

Transport system

The invention relates to a transport system for moving at least one automated maintenance device for large, essentially vertical surfaces, such as ship hulls, having a monorail system which can be laid freely and at least one drive device which can be moved along one direction of movement on the monorail system.

In many areas of technology, large surfaces, for example made of steel, have to be examined and machined. In particular, ship hulls must be protected against corrosion at regular intervals by removing old paints and applying new ones. Maintenance devices such as those described in EP 2 651 754 B1 of the applicant are used for this task. These maintenance devices are usually moved on rails along these hulls in the dock facilities where vessels are inspected and overhauled. Usually the rail systems are rigid, i.e. mounted on the dock in a form-fit manner or arranged within a track bed, so that the maintenance device has to compensate for differences in the distance between the rail system and the surface to be machined. However, since the size and/or shape of the vessels vary, and there is also an increasing distance between the maintenance device and the ship hull, particularly in the bow and stern areas of the vessel, the maintenance device in such rail systems must compensate for this distance in accordance with the prior art, which makes it extremely difficult to stabilize the maintenance device during operation. Such rail systems are therefore extremely inflexible.

The maintenance devices moved on rails usually have a high dead weight. Furthermore, due to their mostly crane- or tower-like construction during maintenance work, they always have a center of gravity that shifts towards the rails and is usually located at a great distance from the base. However, this causes a large moment of force to act on the rail system, so that there is always a risk of the rail being displaced or lifted off. This subsequently leads to instability of the maintenance device, especially if it is moved along the rail.

It is therefore the object of the invention to overcome the disadvantages of the prior art and to provide a transport system that allows a repeatedly precise and controlled movement of a load, for example a maintenance device, along a freely laid rail.

This object is achieved in accordance with the invention by a transport system of the type mentioned above in that the at least one drive device has a drive unit with at least one running wheel, wherein the running wheel can be driven via at

least one preferably electric drive, and furthermore at least one pressing unit is provided, which is connected to the drive unit, wherein the at least one pressing unit has at least one loading roller which can be pressed against the monorail system via at least one spring element, and/or a fixing device is arranged on the drive unit, wherein a fixing roller which interacts with the monorail system is provided.

The drive device is designed to increase the friction between the monorail system, which is not positively anchored, and its base when travelling with a heavy load, in particular a maintenance device.

It is the object of the pressing unit according to the invention to press the rail section before and after the drive unit (seen in the direction of movement) onto the base and to prevent the monorail system from lifting off or shifting. The drive device according to the invention prevents a vertical change in position by lifting and/or a horizontal change in position in the form of displacements of the monorail system due to load acting on the monorail system. The at least one spring element of the pressing unit presses the loading roller onto the rail surface, which runs parallel to the base. The pressing unit thus acts vertically on the rail section to ensure the required stability of this rail section in the immediate vicinity of the drive unit and the maintenance device located thereon.

A fixing device is additionally or alternatively arranged on the drive unit, wherein a fixing roller is provided which cooperates with the rail for fixing the direction of the drive device according to the invention. This fixing device works essentially in one plane parallel to the base and is in contact with a rail flank in particular. An essential advantage of the fixing device according to the invention is that it prevents the rail section from turning or twisting due to high shear forces caused by the load arranged on the drive device.

In order to stabilize the position of the pressing unit on the monorail system, it is provided according to a preferred embodiment of the invention that the at least one pressing unit is in contact with the monorail system via at least one, preferably two guide wheels. These guide wheels are arranged in a plane parallel to the base and are in frictional contact with the flank of the rail section.

The at least one pressing unit is preferably in articulated connection with the drive unit. If the drive device is moved along the monorail system, the pressing unit is located in front of or behind the drive device, depending on the direction of movement. Since the monorail system laid on the base is usually not in a straight line, but follows the ship's contours, for example, the articulated

connection between the drive unit and the pressing unit allows a flexible movement of the device along a monorail system with a curved course.

The movement of the drive device on the monorail system is further improved in a further embodiment of the invention when the at least one pressing unit is connected to the drive unit via a swivel arm with one, sometimes two, swivel axes.

Controlled and safe movement of the load attached to the drive device is further improved by the fact that, in a preferred embodiment of the invention, the drive unit is additionally in contact with the monorail system via at least one, preferably two guide rollers, wherein the axis of rotation of the at least one, preferably two guide rollers is substantially normal to the axis of rotation of the running wheel of the drive unit. Thus the running wheel of the drive unit is in frictional contact with the rail surface, while at least one guide roller of the drive unit is in contact with a rail flank.

The function of the fixing device according to the invention is further improved if it has at least one, preferably two pivoting stabilizing rollers which interact with the monorail system.

In this case it is particularly preferably provided that the at least one, preferably two pivotable stabilizing rollers can be pressed against the rail section via an adjusting device, preferably via at least one hydraulic cylinder. Depending on the direction of movement, the stabilizing roller which precedes the fixing roller is pressed against the rail flank in order to improve the stability of the drive device on the monorail system.

The drive device is designed to take loads and move them via the monorail system. For this purpose, a particularly preferred variant provides that the drive device is equipped with a load-bearing device, preferably a king pin. This type of load bearing device is particularly suitable for connecting the drive device to a crane-type maintenance device because a king pin provides an additional axis of rotation which allows the maintenance device to be rotated relative to the drive device. This allows, for example, the maintenance device to be optimally aligned with the surface to be machined, for example a ship's hull.

In a further preferred embodiment of the invention it is provided that the monorail system has a plurality of rail segments, wherein preferably at least two curved rail segments are provided which have a convexly constructed rail end piece and a concavely constructed rail end piece, and in the assembled state at least one convexly constructed rail end piece of a first curved rail segment is in

articulated connection with a concavely constructed rail end piece of an adjacent second curved rail segment.

Such a modular rail system with only one rail track, on which at least one maintenance device can be moved, can be set up especially quickly and flexibly and adapted to the shape of the ship, because the individual curved rail segments can be pivoted to each other via the articulated connection and thus a suitable curved course of the rail track can be set.

In a preferred embodiment of the invention, the at least one convex rail end piece of the first curved rail segment engages in the concave rail end piece of the adjacent second curved rail segment, wherein a fitting bolt connects the two curved rail segments to one another in a pivotable manner. The assembly of the rail end pieces of the individual curved rail segments, which essentially fit perfectly, as well as the use of a fitting bolt for their connection, permits a particularly rapid assembly of the monorail system in accordance with the invention.

In order to adjust the curvature or the curve area of a track section of the monorail system according to the invention, it is provided that two set screws are preferably provided on each curved rail segment, which cooperate with a stop arranged on the adjacent curved rail segments. In order to simplify the mounting of the monorail system, the individual curved rail segments are first joined together and then, arranged on the base, are pivoted to each other via the articulated connection in order to achieve the desired curve shape of the track section.

A major advantage of this monorail system is that, due to its modular design, it can be flexibly adapted to practically any course of the track. Furthermore, no force-locked fixing of the individual rail segments to the base is provided. The positioning of the rail segments is achieved exclusively by force-locked/frictional connection, which is achieved by moving devices arranged on the monorail system, in particular maintenance devices, which are each arranged on at least one drive device in accordance with the invention.

It is provided in another preferred embodiment of the invention that additional ballast elements, preferably concrete slabs, can be arranged on at least one rail segment, and preferably on two adjacent rail segments, in order to further improve this frictional connection. Such ballast elements are also particularly advantageous at the end areas of the monorail system, which is usually not designed as a self-contained rail track, in order to prevent the rail segments located in the end area from lifting off and/or moving during operation.

In one variant of the present invention, at least one switch element is additionally provided, which allows maneuvering of the maintenance device(s) located on the monorail system.

Advantageously, at least one switch element has two switch tongues, which can be pivoted essentially parallel to each other and allow a rapid diversion of devices located on the monorail system.

The monorail system is predominantly installed outdoors, for example on ship docks. It is thus exposed to environmental conditions such as temperature fluctuations and solar radiation. As a result, the rail segments expand and shrink again, which can lead to considerable length changes when steel rail segments are used. These changes in length can in turn lead to distortions in the track run of the exposed monorail system. Therefore, preferably in addition, at least one length compensation element is provided to compensate for these changes in length caused by temperature.

In this case, the at least one length compensation element particularly preferably has two running surface elements which are separated from one another by a gap that preferably extends obliquely to the longitudinal axis of the length compensation element and which are arranged on a base element so as to be movable relative to one another. The changes in length can be absorbed by this changing gap.

The monorail system has proved to be particularly suitable for moving maintenance devices for processing essentially vertically extending surfaces, in particular ship hulls or container surfaces. As described above, it allows an individual and adaptable routing of the monorail system in order to bring a maintenance device movable on it into an optimal position to the surface to be machined, for example a ship's hull. The exclusive fixing of the monorail system to the base by means of force-locked/frictional connection enables particularly quick and flexible assembly and disassembly of the monorail system.

The transport system according to the invention has proved itself in particular for use with maintenance devices, because it allows flexible movement of automated maintenance devices in particular for processing large, essentially vertical surfaces, such as ship hulls, along exposed rails.

The object is also advantageously achieved by a maintenance system consisting of at least one maintenance device and the monorail system according to the invention, wherein the maintenance system is characterized in particular by quick assembly, adaptable routing and simple and reliable operation.

In the following, the invention will be explained in more detail using non-restrictive embodiment examples with associated figures, wherein:

- Fig. 1 shows a perspective view of the transport system according to the invention;
- Fig. 2 a sectional view of the drive device from Fig. 1;
- Fig. 3 shows a sectional view of the pressing unit from Fig. 1 and Fig. 2;
- Fig. 4 shows a second embodiment of the drive unit of the drive device in a first perspective view;
- Fig. 5 shows the drive unit from Fig. 4 in a second perspective view;
- Fig. 6 shows the drive unit from Fig. 4 in a third perspective view which is arranged on a rail section of the monorail system;
- Fig. 7 shows a schematic view of the transport system according to the invention with maintenance devices;
- Fig. 8 shows a section of the monorail system from Fig. 1 or Fig. 7;
- Fig. 9 shows a first detailed view of the monorail system from Fig. 8 on the straight rail segments;
- Fig. 10A shows a second detailed view of the monorail system from Fig. 8 on the curved rail segments;
- Fig. 10B shows a detailed view of the curved rail segments from Fig. 10A;
- Fig. 11A shows a top view of a switch element in a first position;
- Fig. 11B shows a top view of the switch element from Fig. 11A in a second position;
- Fig. 12A shows a top view of a length compensation element; and
- Fig. 12B shows a sectional view of the length compensation element from Fig. 12A.

Fig. 1 shows the transport system 1000 according to the invention in a perspective view. Here a rail-bound drive device 100 can be moved along a monorail system 200 in two directions of movement A1, A2. The drive device 100 is provided, for example, for accommodating an automated maintenance device.

The drive device 100 has a drive unit 101 with a drive 102, wherein this drive 102 is designed, for example, as an electric drive in the form of an electric motor.

To support a load, for example a maintenance device, a connecting element 110, which in the present embodiment of the invention is designed as a king pin, is arranged on the drive unit 101.

The sectional view of the rail-bound drive device 100 shown in Fig. 2 shows a running wheel 103 arranged in the drive unit 101, which is in friction contact with the rail surface 201, the upper flange (Fig. 1), and causes the movement of the rail-bound drive device 100 along the monorail system 200 via the drive 102. Since the running wheel 103 is moved substantially unguided along the sliding surface 201 as a non-profiled roller, two guide rollers 104a, 104b engaging in the rail flank 202 are provided, the axes of rotation D1 of which are substantially normal to a parallel to the axis of rotation D2 of the running wheel 103. In this way, the two guide rollers 104a, 104b stabilize the position of the running wheel 103 on the rail surface 201.

The rail-bound drive device 100 according to the invention has two pressing units 120a, 120b in this embodiment of the invention, which can be taken in detail in particular from Fig. 3. The pressing units 120a, 120b are each connected to the drive unit 101 via a swivel arm 121a, 121b. Each pressing unit 120a, 120b can be pivoted via two swivel axes S1a, S1b, S2a, S2b via the swivel arm 120a, 120b. Each pressing unit 120a, 120b also has a loading roller 122a, 122b, which is in contact with the rail surface 201. The loading roller 122a, 122b is pressed in this case onto the rail surface 201 via a spring element 123a, 123b. The spring element 123a, 123b is arranged in such a way that its longitudinal center axis, which coincides with the swivel axis S2a, S2b, stands normal to the base in order to ensure maximum transmission of force to the loading roller 122a, 122b and subsequently to the monorail system 200. This contact pressure ensures that the monorail system 200 is pressed onto the base in a stable and non-displaceable manner. An improved guidance of the pressing unit 120a, 120b is achieved by the additional guide wheels 1241a, 1241b, 1242a, 1242b of the pressing units 120a, 120b, which in turn are in contact with the rail flank 202.

If, for example, the rail-bound drive device 100 according to the invention is moved along the direction of movement A1 along the monorail system 200, which is laid on the base without additional fixation such as for example by means of bolts, then the pressing unit 120a, which moves forward in the direction of movement A1, ensures by means of the loading roller 122a, which is pressed onto the monorail system 200 via the spring element 123a, and the thus

resulting contact pressure that the monorail system 200 remains in its position on the base and is not displaced or even partially lifted from the base as a result of a load, for example a maintenance device, arranged on the rail-bound drive device 100. The second pressing unit 120b trailing in the direction of movement A1 also ensures the stability of the rail section of the monorail system 200 in the immediate vicinity of the rail-bound drive unit 100.

The pivotability of the pressing unit 120a, 120b via the swivel axes S1, S2 improves the movement of the rail-bound drive device 100 according to the invention along the monorail system 200, which usually also extends in curves.

Another embodiment of the drive device 100 according to the invention is shown in Figures 4 to 6. The drive unit 101 of the rail-bound drive device 100 according to the invention has an additional fixing device 130, which further improves the running stability of the running wheel 103 on the monorail system 200. The fixing device 130 consists of a fixing roller 131, which is arranged in a plane normal to the running roller 103, and which is also designed to be in frictional contact with the rail flank 202. Further stabilizing rollers 134a, 134b can be pressed against the rail flank 202 via one hydraulic cylinder 132a, 132b each, which is in articulated connection with an oscillating lever 133a, 133b.

The fixing roller 131 of the fixing device 130 as well as the guide rollers 104a, 104b of the drive unit 101 each lie in one plane (Fig. 4) and form a (virtual) triangle, in the center of which the running roller 103 of the drive unit 101 is arranged parallel to the base line of the triangle. The pivotable stabilizing rollers 134a, 134b of the fixing device 130 are pressed against the rail flank 202 depending on the direction of movement A1, A2 in such a way that the leading stabilizing rollers 134a, 134b are in frictional contact with the rail section of the monorail system 200 (Fig. 6).

The variant of the drive unit 101 shown in Figs. 4 to 6 can be driven with or without additional pressing units 120a, 120b, as shown in Figs. 1 to 3.

The monorail system described in the following is also part of the transport system 1000 according to the invention, which is shown in a preferred embodiment in Fig. 7. Here the monorail system 200 is arranged along a ship hull 1 in order to be able to move maintenance devices 1100 as required along the hull 1. The maintenance devices 1100 are arranged on the drive device 100 described above. According to the invention, the monorail system 200 is simply laid on the ground without additional fixation, in this case on the ship dock.

It can be seen from Fig. 8 that the monorail system 200 according to the invention is composed of a multitude of straight rail segments 210a, 210b as well

as curved rail segments 220a, 220b, 220c. The monorail system 200 is held in this case in position on the base solely by frictional engagement, wherein the weight of the maintenance devices 1100, which can be moved on the monorail system 100, in particular presses said device onto the often uneven surface.

In addition, this frictional connection is supported by ballast elements 230, preferably in the form of concrete slabs, which are detachably attached to one, preferably two, adjacent rail segments 210a, 210b, 220a, 220b, 220c. These ballast elements 230 can also be equipped with anti-slip mats arranged on their support surface.

Elongated rail segments 210a, 210b are provided for the laying of essentially straight sections, which are laid flush together with their straight rail segment ends 211a, 211b and screwed together by means of fixing screws 212 (Fig. 9). These elongated rail segments 210a, 210b have an essentially I-shaped cross-section with a bearing surface resting on the base, the lower flange 203, a rail surface preferably provided with a wear layer, the upper flange 201 as well as a web which is positioned normal to the lower flange 203 and the upper flange 201 and which forms the rail flank 202.

Curved rail segments 220a, 220b, 220c are provided according to the invention for the laying of curved sections. These curved rails segments 220a, 220b, 220c each have a convex rail end piece 221a, 221b, 221c which engages in a concave rail end piece 222b, 222c of an adjacent curve segment 220a, 220b (Fig. 10A).

According to Fig. 10A and Fig. 10B, in which the upper flange 201 of the first curved rail segment 220a was only partially shown to illustrate the articulated connection between adjacent curved rail segments 220a, 220b, 220c, a fitting pin 223 is provided, which connects the rail end pieces 221a, 222b to each other so that they can be pivoted in relation to each other. To adjust and fix the curvature of the track section, the curved rail segments 220a, 220b, 220c which are connected to each other in an articulated manner are rotated relative to each other via the longitudinal axis L1 of the fitting bolt 223 and fixed in their position relative to each other by means of set screws 224a, 224b. The set screws 224a, 224b of the first curved rail segment 220a each interact for this purpose with a stop 225a, 225b on the adjacent second curved rail segment 220b.

If both set screws 224a, 224b touch the respective stop 225a, 225b, then the two adjacent curved rail segments 220a, 220b are aligned straight to each other as shown in Fig. 10B, their respective longitudinal axes lie on a common straight line. If the two adjacent curved rail segments 220a, 220b are arranged pivoted relative to each other in order to obtain a curvature of the track section of the

monorail system, their respective longitudinal axes intersect at a predeterminable angle, wherein the first set screw 224a touches its stop 225a, while the second set screw 224b is in a position spaced from its stop 225b.

Furthermore, the monorail system 200 according to the invention has switch elements 240, as shown in Figs. 11A and 11B. The switch element 240 according to the invention has two pivoting switch tongues 241a, 241b, each of which is in articulated connection with one rail section 204a, 204b. By pivoting the two switch tongues 241a, 241b substantially parallel, either the first rail section 204a is connected to a third rail section 204c (Fig. 11A) or the second rail section 204b is connected to the third rail section 204c (Fig. 11B) and can be driven on accordingly by the maintenance device 1100 (Fig. 7).

The monorail system 200 according to the invention is usually installed outdoors, for example on ship docks, and is thus exposed to outside temperatures and at least partially to solar radiation. These often high temperatures cause a linear expansion of the monorail system 200, which may lead to bulging and/or displacement of the monorail system 200. However, this poses a significant risk to the operation of maintenance devices 1100.

Therefore, in this embodiment of the invention, additional length compensation elements 250 are provided (Figs. 12A and 12B), which are preferably arranged at regular intervals, usually in the straight line sections, between the rail segments 210a, 210b.

The length compensation element 250 is rigidly connected to the adjacent rail segments 210a, 210b via rail connection elements 251. It consists of two tread elements 252a, 252b, which are each connected to a base element 253, which rests on the base when assembled, via a screw connection 254a, 254b. These screw connections 254a, 254b are immovably screwed to the tread elements 252a, 252b, but can be moved within the base element 253 parallel to the longitudinal axis L2 of the length compensation element 250. The two tread elements 252a, 252b are arranged at a distance from each other via a gap 255. If, for example, the longitudinal extension of the rail segments of the monorail system 200 changes due to solar radiation, the distance between the tread elements 252a, 252b also changes due to the resulting compression and the gap 255 is thus reduced. Since the change in the length extension of the rail segments due to temperature fluctuations can be significant, this embodiment of the length compensation element 250 according to the invention provides that the required gap 255 extends obliquely to the longitudinal axis L2 of the length compensation element 250 in order to ensure trouble-free movement of a

running wheel 103, located on the tread elements 252a, 252b, of the previously described drive device 100 for the maintenance device 1100.

In order to lay the monorail system 100 according to the invention on a base, e.g. a ship dock, it is preferably provided that in a first step the individual rail segments 210a, 210b, 220a, 220b, 220c as well as, if necessary, switch elements 240 and length compensation elements 250 are connected to each other. The curved rail segments 220a, 220b, 220c are first joined together in a straight line and then, by adjusting the corresponding set screws 223a, 223b in the manner described above, a curved course of this section of track is obtained, for example by means of ground markings on the ground.

In a final step, ballast elements 230 may be placed at particularly vulnerable points on the rail segments 210a, 210b, 220a, 220b, 220c in order to improve the frictional connection of the monorail system 200 with the base in the corresponding areas. This is particularly necessary at the end sections 205 of the monorail system 200 to prevent the end sections 205 from being lifted off when the 200 monorail system is driven over by the maintenance devices 1100 which weigh tons. In fact, the fixation of the monorail system 200 on the base is practically achieved by the frictional locking achieved by the weight of the maintenance devices 1100.

An essential advantage of the monorail system 200 according to the invention lies in its frictional or non-positive positioning on the base, without the need for additional positive-locking measures such as screw or bolt connections with the base or complex preparations of the base, such as in the form of a track bed. This allows a quick assembly or disassembly of the monorail system 200 according to the invention on the spot, as well as a quick and easy relocation of the monorail system and, if necessary, adaptation of the rail course.

CLAIMS

1. Transport system (1000) for moving at least one automated maintenance device (1100) for large, essentially vertical surfaces, for example ship hulls (1), having a monorail system (200) which can be laid freely and at least one drive device (100) which can be moved on the monorail system (200) along a direction of movement (A1, A2), **characterized in that** the at least one drive device (100) has a drive unit (101) with at least one running wheel (103), wherein the running wheel (103) is drivable via at least one preferably electric drive (102), and furthermore at least one pressing unit (120a, 120b) is provided, which is connected to the drive unit (101), wherein the at least one pressing unit (120a, 120b) has at least one loading roller (122a, 120b), 122b) which can be pressed against the monorail system (200) via at least one spring element (123a, 123b), and/or a fixing device (130) is arranged on the drive unit (101), wherein a fixing roller (131) is provided which interacts with the monorail system (200).
2. Transport system (1000) according to claim 1, **characterized in that** the at least one pressing unit (120a, 120b) is additionally in contact with the monorail system (200) via at least one, preferably two guide rollers (104a, 104b).
3. Transport system (1000) according to claim 1 or 2, **characterized in that** the at least one pressing unit (120a, 120b) is in articulated connection with the drive unit (101).
4. Transport system (1000) according to one of claims 1 to 3, **characterized in that** the at least one pressing unit (120a, 120b) is connected to the drive unit (101) via a swivel arm (121a, 121b) with one, preferably two swivel axes (S1a, S1b, S2a, S2b).
5. Transport system (1000) according to one of claims 1 to 4, **characterized in that** the drive unit (101) is in contact with the monorail system (200) via at least one, preferably two guide rollers (104a, 104b), wherein the axis of rotation (D1) of the at least one, preferably two guide rollers (104a, 104b) is aligned substantially normally to the axis of rotation (D2) of the running wheel (103) of the drive unit (101).
6. Transport system (1000) according to one of claims 1 to 5, **characterized in that** the fixing device (130) additionally comprises at least one, preferably two pivotable stabilizing rollers (134a, 134b) which cooperate with the monorail system (200).

7. Transport system (1000) according to claim 6, **characterized in that** the at least one, preferably two pivotable stabilizing rollers (134a, 134b) can be pressed against the monorail system (200) via an adjusting device, preferably via at least one hydraulic cylinder (132a, 132b).
8. Transport system (1000) according to one of claims 1 to 7, **characterized in that** the drive unit (101) has a connecting element (110), preferably in the form of a king pin.
9. Transport system (1000) according to one of claims 1 to 7, **characterized in that** the monorail system (100) comprises a plurality of rail segments (210a, 210b, 220a, 220b, 220c), wherein preferably at least two curved rail segments (220a, 220b, 220c) are provided which comprise a convexly constructed rail end piece (221a, 221b, 221c) and a concavely constructed rail end piece (222a, 222b, 222c), and in the assembled state at least one convexly constructed rail end piece (222a, 222b, 222c) of a first curved rail segment (220a, 220b, 220c) is in articulated connection with a concavely constructed rail end piece (222a, 222b, 222c) of an adjacent second curved rail segment (220a, 220b, 220c).
10. Transport system (1000) according to claim 9, **characterized in that** the at least one convexly constructed rail end piece (221a, 221b, 221c) of the first curved rail segment (220a, 220b, 220c) engages into the concavely constructed rail end piece (222a, 222b, 222c) of the adjacent second curved rail segment (220a, 220b, 220c), wherein a fitting bolt (223) connects the two curved rail segments (220a, 220b, 220c) to one another so as to be pivotable relative to one another.
11. Transport system (1000) according to claim 9 or 10, **characterized in that** two set screws (224a, 224b) are preferably provided on each curved rail segment (220a, 220b, 220c) for adjusting the curvature of a section of track which is essentially formed from curved rail segments (220a, 220b, 220c) and which cooperate with a stop (225a, 225b) arranged on the adjacent curved rail segment (220a, 220b, 220c).
12. Transport system (1000) according to one of claims 9 to 11, **characterized in that** additional ballast elements (230), preferably concrete slabs, can be arranged on at least one, preferably two adjacent rail segments (210a, 210b, 220a, 220b, 220c) of the monorail system (200).
13. Transport system (1000) according to one of claims 9 to 12, **characterized in that** the monorail system (200) additionally comprises at least one switch element (240).

14. Transport system (1000) according to claim 13, **characterized in that** the at least one switch element (240) has two switch tongues (241a, 241b) which can be pivoted substantially parallel to one another.
15. Transport system (1000) according to one of claims 9 to 14, **characterized in that** the monorail system (200) additionally has at least one length compensation element (250).
16. Transport system (1000) according to claim 15, **characterized in that** the at least one length compensation element (250) has two running surface elements (252a, 252b) which are separated from one another by a gap (255) preferably extending obliquely to the longitudinal axis (L2) of the length compensation element (250) and which are arranged movably relative to one another on a base element (253).
17. Use of a transport system (1000) according to one of claims 1 to 8 for moving maintenance devices (1100) for processing substantially vertically extending surfaces, in particular ship hulls (1) or container surfaces.
18. Use according to claim 17, **characterized in that** the fixing of the monorail system (200) to the base, for example a ship dock, is effected exclusively by means of frictional locking.
19. Maintenance system consisting of at least one maintenance device (1100) and a transport system (1000) according to one of claims 1 to 16, **characterized in that** the at least one maintenance device (1100) is arranged on a drive device (100) of the transport system (1000) and can preferably be moved automatically on the monorail system (200).