of metal plate 1. As a result, a greatest possible space is available, so that the lightest possible dampers 6 can be used. Without deviating from the invention, the one or more dampers can be connected to, or receive metal plate 6 at other, or even at various locations.

[0019] Fig. 4 shows a usable damper characteristic representing the reaction force of damper 6 as function of the speed of compression. Dampers with such a damper characteristic are commercially available and are constructed with, for instance, a pipe with a piston therein moving through a liquid and provided with flow channels for passage of the liquid, while, if necessary, a part of the flow channels is provided with valves which open or close at a specific pressure difference across the valve so as to realize the desired damper characteristic.

[0020] Fig. 4 shows a damper characteristic in which the reaction force for low speeds increases by a small gradient. This defines the effect on cars driving over the bump below a maximum speed. Above a first threshold speed, the reaction force increases strongly. This defines the effect on cars driving over the bump above the maximum speed. Above the second threshold speed, the reaction force saturates (it becomes virtually constant). The reaction force occurring with this second threshold speed is selected such that it is higher than the force passenger cars with a normal weight apply on damper 6 (as a result of the axle pressure, taking into account the number of dampers 6 present in the damper and the resilience of metal plate 1). In this manner, the second threshold speed only plays a part for heavier vehicles such as trucks or buses. Preferably, the reaction force occurring with this second threshold speed is so low that it has no real influence on these heavier vehicles. That is why such heavier vehicles are not inconvenienced by the bump. In one example, use is made of a damper 6 wherein, at a speed of 0.5m/s, a threshold speed occurs at a reaction force of 500 Newton, and at around 0.8 m/s, a threshold speed at a reaction force of 1000 Newton. Naturally, other threshold speeds can be chosen, depending on the allowed speed. The forces are chosen so that the lowest force is hardly inconvenient to passenger cars and the highest is inconvenient to passenger cars but not to heavier vehicles, and can be chosen differently if this is necessary.

[0021] In another embodiment, use is made of a damper that has no saturation (where the reaction force continues to increase with increasing speed above the lowest threshold speed). In this case, heavier vehicles too are compelled to observe a maximum speed.

[0022] In operation, damper 6 gives no, or virtually no support to the metal plate 1 in the condition of rest. This is the function of the supports 2. Damper 6 has effect primarily when a car drives (too) rapidly over the speed bump. In that case, the bump is not or hardly depressed because of the great reaction force of damper 6 that is generated.

[0023] Preferably, one extremity of damper 6 is provided in a recess with respect to rubber mat 3, so that the eventual maximum depression of the bump is determined by rubber mat 3. Rubber mat 3 is arranged such that it prevents holes from being formed in the road surface, with associated, undesired driving and noise effects.

[0024] Preferably, as shown in Fig. 4, use is made of a damper 6 with which the reaction force cannot exceed a maximum, the maximum being selected such that this is insufficient to prevent the speed bump (and damper 6) from lowering for relatively heavier cars (for instance trucks and/or buses) but sufficient to prevent lowering for relatively lighter cars (passenger cars). That is why the bump has, on the one side, no harmful or undesired effects on heavier cars and, on the other side, has a cautionary effect on the lighter cars.

[0025] Through a selection of the damper characteristic, the behavior of the speed bump can be adjusted to the desires of the road administrator, for instance to the desired maximum speed or weight of cars on which the bumps has hardly any effect, if at all.

[0026] As dampers can be utilized a standard damper filled with liquid, available on the market. It is therefore not required that the entire bump be filled with liquid. As a result, the bump needs not be entirely watertight or airtight. When damage occurs to the driving surface, the bump is therefore not immediately unusable and, when the damper is damaged, only the damper needs to be replaced. In the embodiment shown, the damper cannot be reached or damaged by vandals, or only with great difficulty.

[0027] It is preferred that the bump is supplied as a prefab unit as shown in Figs. 1-3. The prefab unit is provided with a ground plate 8 (for instance a concrete slab) on which, prior to installation, metal plate 1, supports 2, rubber mat 3 and, optionally, damper 6 are provided. Upon installation, in this case, a recess is made in the road surface in which the bump unit is laid, ground plate 8 included.

[0028] Although the invention is described with reference to advantageous embodiments, it will be clear that these embodiments are not limitative. For instance, instead of metal plate 1, a plastic plate with sufficient rigidity can be used. Also, a plate is possible which is built up from several layers of different materials, to thus obtain a desired combination of properties. However, a metal plate 1, for instance from (for instance non-corrosive) steel renders the embodiment simple, low-maintenance and cost-effective.

[0029] Although, in the embodiment shown, the plate has (the upper side of) a trapezium shape, that is to say, with two folds, on both sides of a central part, it will be clear that the invention is not limited thereto. Instead thereof, for instance, a continuously bent plate can be used (in the shape of a sector of a cylinder). The folded trapezium shape however has the advantage that it is easily producible.

[0030] It will further be clear that although the Figures show supports 2 on both sides of the speed bump, as an

alternative, the bump can also be attached with one side hinged to the road. This is preferably done on the side where the traffic approaches but, alternatively, instead thereof it can be done on the other side. In these cases, a support 2 (or supports) on one transverse edge of metal plate 1 receives all horizontal movement of the plate. However, the embodiment with elastically deformable supports on both transverse edges has the advantage that no maintenance-prone and potentially noisy hinge is required and that per support less movability is required.

[0031] It will further be clear that the invention is not limited to the embodiment with supports containing a rubber connecting part. Other elastically deformable supporting elements such as, optionally, springs, for instance leaf springs can be used, or other resilient materials. It will furthermore be clear that although it is described that the supports are connected to the transverse edge at the extremity of plate 1, they can, in practice, naturally (also) be connected to the plate 1 at a small distance from the edge. It suffices that the distance is so small that the wheels of a car cannot apply a significantly deforming force on a possibly overhanging part.

[0032] Although, preferably, supports 2 are used which are deformable both in vertical direction and parallel to the driving direction, it will be clear that deformation parallel to the driving direction suffices. However, the plate 1 is preferably suspended such that the supports support the plate in both directions.

[0033] Although a rubber mat 3 is shown, it will be clear that this may be omitted when no heavy traffic needs to be received. Rubber mat 3 can also be replaced by a different, resilient layer, of, for instance, a different material or, for instance, in the shape of a plate with spring elements thereunder.

Claims

1. A speed bump which provides a locally raised road surface, wherein the road surface on the speed bump is formed by a bent plate with a transverse edge running transverse to a driving direction, and wherein, at the transverse edge, the plate rests virtually completely on one or more supports at the transverse edge, which supports are elastically deformable parallel to the driving direction, the plate and the supports having a rigidity such that elastic deformation of the plate due to weight on the plate is converted, without increase of bending, into displacement of the transverse edge parallel to the driving direction.
2. A speed bump according to claim 1, wherein the plate has a further transverse edge transverse to the driving direction, opposite the above-mentioned transverse edge, and wherein the plate rests at least virtually completely on elastically deformable supports at the transverse edge and the further transverse edge.
3. A speed bump according to any one of the preceding claims, wherein the supports include an elastic connection between the plate and an underground.
4. A speed bump according to claim 3, wherein the supports are provided in a recess of a road surface under an extremity of the plate, which recess comprises sufficient space for allowing the elastic connection for absorbing the stretch of the plate parallel to the driving direction to move freely in the recess.
5. A speed bump according to any one of the preceding claims, provided with an elastically resilient surface which lies under the plate, but which, with the speed bump in a condition of rest, makes no or virtually no contact with the plate.
6. A speed bump according to claim 4, wherein the resilient surface is a rubber mat.
7. A speed bump according to any one of the preceding claims, provided with a discrete damper element arranged between a part of the plate and an underground, and which has a damping characteristic with increasing reaction force upon increasing speed of compression of the damper element.
8. A speed bump according to claim 7, wherein the damper element is designed such that in a first, relatively lower range of speed of compression, the reaction force increases less rapidly than in a second, relatively higher range of speed of compression.
9. A speed bump according to claim 7 or 8, wherein the damper element is designed such that upon increasing loading force, the reaction force saturates below an upper limit.
10. A speed bump according to claim 7, 8 or 9, provided with an elastically resilient surface which lies under the plate but which, with the speed bump in a condition of rest, makes no or virtually no contact with the plate, the damper element being provided through a recess in the resilient surface on an underground in a manner such that, when

loaded, the plate is deformable until it touches the resilient surface.

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11. A speed bump which provides a locally raised road surface, wherein the road surface on the road bump is formed by a bent plate with a transverse edge running transverse to the driving direction, and wherein, at the transverse edge, the plate rests at least virtually completely on one or more deformable supports, the speed bump being provided with a discrete damper element having a housing which is coupled, on the one side, to a part of the plate and, on the other side, to an underground, and having a damper characteristic with increasing reaction force at increasing speed of compression of the damper element.
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12. A speed bump according to claim 11, wherein the speed bump is designed such that in a first, relatively lower range of the speed of compression the reaction force increases less rapidly than in a second, relatively higher range of speed of compression.
- 15
13. A speed bump according to claim 11 or 12, wherein the damper element is designed such that upon increasing loading force, the reaction force saturates below an upper limit.
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14. A speed bump according to claim 11, 12, or 13, provided with an elastically resilient surface which lies under the plate but which, with the speed bump in a condition of rest, makes no or virtually no contact with the plate, while the damper element is arranged through a recess in the resilient surface on an underground in a manner such that, when loaded, the plate is deformable until it touches the resilient surface.
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15. A prefab bump unit for use in a road surface, provided with a ground plate on which a speed bump according to any one of the preceding claims has been provided.
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- 55

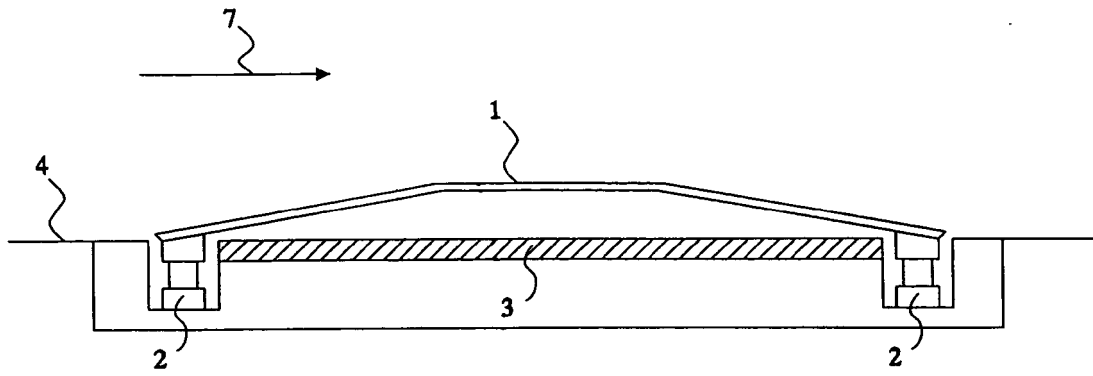


Fig.1

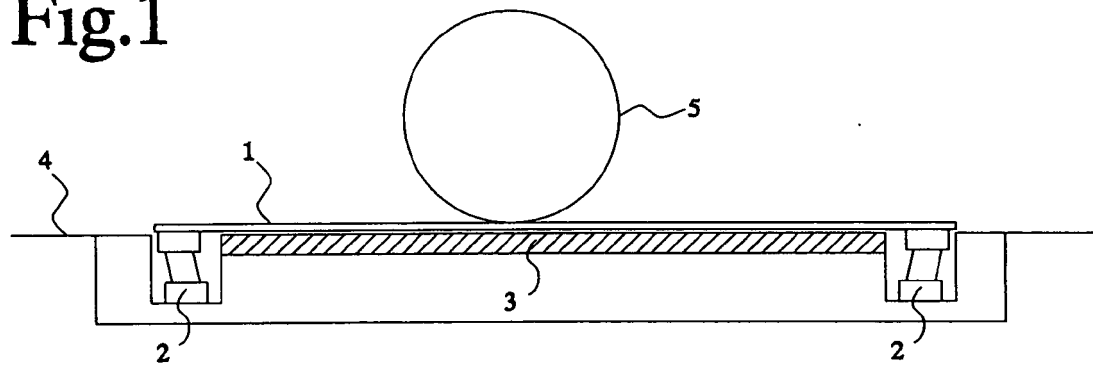


Fig.2

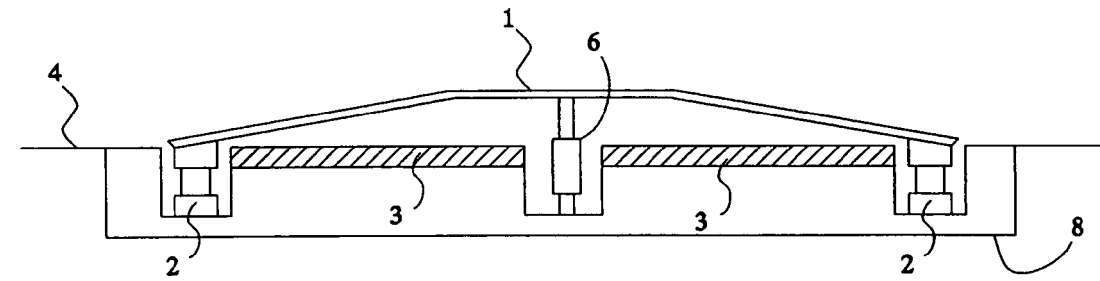


Fig.3

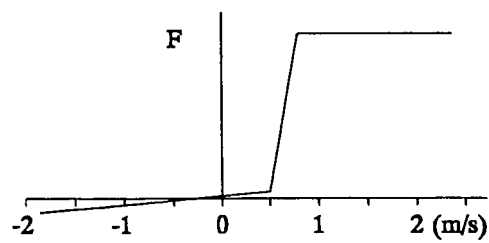


Fig.4



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EUROPEAN SEARCH REPORT

Application Number
EP 06 07 5491

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 010 277 A (FOLLMAN ET AL) 4 January 2000 (2000-01-04) * column 4, line 1 - line 62; figures 2,4,5 *	1-4	INV. E01F9/047
Y		7-15	
Y	----- PATENT ABSTRACTS OF JAPAN vol. 2002, no. 08, 5 August 2002 (2002-08-05) -& JP 2002 115215 A (YOKOHAMA RUBBER CO LTD:THE), 19 April 2002 (2002-04-19) * abstract * -----	7-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			E01F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 June 2006	Examiner Geivaerts, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03 82 (P04C01)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 06 07 5491

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-10

A speed bump having elastically deformable supports

2. claims: 11-15

Speed bump comprising a damper element

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 07 5491

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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12-06-2006

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