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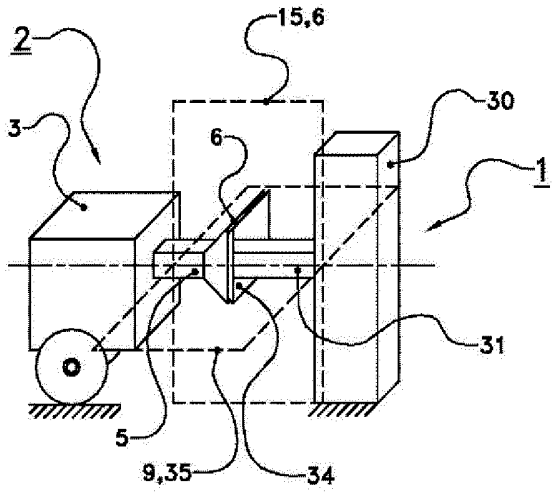
(54) **Vehicle system.**

(57) A vehicle system with a charging station (30) and a autonomously movable, electrically powered vehicle (2) dockable therewith, the vehicle system including mutually engageable inlet-side coupling means (5, 6) on the vehicle and an outlet-side coupling means (31, 32) on the charging station (30) arranged to transport energy between the charging station and vehicle when engaged and further being provided with an inlet-side guiding member (6), an outlet-side guiding member (32), respectively, arranged to guide the inlet-side and outlet-side coupling means from a non-charging position into a charging position upon engaging of said inlet-side and outlet-side coupling means when docking the vehicle to the charging station.



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Vehicle system

The present invention relates to a vehicle system according to the preamble of claim 1, comprising at least one charging station and at least one autonomously movable, electrically powered vehicle dockable therewith,
the vehicle including an inlet-side coupling means and the charging station including an outlet-side coupling means, said inlet-side coupling means and said outlet-side coupling means being mutually engageable and arranged to transport energy between the charging station and vehicle when engaged,
said inlet-side coupling means and said outlet-side coupling means further being provided with an inlet-side guiding member, an outlet-side guiding member, respectively, arranged to guide the inlet-side and outlet-side coupling means from a non-charging position into a charging position upon engaging of said inlet-side and outlet-side coupling means when docking the vehicle to the charging station.

Such vehicle systems are known in the art. The vehicles generally include electrical motors to drive e.g. wheels, as well as working means for executing certain tasks. The power for the electrical motor(s) is generally provided by on-board batteries. These batteries of course need to be recharged at regular intervals to allow the vehicle to function.

Thus known systems also provide for a charging station for supplying power to the onboard batteries. In order for the batteries to be charged, power needs to be transferred from the charging station to the vehicle and the vehicle and the charging station need to be into contact with each other for conductive charging with electrical contacts. To provide for more reliable coupling, guiding members may be provided, to steer the electrical contacts to one another when engaging.

Examples of such vehicle systems include e.g. robotic vacuum cleaners, lawn mowers and automatically guided vehicles (AGV's). Robotic lawn mowers and vacuum cleaners are relatively small and light systems. The charging stations of these known systems include a base or other structure that encompasses or accommodates the vacuum cleaner or lawn mower itself for a substantial part, thus guiding the contacts of the power inlet and power supply into a charging position, i.e. into contact one with the other. E.g. in EP3236279 the robot mower drives up a ramp until the front wheel is lifted clear from the ground, at which point a

front electrical conducting contact is put into contact with a charging contact and a charging position is obtained.

Other systems show a charging or docking station having actively movable arms arranged to be moved towards and into contact with the vehicle in order to realize the charging position between the power inlet and outlet sub-structures. E.g. US4777416 shows an autonomous movable robot having a conductor band as an input coupling means for electricity and a docking station in the form of a housing. Inside the housing is an opening, and a drivable arm is provided as a power outlet coupling means carrying a pair of contacts, the arm being projectable through the opening. Similarly US5272431 and EP0468960 show drivable arms as power inlet-coupling means carried inside electric vehicles, the arms are to be deployed and directed towards a power outlet sub-structure of the charging station when the vehicle is positioned near the station to realize the charging position.

All these systems require manoeuvring the vehicle in a charging position relative to the charging station. Some of these systems require additional manoeuvring of one of the coupling means relative to the vehicle or the station. Even with sophisticated guiding systems it remains a challenge to provide a system that allows for easy, efficient and particularly reliable positioning of the power inlet sub-structure relative to the power outlet sub-structure into the charging position.

It is thus an object of the invention to provide a vehicle system according to the preamble of claim 1, wherein the respective power inlet and outlet coupling means for the vehicle and the charging station can be brought into the charging position easily and reliably.

This object is achieved by providing a vehicle system according to claim 1, wherein said inlet-side coupling means is arranged to be deflectingly movable relative to the vehicle in a first plane, and said outlet-side coupling means is arranged to be deflectingly movable relative to the station in a second plane, wherein said first plane and said second plane are arranged substantially horizontally, to enable alignment of the inlet-side and outlet-side coupling means upon their engaging. Herein, "substantially horizontally" means that when both the vehicle and the station are positioned on a horizontal plane, the two planes of movability are also substantially horizontal. Of course, if the vehicle or station are on a slope, the planes of movability will change correspondingly. Furthermore, since the vehicle can move independently from the station, the first and second plane are in no way coupled

before the vehicle and the station are. What actually matters is the first plane and the second plane can be brought into overlap upon engaging of the inlet-side and outlet-side coupling means. This can be done if the first and second plane are substantially parallel upon said engaging.

By providing deflectingly movable coupling means, a misalignment of the vehicle relative to the charging station can be corrected, because, whatever the offset between the coupling means, since both coupling means are deflectingly movable, both can be guided to deflect in the required direction by the, co-operating, guiding members, and the vehicle need not correct its course. Herein, the required direction is a line connecting the physical or virtual base of the inlet-side coupling means, where said means deflects, and the physical or virtual base of the outlet-side coupling means, where said means deflects. By having both coupling means deflect, they are able to both deflect to become aligned with said line, and thus into perfect alignment. Also by providing deflectingly movable coupling means there is no need to provide complicated driven systems, thus making the system simpler and more economical to build. Note that a single guiding member with deflecting coupling means on either vehicle or charging station cannot provide this alignment. In fact, the deflecting movement would only aggravate alignment problems.

Advantageous embodiments of the invention are mentioned in the dependent claims.

In embodiments, said inlet-side coupling means comprises one of an electric socket or a complementary plug, and said outlet-side coupling means comprises another of said electric socket and said complementary plug. It is in particular with respect to such electrical socket-plug connections that the present invention offers its advantages. Such connections need good alignment to work properly and without lots of wear, and such alignment is provided with the deflectingly movable coupling means. The guiding members, which are of course rigidly connected to their respective coupling member, ensure by mutually co-operating that those coupling means, here the socket and plug, are aligned for reliable connection.

It is noted that the system described above functions well if the coupling means are arranged to deflect in one plane, such that an offset can be present in one direction. Arranging in one plane may suffice in many cases, for example when the height of the vehicle, and of course of the charging station's contacts, is always the same. This plane is preferably a horizontal plane. However, in practice it may occur

that, due to soiling of the floor near the charging station, dirt on the wheels etc of the vehicle, changing tire pressure or load on the vehicle and so on, the coupling means are not always in one plane. In order to conquer this problem, the invention provides embodiments wherein said inlet-side coupling means and said outlet-side coupling means are arranged to be deflectingly movable in a third plane relative to the vehicle, a fourth plane relative to the station, respectively, wherein said third plane and said fourth plane are arranged substantially parallel, to enable alignment of the inlet-side and outlet-side coupling means upon their engaging, and wherein the third plane makes a non-zero angle with the first plane, and preferably is substantially perpendicular to the first plane. These embodiments ensure that any misalignment in more than one direction can be corrected, by having the guiding members cause the coupling means to deflect in the required direction for alignment.

Advantageously, at least one of the coupling means and/or guiding members is arranged to be linearly telescopically movable in a direction within the first plane and relative to one of the vehicle and the station, to which it is provided. This allows for a longer alignment path, thus making alignment and connection even more gentle. Furthermore, the telescopic movement could also be used to actually plug a plug or the like into the socket or the like. The linear telescopic movement is between a first, extended position wherein (e.g.) the guiding member is projected at a maximum distance from the vehicle or station on which it is provided, and a second, retracted position wherein the guiding member is at a minimum distance from the vehicle or the station respectively. Note that the rigid connection between guiding member and its respective coupling means is but for this telescopic moveablility.

In particular, the direction of linear telescopic movement substantially coincides with the direction of travel of the vehicle when docking to the charging station. Here, "substantially" means that the directions are the same except for the misalignment. In other words, when the course of the vehicle is such that the coupling means are already in perfect alignment without deflecting, the direction of the telescopic movement and the traveling direction will coincide perfectly.

In embodiments, a deflecting member is provided between said vehicle and said inlet-side coupling means, and between said charging station and said outlet-side coupling means. This is a simple and elegant way of providing for the deflecting movability.

For example, the deflecting member comprises a hinge with at least a first hinge axis perpendicular to the first plane. This allows the hinge to hinge in the desired direction, preferably a horizontal direction, in order to compensate horizontal offsets. Of course, other directions are also possible. In addition, the deflecting member could further comprise a second hinge with a second axis perpendicular to the second plane, allowing for offset correction in more directions.

Alternatively, the deflecting member comprises a ball joint. This allows offset correction in multiple directions with a single hinge. Of course, well-known alternatives of a ball-joint are deemed to fall within the scope of the concept "ball joint".

In advantageous embodiments, the deflecting member comprises at least one resilient member. This allows the coupling means to return to a neutral, mostly central position after disengaging. Although this is not necessary, it offers the advantage that the guiding members, in that central position, will have the highest likelihood of being within range of their counterpart, to enable correct engaging and aligning.

In embodiments, the deflecting member comprises at least two resilient members positioned one behind the other in a plane perpendicular to the first plane. In between could be e.g. an arm, such that the whole of the resilient members and the arm work to guide the coupling means in a certain direction, without the resilient members themselves having to be made very elaborate.

In embodiments of the system with a linearly telescopically movable guiding member, the linearly movable guiding member is advantageously provided with a biasing means between the guiding member and the vehicle or station to which it is provided, biasing means being arranged to force the guiding member or arm into the first, extended position by means of a biasing force. After engaging, the guiding member will have been forced into the second, or retracted position. But with this embodiment, after disengaging, the guiding member will be biased back to the extended position, ready for maximum range in engaging the other guiding member.

Advantageously, the biasing means comprises biasing force reduction means arranged to exert a smaller biasing force when the guiding member is the second position than when in the first position. Without this measure, the biasing force might be strong enough to disengage the vehicle from the station, which is

undesirable. By arranging for a reduced biasing force when the guiding member is in the second position, a more stable situation, during charging, is obtained.

Preferably, the biasing force reduction means comprises a non-linear force spring, in particular a leaf spring or a torsion leaf spring. Alternatively or additionally, the biasing force reduction means comprise a linkage system with a tension spring having a force moment arm and arranged to shorten the force moment arm as the guiding member moves from the first to the second position. The above are elegant solutions for providing a decreasing biasing force when the guiding member moves into the second position, during engaging of the vehicle and the station.

Further advantageous features will now be shown by way of exemplary embodiments, described below and shown in the following drawings.

Figure 1A is a schematic view of the vehicle system of the invention with the vehicle and the charging station in a non-charging position;

Figure 1B is a schematic view of the vehicle system of the invention with the vehicle docked at the charging station in a charging position;

Figure 2 is a schematic view of the inlet-side coupling means of the vehicle of the vehicle system of the invention;

Figure 3A is schematic view of the outlet-side coupling means of the charging station, according to the invention; and

Figure 3B is a schematic view of another outlet-side coupling means.

Figure 1A shows the vehicle system 1 of the invention with vehicle 2 and charging station 30. Vehicle 2 is an autonomously movable, electrically driven vehicle and is dockable with charging station 30. Vehicle 2 is shown in Figure 1A as being at a distance from charging station 30. Figure 1B shows vehicle 2 docked to the charging station 30.

Vehicle 2 is an autonomously, movable electrically powered vehicle and can move around by wheels driven by an electrical motor (not shown). The power in the vehicle is stored in on-board rechargeable batteries (not shown). An inlet side coupling means 5, 6 (explained below) is provided on vehicle 2 to facilitate docking with an outlet-side coupling means 31,32 on the charging station, explained below. Both coupling means are, when mutually engaged, arranged to transport energy from the charging station to the batteries to charge them. When the batteries need to be recharged, the vehicle is programmed to navigate to charging station 30, dock with it

such that the inlet side coupling means is connected to a power supply outlet of the charging station and energy can flow to the batteries for charging.

Vehicle 2 as depicted in Figures 1A and 1B, is shown only schematically and includes vehicle body 3, drivable wheels 4 and an arm 5 mounted to body 3 at a first arm end 5A and ending at its free end 5B in a truncated pyramid 6. Truncated pyramid 6 includes a pyramid top 7 at arm end 5B and a base 8 facing away from vehicle body 3 and forming an entrance to the pyramid.

Arm 5 and thus pyramid 6 are deflectingly movable relative to vehicle body 3, in at least a first, substantially horizontal plane 9. Arm 5 and thus pyramid 6 is, in this case, also deflectingly movable relative to vehicle 2 in a third, substantially vertical plane 15. A centre line Hv through the center of arm 5 and guiding member pyramid 6 lies in both horizontal plane 9 and vertical plane 15 where these planes intersect.

The vehicle is shown to be positioned and drivable on a horizontal plane, like a floor and horizontal plane 9 is shown to be parallel to the floor. In most imaginable situations, plane 9 will be parallel to a floor plane. However, there are situations when this may not be the case, e.g. when the wheels include inflatable tires and the vehicle has a single flat tire. In such situations plane 9 is at an angle to the floor plane.

Charging station 30, as schematically represented in Figures 1A and 1B, is depicted as a vertical column on a floor in a fixed location.

Arm 31 is mounted at first arm end 31A deflectingly moveable to station 30. Truncated pyramid 32 is provided on arm 31 ends at free end 31B. Truncated pyramid 32 is shaped complenetary to pyramid 6 of the vehicle. Its pyramid top 33 is at free arm end 31B and facing away from the station 30 while pyramid base 34 faces towards station 30. In this manner the two pyramids can mate, with truncated pyramid 6 of the vehicle being the female member and truncated pyramid 32 of the charging station being the male member.

Arm 31 and thus also truncated charging station pyramid 32 can deflectingly move relatively to the charging station in second, substantially horizontal plane and in this case also in a fourth, substantially vertical plane 41. A centre line Hs through the center of arm 31 and guiding member pyramid 32 and lies in both horizontal plane 35 and vertical plane 41 where these planes intersect.

The respective vehicle and station pyramids 6, 15 are rigid members which by being at the end of the deflectingly mounted arms cause deflection in the required directions during mating of the pyramids and thus facilitating alignment

thereof. Since the shape and size of the vehicle pyramid 6 and the charging station pyramid 32 are complementary, they can perfectly mate. Of course, any other couple of complementary forms is possible, such as irregular pyramids, three- to eightsided pyramids, rimmed cones. The preferred shape does include a frustum. Note that shapes with faces provide much more reliable docking, as they limit directional uncertainty. These faces need not necessarily be, but preferably are, flat faces. What counts is that full rotational symmetry is broken.

Once the pyramids 6, 32 are mated, all the corresponding pyramid walls of each pyramid are in contact with each other, and relative movement of one pyramid to the other is no longer possible. In the movement of docking the mated pyramids will then move further towards the charging station, because the charging station pyramid 32 can telescopically move along charging station arm 31. This movement finally causes the charging position to be obtained. As is shown in Figure 1B, when vehicle 2 is docked to station 3 in the charging position, vehicle pyramid 6 is mated to station pyramid 32, and the horizontal planes 9, 35 and the vertical planes 15, 41 coincide and the two centre lines Hv and Hs coincide. Although not shown in Figure 1B, vehicle arm 5 and/or station arm 31 may be at an angle relative to the respective vehicle 2 or charging station 30.

Figure 2 is a schematic view of inlet-side coupling means of vehicle 2, and shows an arm 5, truncated pyramid 6, electrical plug 10 and wire 11. Arm 5 is a hollow arm and is provided at first arm end 5A with a first end plate 12 to which a first deflecting member 13 is mounted. The deflecting member is in the form of a pair of resilient members 13A, 13B in the shape of solid, resilient plastic cylinders. The end plate 12 with the cylinders 13A, 13B and the arm is mounted to vehicle 2 (not shown) by means of a bracket 14. Cylinders 13A, 13B are fixed to both the end plate and the bracket by any suitable means, such as e.g. a bolt and nut connection through a cylinder and both end plate and bracket, or by adhesives. Thus arm 5 and the other parts of the inlet-side coupling means, such as pyramid 6, are deflectingly movable with respect to the vehicle in horizontal first plane 9 (shown in figure 1A, 1B).

The pair of resilient solid cylinders 13A, 13B are mounted, spaced apart one higher than the other, to the first end plate, and by way of the bracket 14 also to the vehicle 2. This orientation of cylinders 13A, 13B one above the other allows for relative more deflection of arm 5 and thus of pyramid guiding member 6, in horizontal plane 9 and then in vertical plane 15. This is acceptable because the height position

of the inlet-side coupling means of the vehicle and thus of arm 5 on the vehicle is designed to match the height position of outlet-side coupling means and thus of arm 31 on charging station 30. These height positions are not expected to vary much in use and vertical misalignment of the coupling means is expected to be small. Some vertical deflection is still desirable and thus provided because some vertical misalignment may still occur: in use, the wheels having air tires may be at a lower pressure, thus lowering the vehicle relative to the station, or e.g. dirt may accumulate at the docking site, lifting the vehicle relative to the station. Thus the deflection member 13 is designed to allow arm 5 to deflectingly move relative to vehicle 2 in horizontal plane 9 and in vertical plane 15 (shown in figures 1A, 1B).

Plug 10 is mounted in the arm at arm end 5B and projects into the truncated pyramid 6 facing towards base 8, and thus away from the vehicle.

Plug 10 is shown to include a plug body 16, a plug shell 17 and plug pins 18. As is shown in Figure 2 the plug shell 17 surrounds the plug pins 18 which project from the plug body 16.

Figure 3A is a schematic view of the outlet-side coupling means of charging station 30, and shows arm 31, truncated pyramid 32, electrical socket 36 and wire 37. Arm 31 is a hollow arm, first end 31A of arm 31 is provided with an end plate 38 to which a deflecting member 39 is mounted. The deflecting member 39 is similar to the deflecting member of vehicle 2 and is in the form of a pair of resilient members 39A, 39A in the shape of solid resilient cylinders 39A,39B. The mounting of the deflecting member 39 to the station is also similar to the mounting of the deflecting member 13 to the vehicle. The end plate 38 with the deflecting member 39 is mounted to charging station 30 by means of a bracket 40. Cylinders 39A, 39B are fixed to both the end plate and the bracket by any suitable means, such as e.g. a bolt and nut connection or by adhesive. Thus arm 31 and the other parts of the inlet-side coupling means, such as pyramid 32, are deflectingly movable with respect to the vehicle in horizontal first plane 9 (shown in figure 1A, 1B).

The deflecting member 39 being similar to the one described relation of the vehicle, also has a pair cylinders 39A, 39B which are mounted, spaced apart one higher than the other, to the end plate 38 , and by way of the bracket 40 also to the charging station 30. Like for the vehicle, the deflection member 39 allows arm 31 to deflectingly move relative to charging station in a horizontal, third plane 35 and but

less so in a vertical, fourth plane 41. This is done for the same reasons as recited above in the description of inlet-side coupling means 5 of figure 2.

As shown in figure 3A socket 36 includes a socket body 42, a socket shell 43 surrounding the socket body and a least one socket contact channel 44 in the socket body 42. Socket 36 is mounted to free arm end 31B with with socket contact channels 44 facing away from the charging station. Truncated pyramid outlet-guiding member 32 is also mounted to arm 31, its open pyramid top 33 also facing away from the charging station 30. Both socket 36 and pyramid 32 are mounted to the arm 31 such that when the charging station 30 is not occupied by vehicle 2, socket 36 is adjacent the opening of pyramid top 42 without projecting beyond it.

The truncated pyramid 32 as outlet-guiding member on the charging station is mounted telescopically movably to arm 31. A mounting member 45 includes mounting plates 46 that are connected to the pyramid 32 on the inside of pyramid sides 32A, 32B. The mounting plates 46 carries freely rotatable rollers 47 positioned such that the rollers 47 rest on an outer surface of the arm 31. Ideally there is at least one pair of rollers that rest on opposite outer surfaces of the arm. Preferably, as shown in figure 3A, for stability of the telescopically movable pyramid 32 relative to the arm, two pairs of rollers are used that are spaced apart along a length of the arm.

Figure 3A also shows a first embodiment of a biasing means 48 positioned between the telescopically movanble outlet-side guiding member or pyramid 32 and the charging station 30. The biasing means 48 forces the pyramid 32 to a position at a maximum distance from the charging station 30, the position it is in when no vehicle is occupying the station. In such a free or rest position, the pyramid surrounds socket 36. This is shown in figure 3A.

The biasing means 48 as shown in figure 3A is a leaf spring 48 that is fixed at one end 49 to the arm 31 and free at another end 50.

The pyramid mounting plate 46 is provided with a leg 51 to which a roller 52 is mounted, and the roller is in contact with the leaf spring 48. As the charging station pyramid 32 is pushed by the vehicle pyramid 6 towards the charging station 30, roller 52 rides along the length of the leaf spring 48, forcing it towards the arm 31 against its spring force. After charging, as the vehicle backs away from the charging station, charging station pyramid 32 is also pushed backwards towards the end of the arm 31 by the biasing force of leaf spring 48. The force of the spring is chosen such that it is strong enough to push the charging station guiding member or pyramid 32 to its

position at maximum distance from the charging station. The force of the leaf spring 48 is also chosen such that it will be too weak to push a docked vehicle away and out of charging contact with the charging station.

Figure 3B is a schematic view of a further embodiment of the biasing means positioned between the telescopically outlet-side guiding member or pyramid 32 and the charging station 30. In the description of this embodiment of the biasing means, like reference numerals are used as in Figure 3A, increased by 100 for the biasing means.

The biasing means 148 includes a pair of spring biased linkages at opposite sides of arm 31, only one of which is shown in figure 3B and is described here. The spring biased linkage includes a first straight bar 149 pivotably mounted at one end 149A to the telescopically movable pyramid 32 and at the other end 149B to a first end 150A of a second curved bar 150. The curved bar 150 is pivotably mounted to arm 31 on a central pivot 151. The second end 150B of curved bar 150 is connected to a first end 152A of a helical tension spring 152. The other end 152B of the helical tension spring is mounted to end plate 38 of arm 31. When no vehicle is occupying charging station 30, tension spring 152 pulls at curved bar 150 and forces the linkage to straighten out to its maximum length. In this position pyramid 32 is at a maximum distance from the charging station 30. The angle between straight bar 149 and curved bar 150 is at a maximum. When a vehicle docks, it drives up to the charging station 30 and following the mating of the vehicle pyramid 6 to the station pyramid 32, pushes station pyramid 32 telescopically inward towards the end plate 38 of arm 31. By this action the straight bar 149 pushes curved bar 150 to rotate about central pivot 151. The distance between central pivot 151 and helical spring 152 is now reduced, and the biasing force on the outlet-side guiding member or charging station pyramid 32 is now reduced to such a level that the vehicle once in docked and when it stops pushing will not be pushed away by the biasing means.

In the charging position as shown in Figure 1B plug 10 of vehicle 2 and socket 36 of charging station are duly plugged-in and an electrical conductive contact of the plug is in contact with a charging contact of the socket.

In use, when vehicle 2 needs to be charged, it will approach the charging station. The vehicle 2 is programmed to drive up to the charging station until it is docked. When the charging position is reached, i.e. when voltage is detected, the vehicle will stop driving. Until that point the vehicle continues to push forward. While

approaching the station for charging, first the vehicle will align itself such as programmed with the station. Further forward movement of the vehicle to the station will bring the vehicle pyramid into contact with the station pyramid and allow the pyramids to mate. Since the pyramids can deflectingly move relative to vehicle and station respectively, deflection in the required direction allows for perfect alignment of the pyramids and thus for mating engagement of one another. The mated surfaces of the vehicle pyramid and station pyramid prevent relative (rotational, shifting etc) movement and ensure perfect alignment of plug 7 with socket 34 and in particular of the electrical contacts and its narrow electrical pins 18 are aligned with electrical socket channels 44 that need to contact each other to allow charging. From the mated position, upon further forward movement of the vehicle station, pyramid 32 is pushed towards the charging station 30 along arm 31. Pyramid 32 slides away and exposes socket 34 and channels 44 and plug 7 with pins 18 is plugged in. The charging position is thus obtained easily and reliably. After the batteries of the vehicle are sufficiently charged, or after a certain time period, the vehicle is programmed to move away from the charging station. Upon backing away from the charging station, the plug is pulled from the socket. As the vehicle moves further away, the vehicle pyramid will move away and out of contact with the station pyramid. The station pyramid, being biased by the biasing member, will resume its position at the end of the arm.

Instead of using a plug on the vehicle and a socket on the charging station, interchanging of plug and socket is of course possible, resulting in a plug on the charging station and a socket on the vehicle.

Also inductive plug and socket arrangements are feasible, similar to e.g. a typical electrical toothbrush charging arrangement, where the charger has a first coil and a pin and the toothbrush includes a secondary coil surrounding an opening which can be mated with the pin of the charger. The electromagnetic field of the coils is used to transfer energy.

The arms 5, 31 between vehicle body 3 and vehicle pyramid 6 and charging station 30 and station pyramid 32 respectively, and in particular the length thereof, influence the range of the deflective movability of the pyramids. If reduction of the range is acceptable, one or both arms may be shortened or omitted. If an arm is omitted, the corresponding pyramid needs to be mounted deflectingly moveable directly to the vehicle.

Charging station 30 need not be a column on a floor as shown in Figures 1A and 1B, but may as well be a power source integrated in a wall, with arm 31 projecting from the wall. Also in the feasible situation where vehicle pyramid 6 is telescopically movable with respect to vehicle arm 5 and charging station pyramid 34 is not telescopically movable, the charging station arm may be shortened or omitted. If the arm 31 is omitted the charging station pyramid must be mounted deflectingly moveable directly to the charging station or wall in which the charging station is integrated.

The deflecting members 13, 39 are shown as pairs of solid resilient cylinders 13A, 13B, 39A, 39B but can be in any other shape allowing the deflective movement of the pyramids relative to the vehicle, respective charging station. Thus hinges may be provided with at least a first hinge axis perpendicular to horizontal planes 9, 35, allowing movement in these horizontal planes of the respective pyramids. Double hinges with additional hinge axes to allow deflecting movement in both horizontal and vertical plane may be used. Alternatively a ball joint may be used.

The term comprising when used in this description or the appended claims should not be construed in an exclusive or exhaustive sense but rather in an inclusive sense.

Conclusies

1. Voertuigsysteem (1) omvattende
ten minste een laadstation (30) en ten minste een daarmee koppelbaar autonoom verplaatsbaar, elektrisch aangedreven voertuig (2),
waarbij het voertuig een inlaatzijdig koppelmiddel (5) omvat en het laadstation een uitlaatzijdig koppelmiddel (31) omvat, waarbij het inlaatzijdige koppelmiddel en het uitlaatzijdige koppelmiddel onderling aangrijpbaar zijn en zijn ingericht om bij aangrijping energie te transporteren tussen het laadstation en het voertuig,
waarbij het inlaatzijdige koppelmiddel en het uitlaatzijdig koppelmiddel voorts zijn voorzien van een inlaatzijdig geleidingsonderdeel (6) respectievelijk een uitlaatzijdig geleidingsonderdeel (32), ingericht om het inlaatzijdige en uitlaatzijdige koppelmiddel te geleiden van een niet- oplaadpositie naar een laadpositie bij aangrijping van het inlaatzijdige en uitlaatzijdige koppelmiddel wanneer het voertuig met het laadstation aan koppelt,
met het kenmerk, dat
het inlaatzijdige koppelmiddel is ingericht om ten opzichte van het voertuig buigend beweegbaar te zijn in een eerste vlak (9), en dat het uitlaatzijdige koppelmiddel is ingericht om ten opzichte van het station buigend beweegbaar te zijn in een tweede vlak (35), waarbij het eerste vlak en het tweede vlak in hoofdzaak horizontaal zijn ingericht, om uitlijning van het inlaatzijdige en uitlaatzijdige koppelmiddel bij hun aangrijping mogelijk te maken.

2. Systeem volgens conclusie 1, waarbij het inlaatzijdige koppelmiddel één van een elektrische contrasteker (36) of een complementaire steker (10) omvat, en waarbij uitlaatzijdige koppelmiddel een andere van genoemde elektrische contrasterker en genoemde complementaire steker omvat.

3. Systeem volgens conclusie 1 of 2, waarbij het inlaatzijdige koppelmiddel en het uitlaatzijdige koppelmiddel zijn ingericht om buigend beweegbaar te zijn in een derde vlak (15) ten opzichte van het voertuig, respectievelijk in een vierde vlak (41) ten opzichte van het station,
waarbij het derde vlak en het vierde vlak in hoofdzaak evenwijdig zijn ingericht, om uitlijning van het inlaatzijdige en uitlaatzijdige koppelmiddel mogelijk te maken bij hun aangrijping, en waarbij het derde vlak een hoek ongelijk nul maakt met het eerste vlak, en bij voorkeur in hoofdzaak loodrecht op het eerste vlak staat.

4. Systeem volgens enige voorgaande conclusie, waarbij tenminste een van de koppelmiddelen en/of geleidingsonderdelen is ingericht om lineair telescopisch beweegbaar te zijn in een richting binnen het eerste vlak en ten opzichte van een van het voertuig en het station waarop het is verschaft.

5. Systeem volgens conclusie 4, waarbij de richting van lineair telescopische beweging in hoofdzaak samenvalt met de verplaatsingsrichting van het voertuig bij aankoppelen aan het laadstation.

6. Systeem volgens een van de voorgaande conclusies, waarbij een afbuigonderdeel is verschaft tussen het voertuig en het inlaatzijdige koppelmiddel, en het tussen het laadstation en het uitlaatzijdige koppelmiddel.

7. Systeem volgens conclusie 6, waarbij het afbuigmiddel (30) een scharnier omvat met tenminste een eerste scharnieras loodrecht op het eerste vlak.

8. Systeem volgens conclusie 7, waarbij het afbuigonderdeel voorts een tweede scharnier met een tweede as loodrecht op het tweede vlak omvat.

9. Systeem volgens conclusie 6, waarbij het afbuigonderdeel een kogelgewricht omvat.

10. Systeem volgens een van de conclusies 6-9 waarbij het afbuigonderdeel tenminste een veerkrachtig onderdeel (13A, 13B; 39A, 39B) omvat.

11. Systeem volgens conclusie 10, waarbij het afbuigonderdeel tenminste twee veerkrachtige onderdelen omvat die achter elkaar zijn geplaats in een vlak loodrecht op het eerste vlak.

12. Systeem volgens een van de voorgaande conclusies, in afhankelijkheid van conclusie 4, waarbij het lineair beweegbare geleidingsonderdeel met voordeel is voorzien een instelmiddel (48) tussen het geleidingsonderdeel en het voertuig of station waarop het is verschaft, waarbij het instelmiddel is ingericht om het geleidingsonderdeel of de arm in een eerste, uitgerekte stand te dwingen door middel van een instelkracht, en in welke eerste stand het geleidingsonderdeel zich op een maximale afstand bevindt van het voertuig of station waarop het is verschaft.

13. Systeem volgens conclusie 12, waarbij het instelmiddel instelkrachtverminderingsmiddelen (149, 150, 151, 152) omvat die zijn ingericht om een kleinere instelkracht uit te oefenen wanneer het geleidingsonderdeel zich in de tweede stand bevindt dan in de eerste stand.

14. Systeem volgens conclusie 13, waarbij de instelkrachtverminderingsmiddelen een nietlineaire veer (48) omvat, in het bijzonder een bladveer of een schroefveer.

15. Systeem volgens conclusie 13 of 14, waarbij de instelkrachtverminderingsmiddelen een koppelsysteem omvatten met een spanveer (152) met een krachtmomentarm, en dat is ingericht om de krachtmomentarm te verkorten wanneer het geleidingsonderdeel van de eerste naar de tweede stand gaat.

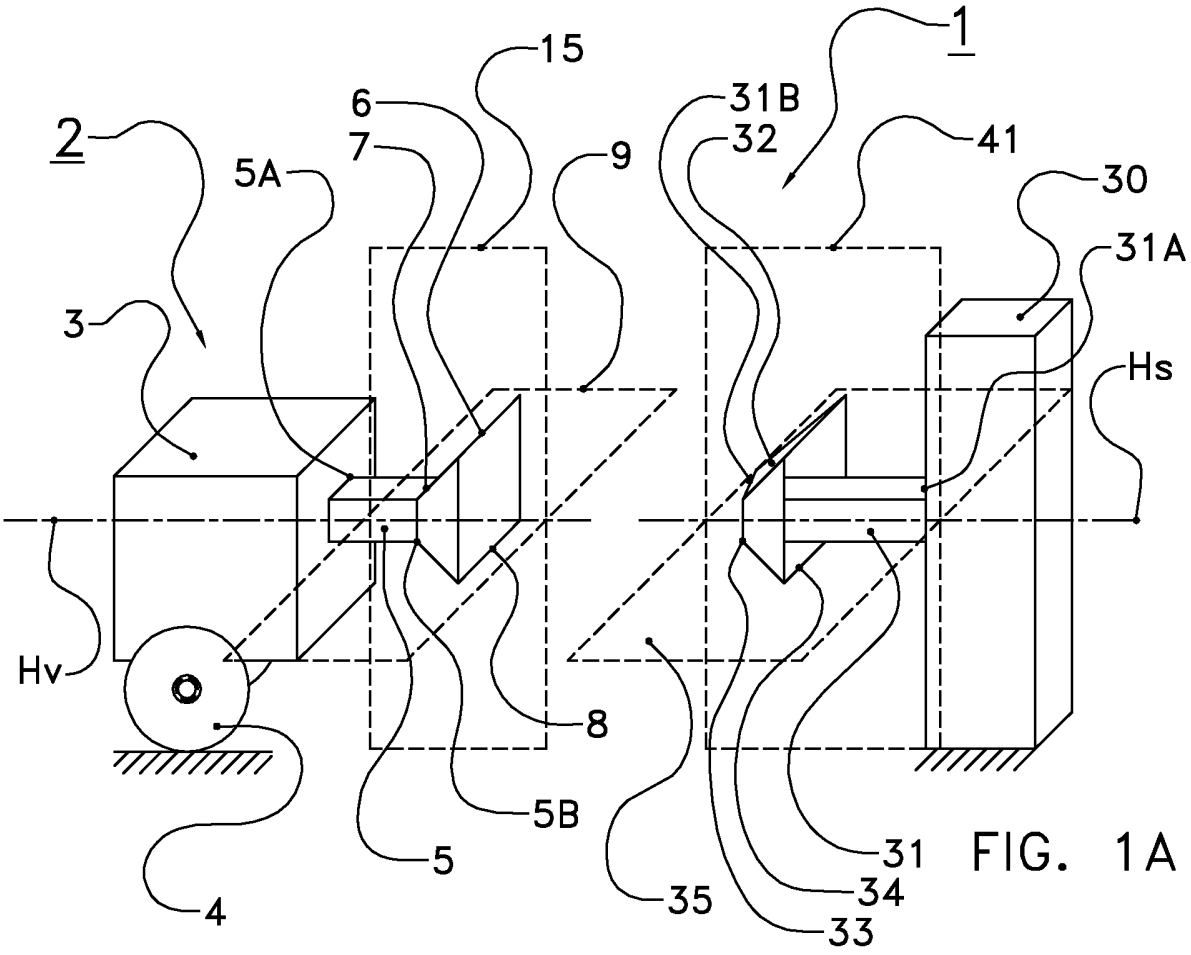
1
2
15
6
7
9
31B
32
41
30
31A
5A
3
Hs
Hv
8
5B
5
4
31
34
35
33

FIG. 1A

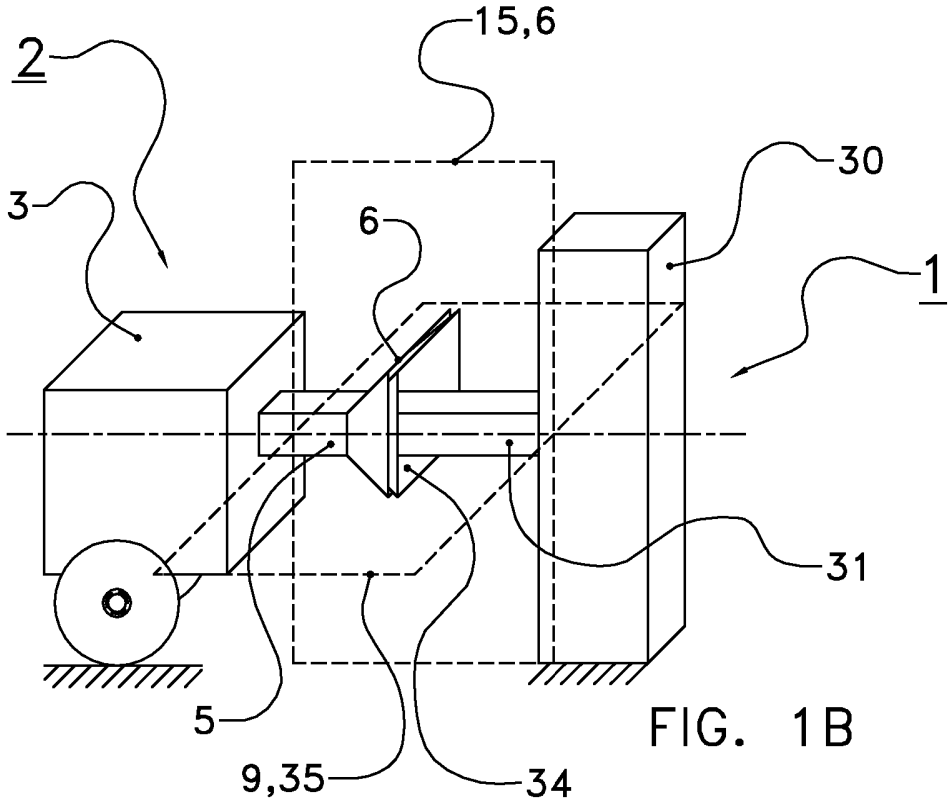
15,6
2
30
3
6
1
31
5
9,35
34

FIG. 1B

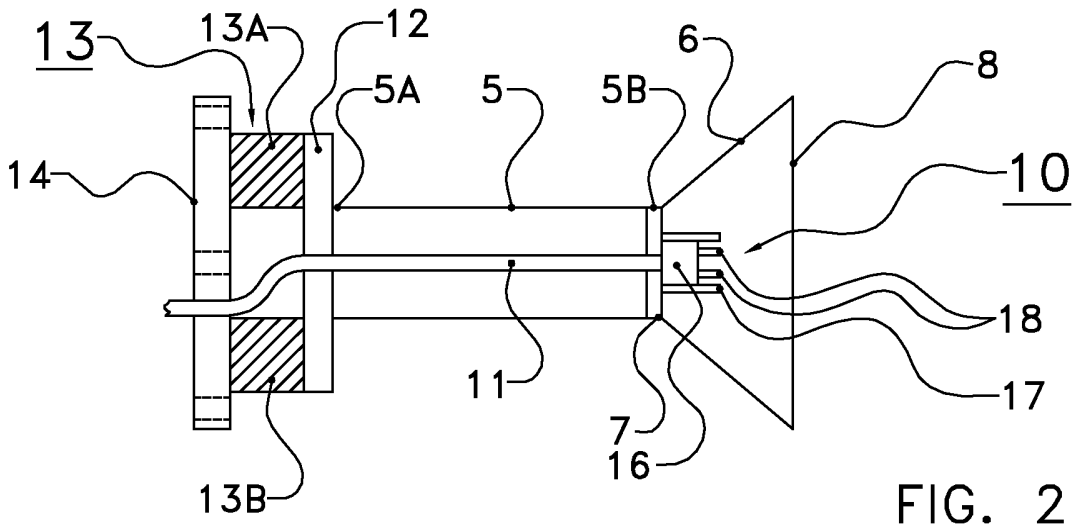

FIG. 2

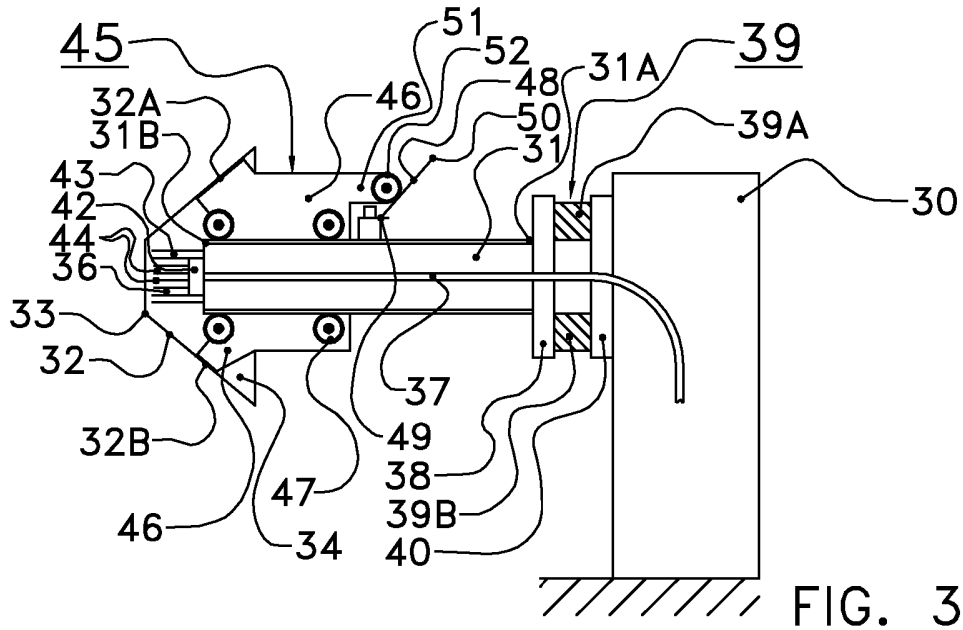

FIG. 3A

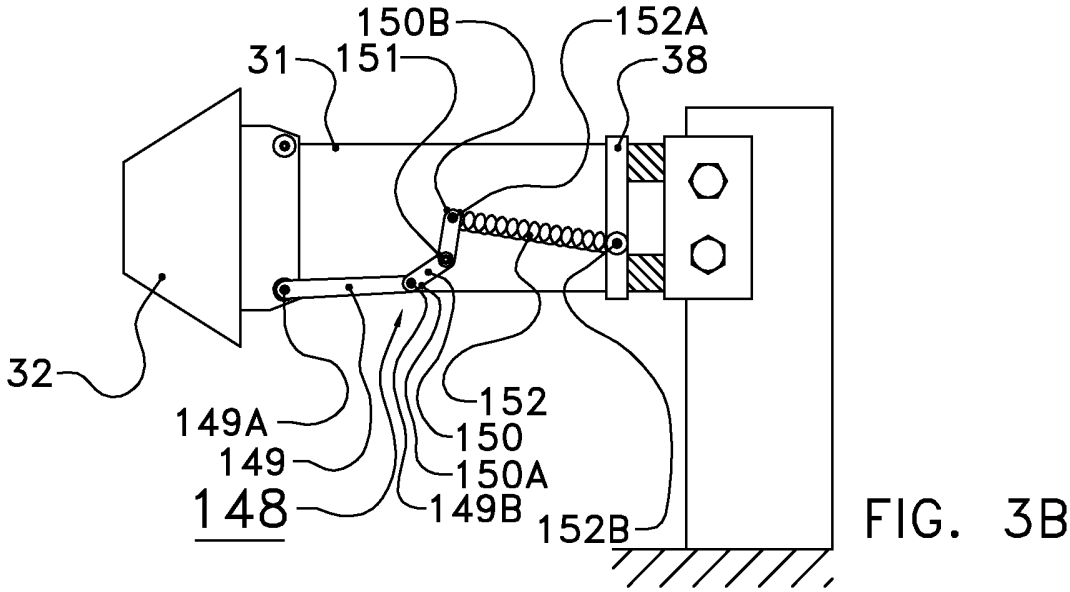

FIG. 3B

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	D4640/NLP
Nederlands aanvraag nr. **2007566**	Indieningsdatum **11-10-2011**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Lely Patent N.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **28-01-2012**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN 57544**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

B60L11/18

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC8	**B60L**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III. ☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES** (opmerkingen op aanvullingsblad)

IV. ☐ **GEBREK AAN EENHEID VAN UITVINDING** (opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2007566

A. CLASSIFICATIE VAN HET ONDERWERP
INV. B60L11/18
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
B60L

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
Y	US 2009/189564 A1 (VASILANTONE MICHAEL M [US]) 30 juli 2009 (2009-07-30) * figuur 2 *	1-12
Y	US 3 986 095 A (NAKAI SABURO ET AL) 12 oktober 1976 (1976-10-12) * figuur 4 *	1-12
A	JP 9 102429 A (SUMITOMO WIRING SYSTEMS) 15 april 1997 (1997-04-15) * figuren 2,3 *	3
A	JP 2003 118671 A (SUMITOMO WIRING SYSTEMS; HONDA MOTOR CO LTD) 23 april 2003 (2003-04-23) * figuur 6 *	3

-/--

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
5 juli 2012	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Wansing, Ansgar

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2007566

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
E	EP 2 393 165 A1 (MULTI HOLDING AG [CH]) 7 december 2011 (2011-12-07) * figuur 6 * -----	1

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek: NL 2007566

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 2009189564 A1	30-07-2009	GEEN	
US 3986095 A	12-10-1976	DE 2538568 A1	18-03-1976
		FR 2283032 A1	26-03-1976
		GB 1519855 A	02-08-1978
		JP 968897 C	31-08-1979
		JP 51027429 A	08-03-1976
		JP 54000064 B	05-01-1979
		SE 404112 B	18-09-1978
		SE 7509679 A	01-03-1976
		US 3986095 A	12-10-1976
JP 9102429 A	15-04-1997	GEEN	
JP 2003118671 A	23-04-2003	JP 3907166 B2	18-04-2007
		JP 2003118671 A	23-04-2003
EP 2393165 A1	07-12-2011	CN 102315545 A	11-01-2012
		EP 2393165 A1	07-12-2011
		FR 2961026 A1	09-12-2011
		US 2011300738 A1	08-12-2011

Agentschap NL
Ministerie van Economische Zaken,
Landbouw en Innovatie

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN57544	11.10.2011		NL2007566

International Patent Classification (IPC)
INV. B60L11/18

Applicant
Lely Patent N.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☒ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

	Examiner
	Wansing, Ansgar

Application number

WRITTEN OPINION

NL2007566

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box II Priority

This opinion has been established as if the claimed priority date were valid, unless indicated otherwise on the **separate sheet**

WRITTEN OPINION

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	1-15
	No:	Claims	
Inventive step	Yes:	Claims	13-15
	No:	Claims	1-12
Industrial applicability	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VI Certain documents cited

☒ Certain published documents

see the Search Report

☐ Non-written disclosures

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2009/189564 A1 (VASILANTONE MICHAEL M [US]) 30 juli 2009 (2009-07-30)

D2 US 3 986 095 A (NAKAI SABURO ET AL) 12 oktober 1976 (1976-10-12)

D3 JP 9 102429 A (SUMITOMO WIRING SYSTEMS) 15 april 1997 (1997-04-15)

D4 JP 2003 118671 A (SUMITOMO WIRING SYSTEMS; HONDA MOTOR CO LTD) 23 april 2003 (2003-04-23)

Lack of inventive step

2 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 does not involve an inventive step.

3 D1 is regarded as being the prior art closest to the subject-matter of claim 1, and discloses

a vehicle system comprising at least one charging station and at least one autonomously movable, electrically powered vehicle dockable therewith,

the vehicle including an inlet-side coupling means and the charging station including an outlet-side coupling means (50), said inlet-side coupling means (40) and said outlet-side coupling means being mutually engageable and arranged to transport energy between the charging station and vehicle when engaged,

said inlet-side coupling means and said outlet-side coupling means further being provided with an inlet-side guiding member (47), an outlet-side guiding member (51), respectively, arranged to guide the inlet-side and outlet-side coupling means from a non-charging position into a charging position upon engaging of said inlet-side and outlet-side coupling means when docking the vehicle to the charging station, with

said outlet-side coupling means is arranged to be deflectingly movable relative to the vehicle in a first plane to enable alignment of the inlet-side and outlet-side coupling means upon their engaging, wherein said first plane is arranged substantially horizontally.

4 The subject-matter of claim 1 therefore differs from this known system in that also *said inlet-side coupling means is arranged to be deflectingly movable relative to the station in a second plane* and is therefore new.

5 The problem to be solved by the present invention may therefore be regarded as better alinement of the coupling means.

6 The solution proposed in claim 1 of the present application cannot be considered as involving an inventive step for the following reasons:

7 The feature of deflectingly arranging both parts of the coupling has already been employed for the same purpose in a similar system (see D2, fig. 4). It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a coupling system according to D1, thereby arriving at a system according to claim 1.

Dependent claims negative assessment

8 Dependent claims 2-11 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of inventive step.

9 In particular:

10 Claim 2: D2 shows a socket and a complementary plug.

11 Claim 3: D3 and D4 show connectors with the possibility to defect in two perpendicular directions.

12 Claim 4 and 5: D1 shows a linear telescopically movable member moving substantially in the driving direction of the vehicle (43-45)

13 Claims 6-11: The features of claim ar merely some of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed. All the cited documents use deflecting means and resilient means to achieve this. The use of this features can not be considered to involve an inventive step.

14 Claim 12: D1 shows a biasing means (43)

Dependent claims positive assessment

15 The combination of the features of dependent claims 13-15 is neither known from, nor rendered obvious by, the available prior art.

Re Item VI

Certain documents cited

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
EP2393165	07/12/2011	07/06/2011	07/06/2010