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(54) **STREET POLE**

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(57) **ABSTRACT**

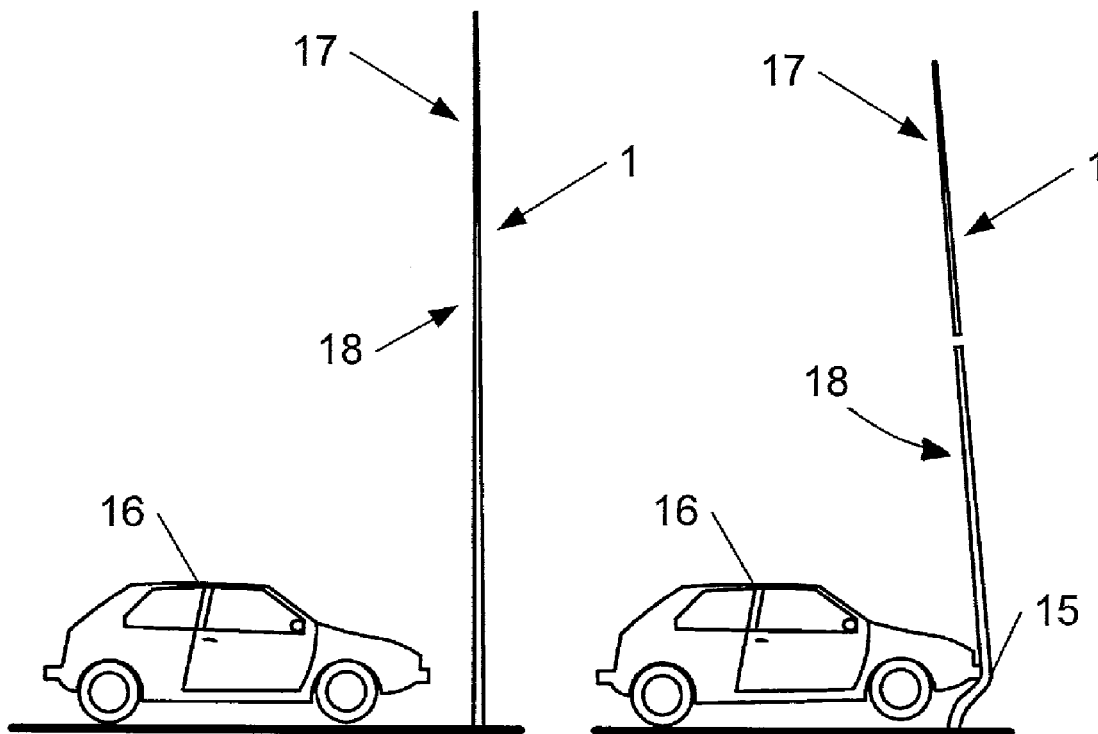
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Impact absorbing street pole extending substantially along a longitudinal direction, the street pole comprising an elongated extension (17) detachably connected at a predetermined height to a first part (18) of the street pole such that upon impact on the first part of the street pole, the elongated extension disconnects from the street pole.



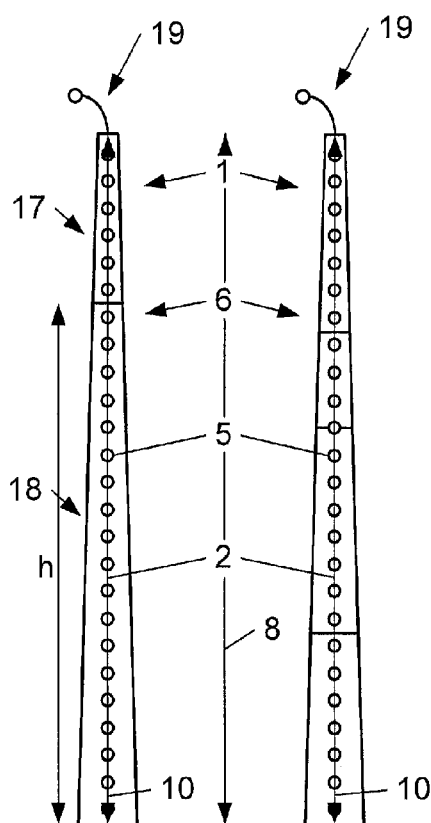


Fig. 1 Fig. 2

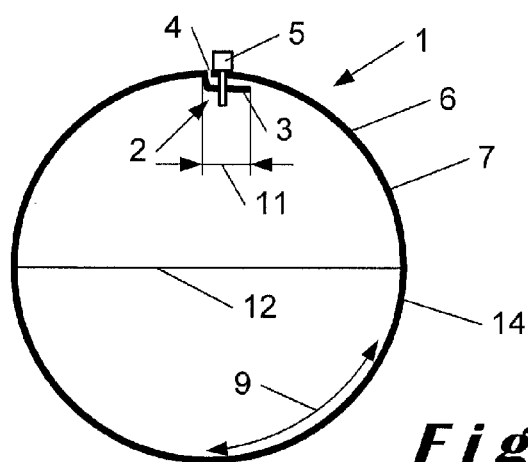


Fig. 3

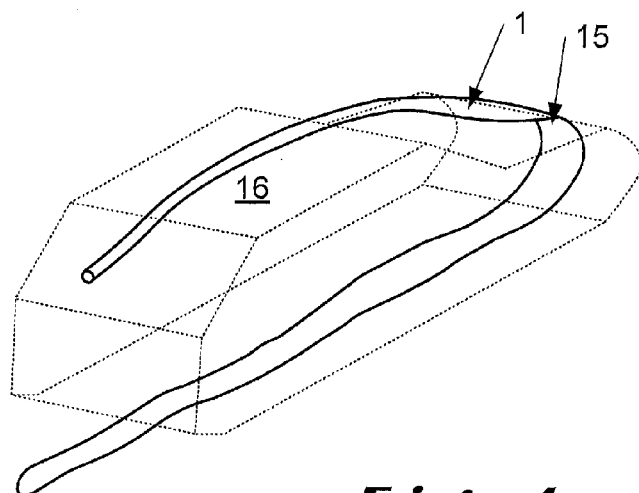


Fig. 4

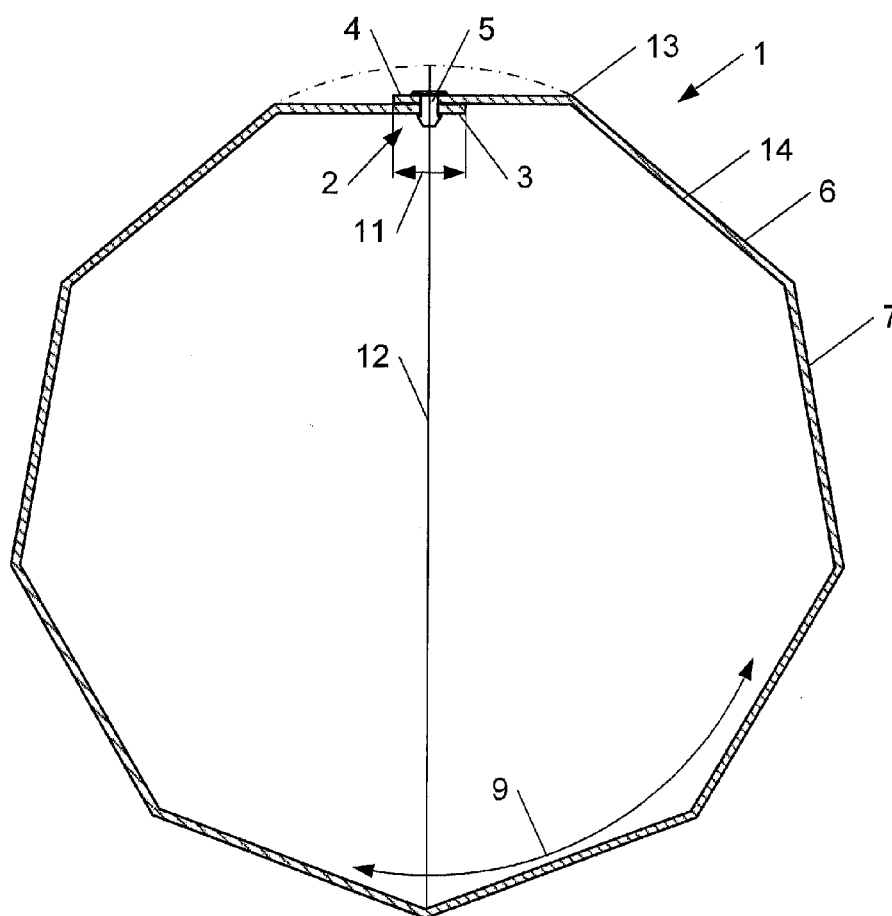


Fig. 5

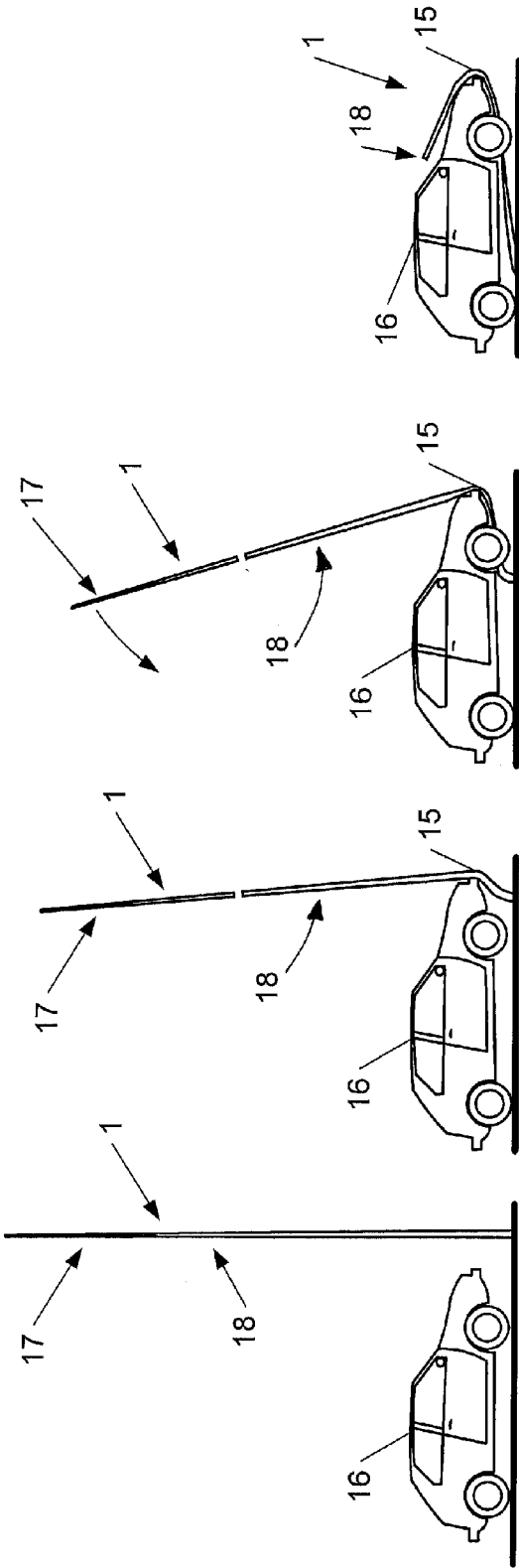


Fig. 6a

Fig. 6b

Fig. 6c

Fig. 6d

STREET POLE

[0001] This invention relates to impact absorbing street poles according to the preamble of the first claim.

[0002] Impacts absorbing street poles are already well known in the art. Design engineers are now indeed increasingly looking at other ways to improve vehicle occupant safety by focussing on the advantages that can be achieved by improving the crashworthiness of street furniture, for example by reducing the effects of a vehicle-street pole impact. In this context, impact absorbing street poles have been developed, i.e. a category of poles that are constructed to at least partially absorb the impact of a vehicle with a pole of this type. An example of such an impact absorbing street pole is known from US 2010/0107521 A1. US 2010/0107521 A1 describes an impact absorbing deformation street pole which is formed in such a way that impact of a vehicle with the pole deforms, i.e. flattens, an area of the pole that is directly contacted by the vehicle initially. The impact then may extrude other sections of the pole above and below this area of the pole as the vehicle moves forward after initial impact with the pole and ultimately may bend (in effect, collapse) the pole rearwardly over the roof of the vehicle. The deformation and the subsequent extrusion absorb the impact energy. The bending of the pole over the roof of the vehicle confines the vehicle. However, it may happen that the pole upon impact of the vehicle, when bending over the roof of the vehicle, actually crushes the roof and may for example injure the occupant(s) of the vehicle.

[0003] The street poles according to the state of the art therefore still represent a substantial risk for the occupants of a vehicle during impact of the vehicle with the street pole.

[0004] There is thus a need for an impact absorbing street pole for which the safety features can be improved.

[0005] Thereto, the street pole comprises an elongated extension detachably connected at a pre-determined height to a first part of the street pole such that upon impact on the first part of the street pole, the elongated extension disconnects from the street pole.

[0006] The inventors have found that providing an impact absorbing street pole with an elongated extension, detachable connected to the first part of the pole substantially reduces the risk for the occupants of the vehicle to be crushed by the bent part of the impact absorbing street pole, more specifically in an impact absorbing deformation street pole, during impact of the vehicle with the street pole. With impact is preferably meant in the context of the present invention an impact with a vehicle of about 900 kg at for example a velocity of 35 km/h and than also a higher velocity of 50 km/h, 70 km/h or 100 km/h, according to the European norm EN 12767/2007 or the American norm NCHRP350 or MASH established at substantially the same velocities, for example a velocity of 30 km/h and than also a higher velocity of 50 km/h, 70 km/h or 100 km/h, but with a heavier vehicles. Upon impact, the impact absorbing street pole absorbs at least part of the energy created during the impact, reducing the deformation of the vehicle upon impact and resulting in a less aggressive drop in acceleration with respect to time for the occupant(s) of the vehicle and the elongated extension disconnects from the street pole such that for example the clasp-knife effect, wherein the street pole bends and the bent part of the street pole crushes the vehicle such as for example in impact absorbing deformation street poles, is reduced. Since the bent part of the street

pole can be reduced in length compared with the deformation street poles of the prior art, both the length of the pole and its momentum when impacting the vehicle are reduced, limiting the damage to the vehicle and the risk of injuries for the occupants of the vehicle. The invention is of course not limited to impact absorbing deformation street poles and can also be applied to other impact absorbing street poles such as for example break-away impact absorbing street poles of which the first part breaks away upon impact with the vehicle.

[0007] The combination of the impact absorbing street pole with an elongated extension enhances the shock absorbing ability of the assembly and allows it to better control the G-forces upon impact. In addition, the combination according to the invention, allows the inventors to erect higher and more robust structures for use as roadside hardware.

[0008] According to preferred embodiments of the current invention, the height of the first part of the street pole is chosen such that upon impact, allows improved control of the G-forces upon impact and, when applied to an impact absorbing deformation street pole, the bent part of the street pole crushing the vehicle does not substantially hit the roof of the vehicle. It has been found that such lengths allow to further reduce the risk that the occupants of the vehicle impacting the street pole are injured is reduced.

[0009] According to embodiments of the street pole according to the invention, the height of the first part of the street pole is smaller or larger than the height of the elongated extension, according to the desired configuration.

[0010] According to preferred embodiments of the street pole according to the invention, the elongated extension comprises a cylindrical body, for example a hollow cylindrical body, extending around the longitudinal direction along a circumferential direction.

[0011] Such an arrangement of the elongated extension makes the construction thereof easier since it may be manufactured for example by bending a sheet of a bendable material around a given axis. If the cylindrical body is hollow, it reduces the risk that the elongated extension, when it disconnects from the first part upon impact of a vehicle, might injure people or damage for example vehicles. It also allows for example electrical wires or any other wires or conduits to pass through the hollow cylindrical body, especially if such wires are coming from a first part of the street pole, comprising a hollow cylindrical body wherein the wires are present.

[0012] According to preferred embodiments of the street pole according to the invention, an attachment, for example any one or more of a lamp, a road sign, a street sign, a traffic light, is connected to the elongated extension. Naturally, any attachment can also be attached at other locations, for example in combination with the attachment connected to the elongated extension. For example, an additional attachment can be attached at a far lower location, for example a road sign at height where traffic participants can easily read the sign, for example car drivers through the windows of their car, for example at some meters above the road.

[0013] Such an attachment may be fixedly connected to the elongated extension and releasably connected from the street pole together with the elongated extension upon impact of a vehicle on the first part of the street pole, thereby avoiding that a relatively heavy object with a relatively large momentum impacts the vehicle and may harm its occupants

or damage property in the surroundings of the street pole, especially when the street pole is an impact absorbing deformation street pole.

[0014] According to preferred embodiments of the street pole according to the invention, the circumference of the first part of the street pole is smaller or larger than the circumference of the elongated extension at the predetermined height according to the desired configuration.

[0015] In such a way, the elongated extension may be easily connected to the first part of the street pole, especially if the circumference of the first part of the street pole is smaller than the circumference of the elongated extension at the predetermined height and the top of the first part of the street pole snugly fits into the elongated extension, bringing about an increased stability of the assembly of the first part of the street pole and elongated extension and in some cases any supplementary connection means may be dispensed with. In addition such a connections prevents falling water, such as for example rain, from entering the street pole.

[0016] According to preferred embodiments of the street pole according to the present invention, the first part of the street pole comprises a cylindrical body extending around the longitudinal direction along a circumferential direction.

[0017] Such an arrangement of the first part of the street pole, in a similar way as for the elongated extension, makes the construction thereof lighter and easier. The arrangement of the first part of the street pole comprising the body reduces the force of the impact of a vehicle, because such a pole may absorb part of the energy of the impact and deform, making it an impact absorbing deformation street pole, and might reduce the risk of injuries people and/or damages to for example vehicles. If the cylindrical body is hollow, it also allows for example electrical wires or any other wires or conduits to pass through the cylindrical body.

[0018] According to preferred embodiments of the street pole according to the present invention, the cylindrical body is hollow and the cylindrical body of the first part comprises at least one overlap of a first and a second edge of a circumferential side wall forming the hollow cylindrical body, the hollow cylindrical body comprising fastening means for interconnecting the first and the second edge, the overlap having a length extending substantially parallel along the longitudinal direction.

[0019] The inventor has found that the first part of a street pole having such an overlap allows for interconnecting the first and the second edge by a wide range of different fastening means such as welding, soldering, bolts, rivets, screws, staples, gluing, etc. The street pole according to the invention with such a first part moreover is aesthetically attractive and is safer for people passing the street pole since it does not have a protruding flange.

[0020] Another option for fastening the adjacent metal sheet(s) which is known from the state of the art is by bending metal sheet(s) such that the adjacent edges become collinearly touching each other. Interconnecting the collinearly touching adjacent edges is however difficult and, in order to achieve a sufficient interconnection of the first and the second edges, is mainly limited to welding. For example, no bolts can directly be used in this interconnection. When the metal sheets are coated with zinc, for example by galvanizing, before being bended and interconnected to form the street pole, the adjacent edges can no longer, or least with increased difficulty, be welded together. So instead, the collinearly touching adjacent edges need to be

welded together before coating with for example zinc and can only be galvanised after the first and the second edge have been welded together, which is more difficult and hence more costly. When street poles comprise a first part comprising an overlap of the first and the second edge, this problem can be solved by using other fastening means than welding, such as for example, bolts, nails, rivets, screws or the like since the fastening means of the first part of the street pole according to the current invention are no longer limited to welding.

[0021] According to preferred embodiments of the street pole according to the invention, the side wall and the fastening means are provided to split open along the overlap by breaking away the fastening means upon impact at a place of impact on the first part of the street pole, the hollow cylindrical body, being provided at the place of impact.

[0022] The first part of such a street pole is designed to absorb an impact of for example a vehicle, such that the kinetic energy of an object, for example a vehicle, impacting the street pole preferably is substantially absorbed by the first part of the street pole by deformation of the first part of the street pole, making the street pole an impact absorbing deformation street pole, due to the impact in stead of for example deformation of the object, which is, in case of for example a vehicle, hazardous for the occupants of the vehicle. It has been found that accidents involving such a street pole impacted by a vehicle have a reduced mortality rate than accidents involving a street pole which does not absorb the energy of the impact with the vehicle. A street pole having the ability to absorb a significant amount of energy of an impact with a vehicle is generally called a street pole which is passively safe.

[0023] A street pole designed to absorb the energy of an impact with a vehicle is for example described by FI94890B. The street pole according to FI94890B however does not comprise the overlap of the street pole of the current preferred embodiment, having a width which extends substantially along the circumferential direction, but instead has an inwardly bent flange, as described above. When a vehicle impacts the street pole according to FI94890B, the fastening means are provided to break away from the overlap and the overlap as a further consequence splits open. However, it has been found that the rigidity of the street pole according to FI94890B generally remains too large during impact with the vehicle such that an insufficient amount of energy is absorbed by the street pole, which increases the amount of energy which needs to be absorbed by the car, causing an increased risk of mortality and/or injuries to occupants of the vehicle.

[0024] The overlap of the first part of the street pole of the current preferred embodiment however allows for an improved absorption of kinetic energy of the vehicle. Without wanting to be bound by any theory, the inventor believes that this is caused by the direction of the width of the overlap, being substantially along the circumferential direction. It has been found that the impact of the vehicle onto the place of impact causes the hollow cylindrical body to collapse in direction of the impact, making the street pole an impact absorbing deformation street pole. As a consequence, a first part and a second part of the side wall of the hollow cylindrical body, the second part opposing the first part along the direction of the impact are pushed together in direction of the impact and a third and a fourth part of the side wall of the hollow cylindrical body, the fourth part

opposing the third part along a direction substantially perpendicular to the direction of the impact, are pushed away from each other. The relative movement of the first, second, third and fourth part causes the two edges to move in opposite directions along the width direction of the overlap so that the first part of the street pole splits open in longitudinal direction along the overlap by breaking away the fastening means. A similar effect can for example be observed in WO2008151862.

[0025] The inventor has found that such an opposing movement of the edges causes the rigidity of the first part of the street pole to drop significantly upon impact, which increases the amount of energy which can be absorbed by the street pole of the current invention. Without wanting to be bound by any theory, the inventor believes that the opposing movement of the edges along the width direction of the overlap causes a shear effect which causes an improved breaking away of the fastening means.

[0026] The inventor also found that the rigidity of the first part of the street pole of the current invention which has not been impacted remains substantially the same. The street pole according to the current invention in other words allows the rigidity of the street pole to be significantly reduced during impact whereas sustaining the rigidity of the street pole before impact.

[0027] According to more preferred embodiments of the street pole according to the current invention, the fastening means are rivets.

[0028] The inventor has found that by interconnecting the two edges with rivets, the interconnecting of the two edges becomes increasingly easy and even edges of for examples galvanised steel can for example be interconnected. Moreover, although the rivets provide the unimpacted first part of the street pole with sufficient rigidity, the rivets are also more easily broken away by the opposing movement of the edges along the width of the overlap during impact so that the amount of energy absorbed by the first part of the street pole is further increased, improving the passive safety of the street pole.

[0029] Other details and advantages of the street pole according to the invention and the method for placing the street pole according to the invention will become apparent from the enclosed figures and description of preferred embodiments of the invention.

[0030] FIG. 1 shows a preferred embodiment of a street pole according to the invention.

[0031] FIG. 2 shows a different embodiment of a street pole according to the invention.

[0032] FIG. 3 shows a cross-section of a preferred embodiment of the street pole according to the invention.

[0033] FIG. 4 shows a street pole according to the prior art which has been impacted by a vehicle.

[0034] FIG. 5 shows a cross-section of a different embodiment of the street pole according to the invention.

[0035] FIGS. 6a-6d successively show the effect of a vehicle impacting a street pole according to the invention during the impact of the vehicle with the street pole.

[0036] A street pole 1 comprising an elongated extension 17 connected to a first part 18 of the street pole 1 according to the invention is shown in FIGS. 1 and 2. The first part 18 of the street pole 1 shown in FIGS. 1 and 2 is fixed to the ground. The first part 18 of the street pole 1 can be fixed to the ground in any way known to the person skilled in the art. The first part 18 of the street pole 1 can for example be dug

into the ground, bolted to the ground, etc. When fixed to the ground, the street pole 1 preferably extends in a substantial upright, preferably vertical, direction as shown in FIG. 1. The street pole 1 can however also be provided to be fastened to for example the wall of a building or the like, extending in a substantial horizontal direction.

[0037] The street pole 1 shown in FIGS. 1 and 2 extends substantially along a longitudinal direction 8. The longitudinal direction 8 extends between a first and a second end.

[0038] The first end is provided to be fastened to a substrate. In FIGS. 1 and 2, the substrate shown, is substantially horizontal. The substrate can however also extend substantially vertically or any other direction. As discussed above, the substrate can for example be the ground, a wall of a building, etc.

[0039] The first end can for example be provided to be dug into the ground. The first end can moreover be provided to be put at least partly in cement. However, other known ways for fastening the first end to the substrate can be used such as for example bolting the first end to the substrate.

[0040] The first end preferably comprises means for allowing electrical wires to enter the street pole 1, preferably the first part 18 of street pole 1, for example to provide electricity to lighting or any other electrically powered means. Thereto, the first end comprises for example an opening leading towards the interior of the street pole 1, preferably the first part 18 of street pole 1. This is however not critical for the invention and the electrical wires can for example also be provided along the exterior of the street pole 1.

[0041] The second end is provided to be provided with means such as for example lights 19, street signs, traffic signs, traffic lights, directions, billboards, etc. The second end for example can be provided with one, two, three, four or even more horizontally bent arms, each arm comprising lighting means, creating a lighting pole which can be used along streets or highways to illuminate the streets or highways. The second end is part of the elongated extension 17.

[0042] The street pole 1 can have any shape and dimension which is deemed appropriate by the person skilled in the art. The longitudinal direction 8 of the street pole 1 shown in FIGS. 1 and 2 is substantially straight. However, the street pole 1 can for example be bent along its longitudinal direction 8, for example when it is provided to be mounted to an upright substrate.

[0043] The street pole 1 comprises an elongated extension 17, detachably connected at a predetermined height h to a first part 18 of the street pole 1. The elongated extension 17 shown in FIGS. 1 and 2 comprises a cylindrical body extending around the longitudinal direction along a circumferential direction. The circumference of the elongated extension 17 may be smaller, equal or larger than the circumference of the first part 18 of the street pole 1 to which it is connected. FIGS. 1 and 2 show that an attachment 19 is connected to the elongated extension 17. The attachment may be for example a streetlamp, a traffic light, a traffic sign or an advertisement sign but is in no way limited to the examples mentioned herein.

[0044] The street pole 1, preferably the first part 18, comprises a cylindrical body 6. The cylindrical body 6 extends around the longitudinal direction 8 along a circumferential direction 9. A cross section of such a cylindrical body 6 is for example shown in FIGS. 3 and 5.

[0045] The cylindrical body 6 can be provided anywhere along the longitudinal direction 8 of the street pole 1, preferably of the first part 18. The street pole 1, preferably the first part 18 can for example comprise a first longitudinal section being solid or hollow, for example, wood, plastic, etc., and a second longitudinal section being formed by at least one cylindrical body 6. The first and second longitudinal section can be provided anywhere along the longitudinal direction 8 such that the first longitudinal section is provided near the first end and the second longitudinal section is provided near the second end, but preferably the first longitudinal section is provided near the second end and the second longitudinal section is provided near the first end. It is preferred that the street pole 1, preferably the first part 18 is made of at least one cylindrical body 6. FIG. 2 shows for example the first part 18 of street pole 1 being made of different subsequent cylindrical bodies 6. Preferably, the first part 18 of street pole 1 however is made of a single cylindrical body 6, as shown in FIG. 1.

[0046] The inventor has found that when the street pole 1, preferably the first part 18, is made of a single cylindrical body 6, preferably a hollow cylindrical body, the street pole 1 can be easily made.

[0047] The cylindrical body 6 can be made of any material such as plastic, wood, metal such as for example aluminium, steel, stainless steel, galvanised steel, etc.

[0048] The cylindrical body 6 can have any shape and dimensions deemed appropriate by the person skilled in the art.

[0049] The dimensions of the cylindrical body 6 preferably are substantially determined by its length and its diameter 12. The length of the cylindrical body is measured along the longitudinal direction 8 of the street pole 1, preferably the first part 18, whereas the diameter 12 is defined as the diameter of an arc defining the circumferential direction 9 of the cylindrical body 6, as shown in FIGS. 3 and 5.

[0050] The diameter 12 of the cylindrical body 6 can be determined by the person skilled in the art.

[0051] The shape of the cylindrical body 6 is substantially determined by the shape of the cross section of the cylindrical body 6. Two examples of shapes of cross sections, polygonal and round, are respectively shown in FIGS. 3 and 5. Any other shape of the cross section is however possible and can be determined by the person skilled in the art such as for example, a regular or irregular polygon having 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 or even more vertices 13, an arcuate shape such as an ellipsoid, etc.

[0052] The cross section of the cylindrical body 6 can change along the length direction of the cylindrical body 6. The area of the cross section can for example become larger or smaller along the length direction or can remain substantially constant.

[0053] Preferably, the area of the cross section of the cylindrical body 6 becomes smaller in a direction from the first end of the street pole 1, preferably the first part 18, towards the second end of the street pole 1, as shown in FIGS. 1 and 2, more preferably, but not essentially, when the cylindrical body 6 has a polygonal cross section.

[0054] Preferably, the area of the cross section of the cylindrical body 6 is substantially constant along the longitudinal direction 8 of the street pole 1, preferably the first part 18, more preferably, but not essentially, when a round cross section is used as shown in FIG. 3.

[0055] The cylindrical body 6 of the street pole 1, preferably the first part 18 of street pole 1, comprises a circumferential side wall 7 forming the hollow cylindrical body 6. The circumferential side wall 7 comprises a first 3 and a second 4 edge which overlap to form an overlap 2. A top view of the overlap 2 is for example shown in FIGS. 3 and 5. The overlap 2 has a length 10 which extends substantially along, preferably parallel to, the longitudinal direction 8, as shown in FIGS. 1 and 2. The length 10 of the overlap 2 can however extend along any possible direction extending substantially along the longitudinal direction 8.

[0056] The circumferential side wall 7 can be a single piece or can be made of different pieces. When the hollow cylindrical body 6 is made of a multitude of pieces, the pieces can be adjoined using any method known in the art such as welding, soldering, gluing, stapling, bolting, screwing, riveting, etc.

[0057] The overlap 2 can be positioned on every location along the circumferential side wall 7. However, when the hollow cylindrical body 6 has a polygonal cross section, the overlap 2 preferably is provided in between two adjacent vertices 13 of the polygonal cross section. The overlap 2 more preferably is provided substantially equidistant from the two adjacent vertices 13. The overlap 2 can however be provided at every location deemed appropriate by the person skilled in the art such as for example at or near a vertex 13.

[0058] Although a single overlap as shown in FIGS. 3 and 5 can be sufficient for the envisaged application of the street pole 1, this is not critical for the invention and the street pole 1 can also have a plurality of overlaps 2. For example, the street pole 1 can have two, three, four five six, seven, etc. overlaps 2 depending on for example the dimensions of the street pole 1. It has been found that by providing multiple overlaps, the impact absorbing properties can be better controlled. Especially when street poles having a relative large diameter are being provided, it has been found that although the increased diameter increases the strength of the street pole 1, the plurality of overlaps can nevertheless provide the desired impact absorbing properties.

[0059] When a plurality of overlaps 2 is provided, preferably, the overlaps 2 are distributed substantially evenly over the circumference of the street pole 1 so as to provide substantially homogeneous impact absorbing properties. For example, when the hollow cylindrical body 6 has a polygonal cross section, the overlap 2 preferably is provided between adjacent vertices 13 leaving, for example, the same, or for example substantially the same, number of vertices 13 in between overlaps 2. So for example, when the hollow cylindrical body 6 is a regular convex nonagon polygon, it has nine vertices 13 and the number of overlaps can be for example three, with 3 vertices 13 or two sides between vertices 13 in between overlaps 2.

[0060] The hollow cylindrical body 6 comprises fastening means 5 for interconnecting the first 3 and second 4 edge of the circumferential side wall 7. Any fastening means 5 known to the person skilled in the art can be used for example bolts, nuts, rivets, screws, nails, staples, glue, welds, solderings, etc.

[0061] When the overlap 2 of the first 3 and the second 4 edge causes one of the first 3 and the second 4 edge to be pressed to the other edge 3, 4, for example due to a resilient force remaining after bending of the edges in the desired overlapping configuration, the friction caused by the pressing of one edge to the other may cause that a sufficient

interconnection of the first 3 and the second 4 edge is reached. In that case the fastening means 5 are the cooperating first 3 and second 4 edge and no additional bolts, nuts, rivets, screws, nails, staples, glue, welds, solderings, etc. are necessary. In this case breaking away the fastening means 5, according to preferred embodiments of the present invention, means that the friction between the first 3 and the second 4 edge is overcome and that first 3 and the second 4 edge are allowed to move in opposite directions along the width direction of the overlap 2.

[0062] The fastening means 5 are preferably provided along the entire length 10 of the overlap 2, for example on regular distances when for example nuts, bolts, screws, nails, staples or the like are used or preferably along the entire length 10 of the overlap 2 when for example cooperating first 3 and second 4 edges, glue, welds, solderings, or the like are used. Other configurations of the fastening means 5 are however possible.

[0063] The overlap 2 has a width 11 which extends substantially along the circumferential direction 9. The first 3 and the second 4 edge of the circumferential side wall 7 in other words overlap each other along the circumferential direction 9. The width 11 is for example shown in FIGS. 1 and 2.

[0064] The width 11 of the overlap 2 can be determined by the person skilled in the art. Preferably, the width 11 of the overlap is determined in function of the fastening means 5 and/or the required strength of the street pole 1. For example, when rivets, bolts, nails, screws, staples, etc. are used to interconnect the first 3 and the second 4 edge of the cylindrical body 6, the width 11 needs to be sufficient to receive the fastening means 5 and to offer a sufficient interconnection of the first 3 and the second 4 edge. When using other fastening means 5 such as for example glue, welds, solderings, etc. the width 11 needs to be adapted to the interconnecting characteristics of the fastening means 5 such that the width 11 needs to be increased or can be decreased in order to offer a sufficient interconnection of the first 3 and the second 4 edge.

[0065] The width 11 can for example be as small as 1 mm for some types of fastening means 5 or the width 11 can extend up to for example substantially the entire width of the sides between the vertices 13 and/or more than 100% of the circumference of the hollow cylindrical body 6 in which case the side wall 7 comprises at least two layers wound around the longitudinal direction of the street pole 1, preferably of the first part 18 of street pole 1.

[0066] The inventor has found that an increased width 11 of the overlap 2, increases the friction between the first 3 and the second 4 edge of the overlap 2 so that additional fastening means 5 such as bolts, nuts, rivets, screws, nails, staples, glue, welds, solderings, etc. can be avoided. Moreover, the increased width of the overlap 2 allows that the fastening means 5, if they are for example distinctly provided to the street pole 1, are positioned in a staggered position with respect to each other along longitudinal direction of the street pole 1.

[0067] The width 11 of the overlap 2 can be substantially constant along the longitudinal direction 8 of the street pole 1, especially if it is for example expressed as percentage of the sides between two vertices 13, preferably of the first part 18 of street pole 1. This is however not critical for the

invention and the width 11 can change along the longitudinal direction 8 of the street pole 1, preferably of the first part 18 of street pole 1.

[0068] The hollow cylindrical body 6 preferably is made of a bendable material such as for example metal. This way the hollow cylindrical body 6 can be made by bending a sheet 14 of the bendable material, preferably a metal sheet, into the desired shape having the desired cross section. However, any other material is possible as described above and the hollow cylindrical body 6 can for example also be cast.

[0069] In case the hollow cylindrical body 6 has a polygonal cross section, more preferably a regular polygonal cross section, as shown in FIG. 1, the hollow cylindrical body 6 preferably is made by bending at least one sheet 14 of the bendable material along longitudinal folding lines forming the vertices 13 of the polygonal cross section. Preferably, these folding lines are created by pushing a longitudinal edge into and/or along the sheet of bendable material. Any other way of making the cylindrical body is however possible.

[0070] For example, the cylindrical body 6 in this case has an uneven number of vertices and the overlap 2 is provided in between two adjacent vertices 13, the last folding line being created being the folding line opposing the overlap 2. The inventor has found that such bending of the sheet 14 of bendable material allows the longitudinal edge to be retracted more easily, after being pushed into and/or along the sheet 14 of bendable material in order to create the folding line, in between the first 3 and the second 4 edge before the overlap 2 is created. However, the cylindrical body 6 can also comprise an even number of vertices.

[0071] In case the cylindrical body 6 has a round cross section, the cylindrical body 6 preferably is made by rolling at least one sheet 14 of bendable material, preferably metal.

[0072] Although the cylindrical body 6 preferably is made of a single bent sheet 14, as shown in FIGS. 3 and 5, the cylindrical body 6 can also be made of several bent sheets 14 forming the different pieces of the circumferential side wall 7, as discussed above.

[0073] Preferably, the side wall 7 and the fastening means 5 are provided to split open along the overlap 2 by breaking away the fastening means 5 upon impact at a place of impact 15 on the street pole 1, the cylindrical body 6, being provided at the place of impact 15.

[0074] Preferably, the side wall 7 and the fastening means 5 are provided to split open along the overlap 2 by breaking away the fastening means 5 upon impact with a vehicle 16. The vehicle 16 can be any vehicle 16, preferably motorised, known to the person skilled in the art such as a car, truck, motorcycle, etc.

[0075] This is especially beneficial for street poles 1, preferably first parts 18 of street poles 1 which are provided to be fixed to the ground since such poles 1 are generally provided next to roads on which traffic passes to street pole 1.

[0076] With impact in the context of this application is for example meant an impact caused when such a vehicle 16 drives into the first part 18 of street pole 1 for example more than 0 km/h, more than 5 km/h, more than 10 km/h, more than 20 km/h or more than 30 km/h or even higher. However, the side wall 7 and the fastening means 5 must be such as to resist normal forces acting on the first part 18 of street pole 1 such as for example varying winds, relative small impacts

caused by for example parking vehicles, etc. when the first part 18 of street pole 1 has not been impacted by vehicle 16.

[0077] Examples of a vehicle impacting such a first part 18 of street pole 1 are shown in FIGS. 4 and 6a-6d.

[0078] When the first part 18 of street pole 1 is impacted, the first 3 and the second 4 edge of the side wall 7 move away from each other as described and the fastening means 5 are broken away from the edges 3, 4. When the impact is large enough, the first and second edge 3, 4 move even further away until subsequent fastening means 5 are broken away. This process is repeated until the impact has been fully absorbed. Due to the impact the first and the second edge 3, 4 can keep moving away from each other until the circumferential sidewall 7 is fully unfolded and becomes substantially flat.

[0079] Preferably, the first part of street pole 1 is provided not to break away from its substrate upon impact but to remain fixed to its substrate, allowing the energy of the impact to be absorbed until the speed of the vehicle 16 impacting the street pole 1 has been significantly reduced. Therefore, after impact of the vehicle 16 with the first part 18 of street pole 1, the risk that the vehicle 16 impacts a further obstacle after impacting the first part 18 of street pole 1 is significantly reduced. In order to achieve such a connection of the first part 18 of street pole 1 to the substrate, the first end preferably is cast into cement, as discussed above. However, this is not critical for the invention and any other connection of the first part 18 of street pole 1 to the substrate may be used.

[0080] A vehicle 16 impacting the street pole 1 causes the first part 18 of street pole 1 to be impacted at the place of impact 15. The preferred hollow cylindrical body 6 then splits open at the place of impact 15. Subsequently, when the impact is large enough the place of impact 15 moves along the longitudinal direction 8 of the street pole 1 as shown in FIGS. 6a-6d such that a part of the first part 18 of street pole 1 moves under the vehicle 16 while another part folds in the direction of the vehicle 16, as shown in FIG. 6d. By keeping the first part 18 of street pole 1 fixed to the ground, the kinetic energy of the vehicle 16 can be absorbed until the speed of the vehicle 16 is reduced. While the place of impact 15 moves along the longitudinal direction 8 of the first part 18 of street pole 1, the first and second edges 3, 4 at the moving place of impact 15 keep moving away from each other along the width direction 11 of the overlap 2 such that the fastening means are broken away and the overlap 2 splits open along the longitudinal direction 8 until the speed of the vehicle 16 has been significantly reduced. Preferably, the speed of the vehicle 16 after impact with the first part 18 of street pole 1 is reduced such that it is less than 50 km/h measured after 12 m after the initial impact.

[0081] Upon impact of a vehicle 16 on the first part 18 of the street pole 1, the impact absorbing street pole 1 absorbs at least part of the energy created during the impact, reducing the deformation of the vehicle 16 upon impact and resulting in a less aggressive drop in acceleration with respect to time for the occupant(s) of the vehicle 16 and the elongated extension 17 disconnects from the first part 18 of the street pole 1, as shown in FIG. 6b, such that for example the clasp-knife effect, wherein the street pole 1 bends and the bent part of the street pole 1 crushes the vehicle 16, as for example shown in FIG. 4, is reduced, as illustrated in FIG. 6d. FIG. 6d no longer shows the extension 17 as it has fallen, for example, next to the vehicle 16. Since for example the

bent part of the street pole 1 is reduced in length compared with the street poles of the prior art, and only comprises the first part 18 of the street pole 1 both the length of the pole 1 and its momentum when impacting the vehicle 16 are reduced, limiting the damage to the vehicle 16 and the risk of injuries for the occupants of the vehicle 16.

[0082] As the extension 17 disconnects from the first part 18 after impact, the material of the extension 17 is less critical for the invention and can be substantially chosen by the person skilled in the art in function of the envisaged application. The extension for example can be a hollow part, for example a bent metal sheet, or even solid, for example wood.

[0083] The part that folds in direction of the vehicle 16, if present, can fold onto the vehicle 16 or next to the vehicle 16. When the street pole 1 is provided to fold next to the vehicle the occupants of the vehicle are even more protected.

[0084] The preferred deformable cylindrical body 6 must be provided at the place of impact 15 in order to be able to absorb the energy of the impact. Therefore, the preferred cylindrical body 6 provided to split open upon impact is preferably provided at a height which can be impacted by vehicles 16. The cylindrical body 6 is for example provided near the substrate. However, the cylindrical body 6 preferably extends along substantially the entire length of the first part 18 of street pole 1 along the longitudinal direction 8, as shown in FIGS. 1 and 2. When the overlap 2 extends along substantially the entire length of the street pole 1, larger impacts can be absorbed since the absorption of the impact by the splitting open of the cylindrical body 6, the braking away of the fastening means 5 and the unfolding of the cylindrical body 6 can continue along the entire length of the street pole 1. A same effect can also be achieved when the first part 18 of street pole 1 is formed of subsequent cylindrical bodies 6, as shown in FIG. 2.

[0085] The cylindrical body 6 in such an embodiment preferably is made from metal, such as for example steel, aluminium, etc. More preferably the cylindrical body 6 is made from steel.

[0086] Preferably, material of the side wall 7 of the cylindrical body 6 has a yield strength R_e of between 50 N/mm²-700 N/mm², preferably 200 N/mm²-550 N/mm², more preferably 330 N/mm²-420 N/mm².

[0087] Preferably, the material of the side wall 7 has a tensile strength R_m of between 50 N/mm²-1350 N/mm², preferably 350 N/mm²-1050 N/mm², more preferably 600 N/mm²-700 N/mm², more preferably at least 410 N/mm², for example 410 N/mm²-700 N/mm².

[0088] Preferably, the material of the side wall 7 has a minimal elongation before breaking A80 of at least 5%, preferably at least 15%, more preferably at least 20%.

[0089] Preferably, the side wall 7 has a thickness of between 20 mm-0.5 mm, preferably 10 mm-1 mm, more preferably 5 mm-1 mm, even more preferably 2 mm.

[0090] Preferably, the cylindrical body 6 has a diameter 12 at the place of impact 15 of between 50 mm-500 mm, preferably 150 mm-400 mm, more preferably 200 mm-350 mm.

[0091] Preferably, the width 11 of the overlap 2 is at least 0.1%, preferably maximal 100%, more preferably between 0.1% and 10%, most preferably between 2% and 3.5% of the circumference of the cylindrical body 6.

[0092] A first example is a first part 18 of the street pole 1 consisting of a single cylindrical body 6 having a length of

about 6-7 m, a diameter of about 320 mm near the first end of the first part 18 of street pole 1 and a substantially constant width 11 of the overlap 2 of 20 mm which is 2.6% of the diameter 12 near the first end.

[0093] Another example is a first part 18 of street pole 1 consisting of a single cylindrical body 6 having a length of about 10 m, a diameter of 208 mm near the first end of the street pole 1 and a substantially constant width 11 of the overlap 2 of 20 mm which is 3.06% of the diameter 12 near the first end.

[0094] According to a further example a first part 18 of the street pole 1 consisting of a single cylindrical body 6 having a length of about 8 m of which 2 m is put into the ground, a diameter of about 322 mm near the first end of the first part 18 of street pole 1 at the ground level. The elongated extension has a height of about 14 m. The elongated extension 17 and the first part 18 are provided such that the elongated extension 17 is slid over the first part 18 with the diameter of the first part 18 at the location where the elongated extension 17 is slid over it is about 234 mm and the diameter of the elongated extension 17 at that location being about 260 mm and the first part 18 and the elongated extension 17 overlapping for about 500 mm. The total height of the street pole 1 therefore is about 21.5 m of which about 2 m is put into the ground. In such an embodiment, preferably, the hollow cylindrical body 6 has a polygonal cross section, for example, a regular convex nonagon polygon with for example three overlaps 2, with 3 vertices 13 or two sides between vertices 13 in between the overlaps 2.

[0095] Preferably, the fastening means 5 have a shear strength, this is the strength in width 11 direction of the overlap 2, of between 2000N-7000N, preferably 3000N-6000N, more preferably 4000N-5000N, most preferably 4100N-4500N.

[0096] Preferably, the fastening means 5 are rivets since the inventor found that they offer a good and easy interconnection of the first and the second edge 3, 4 while being provided to brake away when the first and the second edge 3, 4 move away from each other and allowing an easy interconnection of the first and the second edge 3, 4. However, any other fastening means 5 can be used instead, as described above.

[0097] The first part 18 of street pole 1 may be placed such that the width 11 of the overlap 2 extends substantially along a direction substantially parallel to the direction of oncoming traffic.

[0098] More specifically the width 11 of the overlap 2 extends substantially along a direction having an angle of between 0°-90°, 0°-180°, 0°-45°, preferably 10°-30°, more preferably 15°-25°, most preferably 20° with the direction of oncoming traffic.

[0099] The overlap 2 can however also be provided in any other possible direction. The first part 18 of the street pole 1 can for example be placed such that the width 11 of the overlap 2 extends substantially along a direction which is substantially perpendicular to the direction of oncoming traffic or any other possible direction.

1. An impact absorbing deformation street pole extending substantially along a longitudinal direction, wherein the street pole bends upon impact and the bent part of the street pole crushes the vehicle, characterized in that the height of the first part of the street pole is chosen such that upon impact the bent part of the street pole crushing the vehicle does not substantially hit the roof of the vehicle and wherein

the street pole comprises an elongated extension detachably connected at a pre-determined height to a first part of the street pole such that upon impact on the first part of the street pole, the elongated extension disconnects from the street pole.

2. The impact absorbing street pole as claimed in claim 1, characterised in that the height of the first part of the street pole is smaller or larger than the height of the elongated extension.

3. The impact absorbing street pole as claimed in claim 1, characterised in that the elongated extension and/or the first part of the street pole comprises a cylindrical body extending around the longitudinal direction along a circumferential direction.

4. The impact absorbing street pole as claimed in claim 3, characterised in that the circumference of the first part of the street pole is smaller than the circumference of the elongated extension at the predetermined height.

5. The impact absorbing street pole as claimed in claim 3, characterised in that the cylindrical body of the first part is hollow and comprises at least one overlap of a first and a second edge of a circumferential side wall forming the cylindrical body, the cylindrical body comprising fastening means for interconnecting the first and the second edge, the overlap having a length extending substantially parallel along the longitudinal direction.

6. The impact absorbing street pole as claimed in claim 5, characterised in that the overlap has a width extending substantially along the circumferential direction.

7. The impact absorbing street pole as claimed in claim 5, characterised in that the side wall and the fastening means are provided to split open along the overlap by breaking away the fastening means upon impact at a place of impact on the street pole, the cylindrical body, being provided at the place of impact.

8. The impact absorbing street pole as claimed in claim 5, characterised in that the material of the side wall has a yield strength (Re) of between 50 N/mm²-700 N/mm², preferably 200 N/mm²-550 N/mm², more preferably 330 N/mm²-410 N/mm².

9. The impact absorbing street pole as claimed in claim 5, characterised in that the material of the side wall has a tensile strength (Rm) of between 50 N/mm²-1350 N/mm², preferably 350 N/mm²-1050 N/mm², more preferably 600 N/mm²-700 N/mm².

10. The impact absorbing street pole as claimed in claim 5, characterised in that the material of the side wall has a minimal elongation before breaking of at least 5%, preferably, 15%, more preferably 21%.

11. The impact absorbing street pole as claimed in claim 5, characterised in that the side wall has a thickness of between 20 mm-0.5 mm, preferably 10 mm-1 mm, more preferably 5 mm-1 mm, even more preferably 2 mm.

12. The impact absorbing street pole as claimed in claim 3, characterised in that the cylindrical body of the first part has a diameter at the place of impact of between 50 mm-500 mm, preferably 150 mm-400 mm, more preferably 200 mm-350 mm.

13. The impact absorbing street pole as claimed in claim 5, characterised in that the width of the overlap is at least 0.1%, preferably maximally 100%, more preferably between 0.1% and 10%, most preferably between 2% and 3.5% of the circumference of the cylindrical body.

14. The impact absorbing street pole according to claim 5, characterised in that the fastening means have a shear strength of between 2000N-7000N, preferably 3000N-6000N, more preferably 4000N-5000N, most preferably 4100N-4500N.

15. The impact absorbing street pole as claimed in claim 5 characterised in that the fastening means are rivets.

16. The street pole as claimed in claim 3, characterised in that the cylindrical body has a round cross-section.

17. The impact absorbing street pole as claimed in claim 3, characterised in that the cylindrical body of the first part has a regular polygonal cross-section.

18. The impact absorbing street pole as claimed in claim 17, characterised in that the overlap is substantially positioned at the centre between two adjacent vertices of the regular polygonal cross-section.

19. The impact absorbing street pole as claimed in claim 16, characterised in that the regular polygonal cross-section comprises an uneven number of vertices.

20. The impact absorbing street pole as claimed in claim 5, characterised in that the circumferential side wall forming the cylindrical body comprises at least one bent metal sheet.

21. The impact absorbing street pole as claimed in claim 20, characterised in that the metal sheet is made from steel.

22. The impact absorbing street pole as claimed in claim 1, characterised in that an attachment is connected to the elongated extension.

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