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Kingpin Assembly

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DESCRIPTION

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The invention relates to a kingpin assembly for a semitrailer of an articulated vehicle, comprising a kingpin defining an axis of rotation, a rotary bearing arranged about the axis of rotation, and a driver connected to the rotary bearing and pivotable about the axis of rotation, the kingpin having a kingpin flange for mounting the kingpin indirectly or directly on the semitrailer, the rotary bearing having a stationary bearing ring or a stationary bearing-ring segment that is stationary relative to the kingpin and a rotatable bearing ring or a rotatable bearing-ring segment that is rotatable relative thereto, and the driver being fixed to the rotatable bearing ring or rotatable bearing-ring segment.

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Such a kingpin assembly is known, for example, from DE 20 2022 106 659 U, EP 3 891 051 A1, EP 1 918 179 A1 and DE 10 2004 024 333 A1.

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The tractor vehicle and the semitrailer, also simply referred to as the trailer, form the articulated vehicle, which is also referred to as a tractor-semitrailer. A fifth-wheel coupling plate is arranged on the tractor vehicle, with which the kingpin located on the underside of the semitrailer is brought into engagement and locked. For coupling the trailer, the fifth-wheel plate is usually formed with an entry opening tapering wedge-shaped in the direction of travel, the entry opening having a free clearance with a clearance depth that ensures unhindered entry and exit of the kingpin into and out of the fifth-wheel plate. During coupling, the trailer slides with its semitrailer plate, on which the kingpin is mounted indirectly or directly in a fixed position, on the surface of the fifth-wheel plate, whereby vertical positioning is determined. Lateral guidance is ensured via the kingpin, which, during coupling, is forcibly guided in the entry opening until it reaches its locking position. The entry opening is defined downward by the length of the kingpin. In other words, components located below the entry opening, such as reinforcing ribs, cannot be contacted by the kingpin when coupling and uncoupling the trailer.

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Terms such as “vertical”, “horizontal”, “top” and “bottom” refer herein, unless expressly stated otherwise, to the direction of gravity. Terms such as “axial”, “radial” and “tangential” refer herein, unless expressly stated otherwise, to the axis of rotation defined by the kingpin.

When the tractor vehicle and the semitrailer are coupled, it is desirable to know the angular position of the trailer relative to the tractor vehicle as precisely as possible and to communicate it to a control device of the tractor vehicle and/or the semitrailer. This information is relevant, for example, for steerable axles of the trailer or for optimizing driver-assistance systems, both when reversing and driving forward. There are numerous approaches for determining the so-called articulation angle between tractor vehicle and semitrailer. Reference is made by way of example to EP 3 162 665 A1, DE 20 2012 008 717 U1, DE 199 64 059 A1, US 5,152,544 A, WO 2020/248 035 A1, AT 514 448 A1, US 2013/082 453 A1, US 2015/084 311 A1, GB 2 470 610 A, DE 10 2018 123 642 A1. In most known systems, a magnet and a magnetic-field sensor are used. The sensor is usually attached indirectly or directly to the fifth-wheel plate and the magnet to the kingpin. A disadvantage of this assembly is that the measurement result may depend not only on the articulation angle but also on a misalignment between the sensor and the magnet after coupling and on play between the kingpin and the fifth-wheel plate in the coupled state, and these two influencing factors may therefore result in the output of erroneous angle values.

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It is therefore an object of the invention to provide a kingpin assembly that creates the preconditions for simple and accurate determination of the articulation angle. The object is achieved by a kingpin assembly according to claim 1.

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According to the invention, on the one hand on the kingpin or the stationary bearing ring or the stationary bearing-ring segment and, on the other hand, on the rotatable bearing ring or the rotatable bearing-ring segment or on the driver, respectively, one element of a pair consisting of an angle sensor and an angle encoder is arranged.

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This solution differs from all known solutions in that both the angle sensor and the angle encoder are assigned to the kingpin assembly and thus to the semitrailer. As a result, the relative position of the angle sensor and the angle encoder is always the same apart from the articulation angle to be detected, regardless of the condition of the fifth-wheel plate and its spatial position relative to the kingpin after coupling the tractor vehicle to the semitrailer. The solution according to the invention furthermore has the considerable advantage that it can be retrofitted very easily, since a modification is required only on the semitrailer. In this case, elements (stationary and rotatable bearing ring or bearing-ring segment) of the existing rotary bearing around the kingpin are used to ensure a defined rotational movement of the angle sensor and the angle encoder relative to each other.

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It should be noted that for the rotary bearing, stationary bearing rings and rotatable bearing rings having a 360° extent may be used, as well as only respective "bearing-ring segments", or a combination of a bearing ring on the one hand and a "bearing-ring segment" on the other hand. To ensure the degree of freedom of the rotary motion and positional definition in all other dimensions,

bearing-ring segments are fundamentally sufficient, since the fifth-wheel coupling in any case allows only a rotational movement over a partial circle of a maximum of approximately 260°. Completely annular stationary and rotatable bearing rings, however, have the advantage of higher stiffness, which in turn, particularly in the event of tilting moments, ensures more precise positional definition and is therefore generally to be preferred.

Preferably, the angle sensor is arranged on the rotatable bearing ring or the rotatable bearing-ring segment or on the driver, and the angle encoder is arranged on the kingpin or the stationary bearing ring or the stationary bearing-ring segment.

The driver is preferably configured, in the coupled state, to interact with the fifth-wheel plate in such a way that the relative rotation between the kingpin and the fifth-wheel plate is transmitted to the rotatable bearing ring or the rotatable bearing-ring segment with as little play as possible. For this purpose, for example, a form-fit contact between the driver and the fifth-wheel plate or an element fixed thereto is conceivable.

For this purpose, the driver particularly preferably comprises a centering element which is configured to center the driver in the entry opening of a fifth-wheel plate of a tractor vehicle.

The angle sensor is advantageously a contactless measuring sensor, in particular a magnetic-field or Hall sensor, a capacitive sensor or an optical sensor.

Contactless sensor technology has a variety of advantages; in particular, it is not susceptible to wear, is virtually free of slip, and produces an electronic signal directly that can be made available for further processing.

Accordingly, the angle encoder can advantageously comprise a magnetization pattern, in particular one or more magnets or magnetic sections or magnetic coatings, an optically detectable marking pattern, in particular an application of color or a discoloration, a tactile marking pattern, in particular an engraving or a relief, or a combination of these patterns.

It should be noted with regard to the tactile marking pattern that it can be scanned either by contact mechanically or contactlessly by a magnetic-field sensor, a capacitive sensor or an optical sensor.

The angle encoder preferably comprises a pattern that varies in the circumferential direction and/or in the radial direction.

The pattern may exhibit an incremental or continuous change in the circumferential direction and/or the radial direction. This includes, for example, patterns that contain lines that run convergently or divergently in the circumferential direction and/or radial direction, the spacing of which and, therefrom, information concerning the angular position can be determined from signals of the angle sensor. Alternatively, the pattern may contain at least one line running obliquely at an acute angle to the circumferential direction or to the radial direction, the distance of which from an imaginary reference plane perpendicular to the axis of rotation and, therefrom, information concerning the angular position can again be determined from signals of the angle sensor. In another alternative, the pattern may be formed by a line pattern that changes in the circumferential direction, in which a multiplicity of lines running transversely to the circumferential direction or to the radial direction and spaced in the circumferential direction or in the radial direction vary in their length and/or in their width and/or in their spacing in the circumferential direction or in the radial direction, and in which the length and/or the width and/or the spacing of the lines and, therefrom, information concerning the angular position can again be determined from signals of the angle sensor.

As a result of the variation, evaluation electronics are thus able to assign the signal of the sensor to an angular position even when there is currently no relative movement between the angle sensor and the angle encoder, i.e. when the kingpin is not rotating relative to the fifth-wheel plate.

The pattern particularly preferably defines a center position.

This means that the pattern comprises a marking that can be uniquely assigned to the center position. This enables detection of straight-ahead travel in a particularly simple manner. In combination with a pattern varying in the circumferential direction and/or in the radial direction, the marking of the center position provides redundant information, which can be used, for example, for calibration of the angle sensor.

The signal output of the sensor can be provided via a wired connection to the trailer or wirelessly to the trailer, the tractor vehicle, or to a location outside the vehicle, for example to a central control center.

In an alternative embodiment, the angle sensor preferably comprises a wheel and the angle encoder a contact surface on which the wheel bears with frictional engagement.

The driver is preferably designed as a support frame for the indirect or direct holding, in particular, of an electrical and/or electromagnetic and/or pneumatic and/or hydraulic connecting means for connection to a corresponding connection unit of a tractor vehicle.

The electrical and/or electromagnetic and/or pneumatic and/or hydraulic connecting means is part of a plug-in coupling system for connecting lines between the tractor vehicle and the trailer, as described, for example, in DE 10 2004 024 333 A1. Plug-in coupling systems are known in different embodiments. The plug-in coupling system contains at least a plug and a plug socket and, as a rule, also further components that serve to automate the connection and separation of the plug and the plug socket when coupling and uncoupling the semitrailer and the tractor vehicle. In this sense, the term "connecting means" therefore comprises at least a plug or a plug socket. For safety reasons, the live end of the plug-in coupling system on the tractor vehicle is usually designed as a plug socket, while the corresponding plug is arranged on the semitrailer. In particular, the plug socket is arranged in a fixed position on the fifth-wheel coupling below the entry opening and is thus located in a protected area in which it cannot collide with the kingpin during insertion. The connecting means, usually the plug, is typically arranged on the underside of the support frame or within the support frame in a cavity.

As a support frame, the driver fulfills a dual function. It ensures that the connecting means is pivoted around the kingpin and in the process is always oriented toward the corresponding connection unit of the tractor vehicle. Advantageously, for this purpose the support frame, viewed in projection onto a horizontal plane, has a wedge- or V-shaped configuration that is at least in sections complementary to the wedge-shaped entry opening, such that, upon insertion, the support frame is oriented in a defined manner relative to the fifth-wheel coupling by form fit. In this way, the driver in the form of the support frame simultaneously comprises the centering element in order to transmit the relative rotation between the kingpin and the fifth-wheel plate to the relative movement between the angle sensor and the angle encoder with as little play as possible.

Furthermore, it is known for the plug to be arranged on a base plate on the support frame, which is mounted resiliently with respect to the support frame in the vertical direction. When coupling the trailer until the connection between the plug and the plug socket is finally established, the spring-loaded base plate or the plug is guided against a lead-in aid in the region of the entry opening, whereby positioning in the vertical direction also takes place automatically, thus ensuring any height compensation that may be required.

The support frame preferably has a support element that is axially spaced apart from the rotatable bearing ring or the rotatable bearing-ring segment and bears directly against the kingpin.

The rotatable bearing ring or the rotatable bearing-ring segment forms, together with the stationary bearing ring or the stationary bearing-ring segment, an axial-radial rotary bearing, i.e. an upper suspension for the support frame with only one rotational degree of freedom for the latter. The position of the support frame is determined by the rotary bearing radially and axially relative to the

kingpin and thus to the semitrailer plate. However, due to its radial overall length and an unfavorable lever at its free, plug-side end, the support frame may tilt downward, particularly when wear occurs. This can be countered only in part by stiffening the bearing structure and the support frame, especially since these components should be of the lightest possible design. For this reason, the support element is provided, which counteracts the tilting by forming, axially spaced from the plane of the rotary bearing — this is defined by the plane of the mutually superposed sliding surfaces of the bearing rings/bearing-ring segments — a lower support for the support frame on the kingpin. The support element bears against the kingpin and particularly preferably against the upper or the lower collar of the kingpin and transmits any tilting moments into the kingpin. As a result, the vertical position of the support frame and the plug relative to the kingpin and to the semitrailer plate is defined, and it is ensured that the coupling process can safely take place in the manner described above through vertical and horizontal guidance.

It is further preferred that the support element is length-adjustable in the radial direction with respect to the axis of rotation.

Due to wear and, in particular, in the case of retrofitted or replaced kingpin assemblies, variations may occur due to manufacturing tolerances in the relative assembly of the connection elements and the kingpin that jeopardize safe coupling despite the support described above. The length-adjustable support element in the radial direction provides an adjustment option for the inclination of the support frame. This enables fine adjustment of the vertical position of the plug relative to the plug socket, by which, for example, manufacturing tolerances, wear or the like can be compensated, so that coupling can safely take place in the usual manner.

The support element preferably has a sliding surface that is in contact with the kingpin. Since the support element is a separate component, it can be optimized in a simple manner with regard to its function as a sliding element. This is particularly preferably accomplished in that the sliding surface is formed by a surface of a friction-reduced material. In this sense, the sliding element can be made predominantly of the friction-reduced material — referred to as a solid material — or may have a coating of such a material. A friction-reduced material denotes a material that contains tribologically effective fillers, so-called solid lubricants such as preferably graphite, PTFE, MoS₂, h-BN, lead, tin or the like and therefore, in interaction with the kingpin, exhibits a lower coefficient of friction than the aluminum or steel material without fillers usually used for the support frame. As matrix material for such solid materials or coatings, plastics, bronze or aluminum may be considered, for example.

It is likewise preferred that the support element therefore has, at least along the sliding surface, a plastics matrix, in particular made of thermoplastic material, in particular polyethylene (PE),

polyamide (PA), polypropylene (PP), polyether ether ketone (PEEK), polyetherimide (PEI), polyoxymethylene (POM), acrylonitrile-butadiene-styrene (ABS).

5 The kingpin preferably has a cylindrical lateral surface arranged coaxially about the axis of rotation with radius r , or at least a segment thereof, against which the support element bears. Again it should be noted that, due to the limited angle of rotation of the fifth-wheel coupling, a cylindrical segment is sufficient; as a rule, however, the kingpin over its entire axial extent has one — or, due to its obligatory necking, several — circular cross-sections and, in this sense, has at least one cylindrical lateral surface against which the support element can brace itself. Since the obligatory necking is
10 provided for locking with the fifth-wheel coupling, the kingpin can optionally brace itself either above it, on the so-called upper collar, or below it, on the so-called lower collar.

The sliding surface is preferably configured geometrically in such a way that the support element is centered relative to the kingpin in a direction perpendicular to the axis of rotation. This is advantageously realized either in that the sliding surface forms a V-shaped contour in a plane perpendicular to the axis of rotation, or in that the sliding surface is formed as a concavely curved surface having a radius r' , the radius r' being between $r - 5$ mm and $r + 5$ mm, more preferably between $r - 1$ mm and $r + 5$ mm, and particularly preferably between r and $r + 5$ mm. In both cases, the position of the sliding surface in the tangential direction with respect to the axis of rotation or the
15 cylindrical surface of the kingpin is defined.
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The support element is preferably connected to the support frame by means of a connecting element that is length-adjustable in the radial direction with respect to the axis of rotation. As part of the support element, the connecting element provides for its adjustability in the radial direction. It
25 is particularly preferred that the support element is connected to the support frame by a threaded rod (as the connecting element) that extends in the radial direction with respect to the axis of rotation. Alternative embodiments provide, instead of the threaded rod, pins or rods in combination with clamping pieces or clamping screws, bars with elongated holes and connecting screws, a toggle-lever assembly, or toothed or latched elements such as, for example, a rack and corresponding
30 counterparts engaging in the toothing.

The support frame preferably has a cross strut on which the length-adjustable connecting element and/or the threaded rod is supported. The cross strut extends in a plane perpendicular to the axis of rotation and essentially tangentially at a sufficient distance from the kingpin to enable length
35 adjustment of the support element.

The stationary bearing ring or the stationary bearing-ring segment is preferably fastened directly to the kingpin flange. This enables simple replaceability or retrofittability of the kingpin assembly

without having to make structural changes to the semitrailer itself. For example, an old kingpin can be unscrewed from the semitrailer plate and a new kingpin with the same hole pattern in the kingpin flange, together with the rotary bearing and support frame, can be mounted in its place.

- 5 The stationary bearing ring or the stationary bearing-ring segment is preferably arranged radially inside with respect to the axis of rotation, and the rotatable bearing ring or the rotatable bearing-ring segment is arranged radially outside. This likewise contributes to simple replaceability or retrofitability of the kingpin assembly while at the same time providing optimal rotational guidance, as will be explained below with reference to the drawings.

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A spacer piece projecting upward from the support frame in the direction of the axis of rotation is preferably arranged on the support frame, which is configured to support the support frame indirectly or directly on the semitrailer.

- 15 The length-adjustable support element is preferably set in such a way that the support frame bears against the semitrailer plate with the spacer piece, as a result of which a tendency of the support frame to vibrate is reduced and the position of the free end of the support frame on which the connecting means is arranged is determined even more precisely. In order to avoid mechanical prestressing during rotation of the support frame about the kingpin, the support element is advantageously aligned after the lowest point of the area of the semitrailer plate that can be swept over by the support frame during rotation.

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The rotatable bearing ring or the rotatable bearing-ring segment advantageously has a cylindrical wall segment that extends in the direction of the axis of rotation, on which the support frame is fixed. The cylindrical wall segment forms the vertical connection from the plane of the axial rotary bearing to the support frame and is also suitable for forming the cross strut for supporting the length-adjustable connecting element and/or the threaded rod.

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- 30 The cylindrical wall segment preferably has a width in the tangential direction of $< (2.1 \times r)$ and thus, as the radially innermost part of the V-shaped support element, participates in guiding the connecting means during coupling.

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- 35 In a preferred embodiment, the support element is configured to be elastically deformable at least in the radial direction with respect to the axis of rotation and/or has a spring element acting in this direction, so that the support element bears against the kingpin under an adjustable preload. The spring element may be, for example, a helical compression spring, a stack of disc springs or an elastically deformable plastics body. This configuration, in conjunction with the length adjustment of the support element, makes it possible to set a targeted preload that always ensures that the

support element bears against the kingpin and the support frame bears against the semitrailer plate with a constant contact pressure. As a result, any prestressing of the support frame is reduced and, at the same time, vibrations of the support frame can be damped even better.

- 5 In one embodiment, the angle sensor is arranged on or in the support element.

The angle encoder is correspondingly preferably arranged on or along a circumferential surface of the kingpin.

- 10 The contact of the support element bearing against the kingpin ensures that the circumferential surface of the kingpin is free of dirt or other interfering influences along the location scanned or read by the sensor, and the sensor therefore always outputs a largely constant, interference-free signal.

- 15 Alternatively, the angle encoder is preferably arranged on or along the surface of the stationary bearing ring or on or along the surface of the kingpin flange.

Accordingly, the angle sensor is alternatively preferably arranged on or in the rotatable bearing ring or on or in the rotatable bearing-ring segment.

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These and further features and advantages of the invention are explained in more detail below with reference to the figures. In the drawings:

- 25 Figure 1 shows a perspective sectional view of a first embodiment of the kingpin assembly;

Figure 2 shows the kingpin assembly according to Figure 1 in section in side view;

Figure 3 shows a perspective sectional view of a second embodiment of the kingpin assembly;

- 30 Figure 4 shows a perspective sectional view of a third embodiment of the kingpin assembly;

Figure 5 shows a perspective sectional view of a fourth embodiment of the kingpin assembly;

- 35 Figure 6 shows a perspective sectional view of a fifth embodiment of the kingpin assembly;

Figure 7 shows a sixth embodiment of the kingpin assembly in section in side view;

Figure 8 shows the kingpin assembly from below;

Figure 9 shows the kingpin assembly from below with support frame;

Figure 10 shows the kingpin assembly in an exploded view; and

Figure 11 shows a schematic view of one embodiment of the kingpin assembly according to the invention in side view.

Figures 1 and 2 and 8 to 10 show the same kingpin assembly 1 for a semitrailer of an articulated vehicle, comprising a kingpin 2 defining an axis of rotation A, a rotary bearing 3 arranged about the axis of rotation A, and a support frame 4 connected to the rotary bearing 3 and pivotable about the axis of rotation A. In this multi-part embodiment, the support frame 4 has a mounting base with a cylindrical wall segment 16 and two fork-shaped holding arms 21 projecting essentially radially from the cylindrical wall segment 16.

On its upper side, the support frame 4 has a protective cover 22. Under the protective cover 22, at the free end 23 of the support frame 4 and attached thereto indirectly via a base plate, there is arranged within the support frame a connecting means, as a rule in the form of a plug (not shown). The support frame 4 is formed in sections as a V-shaped frame structure whose sides are adapted to the angle of the correspondingly configured entry opening.

The kingpin 2 has a kingpin flange 6 for mounting the kingpin 2 on the semitrailer and, more precisely here, on a disc 18 welded to the semitrailer plate 24. Mounting is performed, as is known in the prior art, by means of bolts 25 arranged along the flange 6 in a circular pattern. The disc 18 has an upward recess 26 in which the kingpin flange 6 and parts of the rotary bearing 3 are received. The depth of the recess 26 plus the thickness of the semitrailer plate 24 are dimensioned such that the rotary bearing 3, with the exception of the integrally formed cylindrical wall segment 16 of the support frame 4, does not project beyond the underside of the semitrailer plate 24.

Apart from this, the kingpin comprises, in a manner known per se, viewed from top to bottom, an upper collar 27, a necked portion 28 and a lower collar 29. The upper collar 27, the necked portion 28 and the lower collar 29 all have a circular-cylindrical basic form. At the upper collar, the kingpin has a radius r . The necked portion 28 is the section at which the lock of the fifth-wheel coupling engages.

The rotary bearing 3 comprises a bearing ring 7 stationary relative to the kingpin 2 and a bearing ring 8 rotatable relative thereto. The stationary bearing ring 7 is fastened directly to the kingpin flange by bolts 30. By screwing the flange 3 to the welded-in disc 7 and by screwing the stationary

bearing ring 31 to the flange 3, the kingpin assembly 1 as a whole or even only parts of the rotary bearing 3 can be replaced in a simple manner. In particular when retrofitting, no structural changes have to be made to the semitrailer because the kingpin assembly 1 according to the invention can simply be mounted in place of an old one. This is ensured not only by the identical bolted connection
5 but also by the small installation space required for the rotary bearing 3 together with the support frame 4. For this purpose, it is again advantageous if, as can be seen in particular in Figures 1 and 4, the stationary bearing ring 7 is arranged radially inside with respect to the axis of rotation A and the rotatable bearing ring 8 is arranged radially outside.

10 The rotatable bearing ring 8 together with the stationary bearing ring 7 forms an axial-radial rotary bearing. In the axial direction, the bearing is provided by the mutually superposed axial sliding surfaces of the bearing rings 7 and 8. The sliding surfaces define the "plane of rotation" or "plane of the rotary bearing" 32; see Figure 4. In the radial direction, the bearing rings bear against one another along circular-cylindrical surfaces 34 and thus restrict the degree of freedom of movement
15 of the support frame 4 to pure rotation. Along its outer circumferential surface, the rotatable bearing ring 8 has a circumferentially recessed stiffening rim 36.

The support frame 4 is fixed to the rotatable bearing ring 8. In the exemplary embodiment shown, it is integrally formed thereon with its cylindrical wall segment 16. The cylindrical wall segment thus
20 forms the vertical connection from the plane 32 of the axial rotary bearing to the support frame 4. The position of the support frame 4 is thus determined by the rotary bearing 3 radially and axially relative to the kingpin 2 and semitrailer plate 24.

So that the support frame 4 does not tilt downward, or tilts as little as possible, due to its radial
25 overall length, the kingpin assembly 1 has a support element 9. This is connected to the support frame 4 by means of a connecting element 12 that is length-adjustable in the radial direction R with respect to the axis of rotation A. It is arranged axially spaced below the plane 32 of the rotary bearing 3 and there bears directly against a circumferential or cylindrical lateral surface 11 of the upper collar 27 of the kingpin 2 arranged coaxially about the axis of rotation A. While the necked
30 portion 28 must remain completely free for locking with the fifth-wheel coupling, in an alternative embodiment the support element 9 can also brace itself against the lower collar 29, which results in an overall larger lever and thus a firmer support.

In this example, the connecting element 12 is embodied as a threaded rod 13 which, on the radially
35 outer side, is screwed into the cylindrical wall segment 16, which here forms the cross strut 14, and in this way is supported thereon. Alternatively, it can also be fixed thereto, for example, by a material bond or a frictional connection. On the other side, the threaded rod 12 is screwed into a metal block 40 of the support element 9 and locked with a nut 42. As part of the support element 9, the

threaded rod 12 provides for its adjustability in the radial direction R. If the support element is lengthened in the radial direction, for example by screwing out the threaded rod, the support frame 4 is raised at its free end 23, at which the (not illustrated) connecting means or plug is located, and conversely is lowered by screwing it in. In this way, the support frame can be adjusted precisely, 5 for example, to the degree of wear of the kingpin, structural tolerances of the support frame, plug or semitrailer plate, such that the plug can be brought exactly into its target vertical position.

The support element 9 furthermore has a sliding surface 10 that is in direct contact with the cylindrical surface 11 of the kingpin 2, which sliding surface is formed on a plastics block 44 that is in 10 turn bonded to, or otherwise fastened on, the metal block 40 of the support element 9. The plastics block 44 has a plastics matrix in which tribologically effective filler particles can be dispersed in order to reduce the coefficient of friction in interaction with the surface of the kingpin 2.

The sliding surface 10 is formed as a concavely curved surface having a radius r' , whereby the 15 support element 9 is oriented in the tangential direction relative to the axis of rotation A or the cylindrical surface 11 of the kingpin 2.

An angle sensor 52 in the form of a contactless measuring magnetic-field sensor is arranged in the support element 9, oriented in the radial direction toward the cylindrical lateral surface 11 of the 20 kingpin 2. In this embodiment, the support frame 4 together with the support element 9 forms the driver on which the angle sensor 52 is arranged. Along the circumferential surface or cylindrical lateral surface 11 of the kingpin 2, here more precisely in the region of the upper collar 27, an angle encoder 54 in the form of magnetic sections of an annular strip is inserted flush with the circumferential surface. The angle sensor 52 is oriented toward this angle encoder 54. The angle encoder 25 54 preferably comprises a pattern of magnetic sections that varies in the circumferential direction so that, when the support frame 4 is pivoted about the kingpin 2 and the angle sensor 52 scans the angle encoder 54, the angle sensor 52 generates a signal that can be assigned to the respective angular position. In this example, the signal is conducted in the radial direction via a signal line 56 to the (not shown) plug and can be handed over via the latter to a coupled tractor vehicle. The 30 signal line can also, or additionally, be routed directly within the semitrailer to a processor which processes the signal, for example for the purpose of controlling steerable axles or driver-assistance systems.

The kingpin assemblies 1 of the exemplary embodiments according to Figures 3 to 7 have the same 35 structural design as that of the first exemplary embodiment according to Figures 1 and 2 and differ only in the positioning of the angle sensor 52 and the angle encoder 54.

In the second exemplary embodiment according to Figure 3, the angle sensor 52 is again arranged in the support element 9, but this time oriented in the axial direction toward the kingpin flange 6 at a radial distance r_1 from the axis of rotation A. The angle encoder 54 is correspondingly arranged flush on or in the kingpin flange 6 in the form of magnetic sections at the same radial distance r_1 from the axis of rotation A.

In the third exemplary embodiment according to Figure 4, the angle sensor 52 is likewise arranged in the support element 9 and this time oriented in the axial direction toward the stationary bearing ring 7 at a radial distance r_2 from the axis of rotation A. The angle encoder 54 is correspondingly arranged flush on or in the stationary bearing ring 7 in the form of magnetic sections at the same radial distance r_2 from the axis of rotation A.

In the fourth exemplary embodiment according to Figure 5, the angle sensor 52 is arranged in the rotatable bearing ring 8 and oriented radially inward toward the stationary bearing ring 7. The angle encoder 54 is correspondingly arranged along the outer circumferential surface of the stationary bearing ring 7 in the form of magnetic sections.

In the fifth exemplary embodiment according to Figure 6, the angle sensor 52 is likewise arranged in the rotatable bearing ring 8 but this time oriented in the axial direction toward the kingpin flange 6 at a radial distance r_3 from the axis of rotation A. The angle encoder 54 is correspondingly arranged flush along the kingpin flange 6 in the form of magnetic sections at the same radial distance r_3 from the axis of rotation A.

In the sixth exemplary embodiment according to Figure 7, the angle sensor 52 and the angle encoder 54 are arranged concentrically with the axis of rotation A at the lower end of the kingpin 2. More precisely, the angle encoder 54 in the form of a magnet assembly is inserted into a counter-bore at the lower end of the kingpin 2. Also at the lower end, the kingpin 2 has a clearance 55 into which the angle sensor 52 is inserted without any axial projection. This is important so that the sensor is protected from mechanical stress and cannot, for example, come into contact with the fifth-wheel plate during coupling. In this example, the angle sensor 52 is connected in a rotationally fixed manner to the support frame 4 by means of a holding bracket 58 which, over a first radial section, likewise lies within the clearance 55 for protection against mechanical loading. For the purposes of this teaching, the holding bracket 58 is considered to be part of the support frame 4 and thus of the driver. The sensor 52 is oriented in the axial direction toward the angle encoder 54 and can only rotate relative thereto about the axis of rotation A. The angle encoder 54 comprises a pattern of magnetic sections that varies in the radial direction, so that the angle sensor 52, during its rotational movement relative to the angle encoder 54 as a result of a pivoting movement of the support frame 4 about the kingpin 2, generates a signal that can be assigned to the respective

angular position. The pattern of magnetic sections that varies in the radial direction may, in the simplest case, be a dipole magnet oriented in the radial direction. However, with a view to good angular resolution, a multiplicity of varying magnetic sections arranged along a circular line is preferred. In this example too, the signal is conducted via the signal line 56, which runs within its first
5 radial section protected inside the holding bracket 58.

Figure 11 schematically shows a kingpin assembly according to the invention with a support frame 4 directed radially outward, on which a spacer piece 46 projecting upward from the support frame 4 in the direction of the axis of rotation A is arranged, which supports the support frame 4 on the
10 semitrailer plate 24 of the semitrailer.

A connecting means 48 is arranged within the support frame 4 at its free end 23, shown in dashed lines.

15 In this embodiment, the support element 9 has a spring element 50 acting in the radial direction R with respect to the axis of rotation A. The spring element 50 is shown schematically and may be, for example, a helical compression spring, a stack of disc springs or an elastically deformable plastics body. In conjunction with the length adjustment of the support element 9, this allows a targeted preload to be set which always ensures that the support element 9 bears against the kingpin 2 and
20 the support frame 4 bears against the semitrailer plate 24 via the spacer piece 46 with constant contact pressure.

List of Reference Signs

	1	kingpin assembly
	2	kingpin
5	3	rotary bearing
	4	support frame
	6	kingpin flange
	7	stationary bearing ring
	8	rotatable bearing ring
10	9	support element
	10	sliding surface
	11	cylindrical lateral surface
	12	connecting element
	13	threaded rod
15	14	cross strut
	16	cylindrical wall segment
	18	disc
	21	holding arm
	22	protective cover
20	23	free end (of the support frame)
	24	semitrailer plate
	25	bolt
	26	recess
	27	upper collar
25	28	necked portion
	29	lower collar
	30	bolt
	32	plane of rotation/plane of the rotary bearing
	34	circular-cylindrical surface
30	36	stiffening rim
	40	metal block
	42	nut
	44	plastics block
	46	spacer piece
35	48	connecting means
	50	spring element
	52	angle sensor
	54	angle encoder

	55	clearance
	56	signal line
	58	holding bracket
5	A	axis of rotation
	r	radius
	R	radial direction

Claims

1. Kingpin assembly (1) for a semitrailer of an articulated vehicle, comprising a kingpin (2) defining an axis of rotation (A), a rotary bearing (3) arranged about the axis of rotation (A),
5 and a driver connected to the rotary bearing (3) and pivotable about the axis of rotation (A), wherein the kingpin (2) has a kingpin flange (6) for mounting the kingpin (2) indirectly or directly on the semitrailer,
wherein the rotary bearing (3) has a stationary bearing ring (7) or a stationary bearing-ring segment that is stationary relative to the kingpin (2) and a rotatable bearing ring (8) or a
10 rotatable bearing-ring segment that is rotatable relative thereto,
wherein the driver is fixed to the rotatable bearing ring (8) or rotatable bearing-ring segment, characterized in that on the kingpin (2) or the stationary bearing ring (7) or the stationary bearing-ring segment on the one hand and on the rotatable bearing ring (8) or the rotatable bearing-ring segment or the driver on the other hand, respectively, one element of a pair
15 consisting of an angle sensor and an angle encoder is arranged.
2. Kingpin assembly according to claim 1,
characterized in that the angle sensor is arranged on the rotatable bearing ring (8) or the rotatable bearing-ring segment or on the driver, and that the angle encoder is arranged on
20 the kingpin (2) or the stationary bearing ring (7) or the stationary bearing-ring segment.
3. Kingpin assembly according to any one of the preceding claims,
characterized in that the driver comprises a centering element which is configured to center the driver in the entry opening of a fifth-wheel plate of a tractor vehicle.
25
4. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle sensor is a contactless measuring sensor, in particular a magnetic-field or Hall sensor, a capacitive sensor, or an optical sensor.
- 30 5. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle encoder comprises a magnetization pattern, an optically detectable marking pattern, a tactile marking pattern, or a combination of these patterns.
- 35 6. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle encoder comprises a pattern that varies in the circumferential direction and/or in the radial direction.
7. Kingpin assembly according to claim 5 or 6,

characterized in that the pattern defines a center position.

- 5 8. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle sensor comprises a wheel and the angle encoder comprises
a contact surface on which the wheel bears with frictional engagement.
- 10 9. Kingpin assembly according to any one of the preceding claims,
characterized in that the driver is designed as a support frame (4) for the indirect or direct
holding, in particular, of an electrical and/or electromagnetic and/or pneumatic and/or hy-
draulic connecting means for connection to a corresponding connection unit of a tractor
vehicle.
- 15 10. Kingpin assembly according to claim 9,
characterized in that the support frame (4) has a support element (9) that is axially spaced
from the rotatable bearing ring (8) or the rotatable bearing-ring segment and bears directly
against the kingpin (2).
- 20 11. Kingpin assembly according to claim 10,
characterized in that the support element (9) is length-adjustable in the radial direction (R)
with respect to the axis of rotation (A).
- 25 12. Kingpin assembly according to either of claims 10 or 11,
characterized in that the angle sensor is arranged on or in the support element (9).
- 30 13. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle encoder is arranged on or along the circumferential surface
of the kingpin (2) or on or along the surface of the kingpin flange (6).
- 35 14. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle encoder is arranged on or along the surface of the stationary
bearing ring (7) or on or along the surface of the kingpin flange (6).
15. Kingpin assembly according to any one of the preceding claims,
characterized in that the angle sensor is arranged on or in the rotatable bearing ring (8) or
on or in the rotatable bearing-ring segment.