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The moistening device (1) comprises

- a member (2) arranged to in use abut the rail (3) side-ways such that a fluid bath (20) is formed wherein a part of the top rail surface (8) forms a wall and
- a plurality of discharge channels (15) connected to the plurality of discharge ducts (12) arranged to transport the fluid from the conduit (10) to the fluid bath (20).



Description

[0001] The invention relates to a moistening device for a rail having a top rail surface comprising a contact surface for supporting railroad vehicles travelling along a travelling direction of the rail, the moistening device comprising a hollow conduit body arranged to transport a fluid along the travelling direction of the rail and comprising a plurality of discharge ducts.

[0002] The invention also relates to a rail system.

[0003] WO2013184002A1 describes a moistening device for a railroad rail. The moistening device comprises a conduit comprising a plastic hollow conduit body. In use, an abutment surface at the side of the hollow conduit body abuts a side surface of the head of a rail.

[0004] At the topside, the hollow conduit body is provided with a curved top surface. The hollow conduit body comprises a plurality of discharge ducts in the curved top surface that are upwardly inclined in the direction of the top surface of the rail head. The hollow conduit body is attached to the rail by metal clamps distributed along the travelling direction of the rail to clamp the abutment surface in a liquid tight manner against the side of the head.

[0005] In vertical direction the topside of the curved top surface is at the level of, or a few millimetres above the highest part of the rail, the contact area. As the hollow conduit body has a curved top surface, has a sidewall that in use abuts the side of the rail and the rail head itself has a convex top surface, a liquid bath is formed when fluid flows out of the discharge ducts.

[0006] The conduits are held up by a bottom surface that partially abuts a top surface of the clamp.

[0007] WO2013184002A1 further describes to flood the top surface of the rail head with the moistening system for at least one hour with an excessive supply of aqueous fluid to dissolve a layer of biological material that is already present on the top surface and to discharge it.

[0008] In practise it is difficult to achieve a liquid tight abutment of the hollow conduit body against the side of the rail. This is because the sides of rails are not perfectly flat. Therefore the abutment will not be liquid tight when applying hollow conduit bodies of nonflexible plastic material and too much water will leak out of the liquid bath. When using a flexible plastic, the abutment may be more liquid tight than with a nonflexible plastic, but at the clamps, the hollow conduit body of flexible plastic is compressed and the cross section changes shape. At such a point, the top surface of the hollow conduit body extends higher above the rail because of the changed shape of the cross section and may come into contact with wheels of vehicles, such a maintenance vehicles and may be damaged. When positioning the hollow conduit body lower to account for this risk, the top surface will be lower at positions where there is no clamp. At such positions the cross section is not changed and may not reach the highest level of the rail. As the wheels make contact with the rail at the contact surface, which is at the highest level of the rail, this will not provide a good solution against

the rail contamination.

[0009] In addition, the placement of the hollow conduit body requires much care, as the discharge ducts need to be upwardly inclined. Moreover, as the clamps are distributed over the length (i.e. along the travelling direction) of the rail, the flexible material of the hollow conduit body will flex over the length of the rail in between the clamps under the influence of gravity. This leads to the top surface of the conduit having a varying height with respect to the highest level of the rail, which is undesirable.

[0010] It is an object of the invention to provide a moistening device that at least partially solves one or more of these problems.

[0011] In a first embodiment of the invention, the object is reached by a moistening device according to claim 1.

[0012] Because the member in use abuts the rail such that a fluid both is formed, the material of which the hollow conduit body is formed does not need to abut and be pressed against the side surface to form a liquid tight abutment. The material of which the hollow conduit is formed also does not need to be suitable to function as a fluid bath wall and have sufficient height to reach the highest level of the rail and at the same time no extending too high above the rail.

[0013] Therefore, more materials are suitable for the hollow conduit body than in the prior art.

[0014] In use a fluid bath is formed because the member abuts the rail sideways. It may for instance abut a side surface of a head of the rail.

[0015] The moistening device is arranged to fill the fluid bath via the plurality of discharge channels extending from and connected to the plurality of discharge ducts.

[0016] Therefore, the discharge ducts do not need to be upwardly inclined, which makes the placement of the moistening device easy.

[0017] Advantageously, the dimensions and shape of the hollow conduit bodies do not depend on the rail. Therefore hollow conduit bodies may be produced according to only one specification (including shape and dimensions) and still be suitable for different rail types because it does not need to abut the rail. Rail types do not only vary between different types of application (for instance between rails for trains, subways and trams), but also when used for the same application. For instance, within the Netherlands for train railroads, three types of rails are used, each with a different cross-section. Also for instance, different countries may use rails for the same use with different cross sections.

[0018] As the dimensions and shape of the hollow conduit bodies does not depend on the for different rail types hollow conduit bodies known from plant irrigation systems may be used, which are well available and relatively cheap which is a important factor as many kilometres of rail may profit from the moistening device. When specially produced hollow conduit bodies are necessary, this could increase the price of the moistening device.

[0019] The moistening device may be arranged to keep

the fluid in the fluid bath and prevent that the fluid flows away in a direction along the travelling direction of the rail or at least decrease the amount of fluid that flows away in such a direction. This may be accomplished by the member comprising one or more end walls of the fluid bath perpendicular to the travelling direction of the rail.

[0020] Although gasses, such as gasses with a volumetric mass density that is larger than that of air can be used as fluid, advantageously liquids are used as fluid. Advantageously water or an aqueous solution for instance comprising antifreeze is used.

[0021] According to a second embodiment of the invention, a moistening device according to claim 2 is provided.

[0022] As the connection ducts each have an opening in the top member surface which in use forms a fluid bath wall, in use the fluid bath can be filled via the member.

[0023] According to a third embodiment of the invention, a moistening device according to claim 3 is provided.

[0024] Because the plurality of discharge channels protrudes out from the top member surface the discharge openings can in use be above the top member surface. Being above the top member surface, the chances that the discharge channels block under the influence of contamination decrease. This is because it is expected that the contamination in most cases will sink to the bottom of the fluid bath in case a liquid is used as fluid.

[0025] The skilled person will appreciate that the top member surface may in use be below the contact surface. Even while the discharge channels stick out of the top member surface, the discharge channels may still be below the maximum level. The maximum level is in use determined by the height of the contact surface because beyond that level, the fluid will pass the rail. Therefore the fluid bath can be filled without the need to protrude above the contact surface. This may be important to satisfy free space profile requirements around the rail.

[0026] According to a fourth embodiment of the invention, a moistening device according to claim 4 is provided.

[0027] As the strip forms a flexible sidewall of the fluid bath, vehicle wheels are less likely to damage the moistening device. In case the wheels come into contact with the strip, the strip may flex away. This may cause fluid to drain from the fluid bath at such a position. When the vehicle wheels have passed, the strip may flex back to its original shape such that the fluid bath can be restored at such a position by supplying a fluid to it.

[0028] According to a fifth embodiment of the invention, a moistening device according to claim 5 is provided.

[0029] Because the strip in use extends above the rail, fluid in the fluid bath is partially shielded from wind. Therefore, less fluid will evaporate from the fluid bath or be blown out of the fluid bath.

[0030] According to a sixth embodiment of the invention, a moistening device according to claim 6 is provided.

[0031] As welds are used to combine different rail parts into a rail, the sidewalls of a rail are not perfectly flat. By sealing the member and the sidewall of the rail with a

leak tight seal of flexible material, the material of the member does not have to be optimized to accommodate unevenness of the rail. The leak tight seal may for instance be a watertight seal. The seal strip may for instance be a strip of compriband.

[0032] According to a seventh embodiment of the invention, a moistening device according to claim 7 is provided.

[0033] As stated later again, herein overpressure is the positive difference between the pressure within the conduit and within the fluid bath.

[0034] In the prior art moistening device, discharge ducts close to the supply of fluid to the conduit discharge fluid. Therefore, downstream of those discharge ducts the pressure in the conduit is lower. As the amount of fluid discharged through the ducts decreases with decreasing overpressure (pressure in the conduit minus the pressure in the fluid bath) discharge ducts downstream of the discharge ducts close to the supply of fluid will discharge less fluid. As the moistening device preferably is several hundreds of meters long and comprises many discharge ducts, the expected pressure difference within the conduit is large. As it is preferred to spill as little fluid as possible because of the risk of saturating or even fluidizing the railroad track bed, the overpressure on the upstream side of the conduit must be kept low and only a limited length of rail can be moistened with the moistening device of the prior art.

[0035] Pressure compensated trickle valves are well known from plant irrigation systems and are typically used with liquids such as water at ambient temperatures. Pressure compensated trickle valves typically open above a threshold overpressure and have a flow rate that is more or less independent of the overpressure.

[0036] An advantage of the pressure compensated trickle valves is that the amount of fluid flowing into the fluid bath is more or less homogeneous along the travelling direction of the rail. This means that the moistening system can be used to moisten a longer rail than the prior art system.

[0037] In addition, this also makes the moistening device suitable for rails of inclined railroads. Even if the height of the railroad with respect to sea level varies over the length of the moistening device, i.e. along the travelling direction of the rail, by supplying a sufficient overpressure, the overpressure in the conduit can be sufficient everywhere, even at higher locations, to open the plurality of discharge channels along the complete length of the moistening device. Separate means may be used to prevent that or to limit the amount of the fluid flows away in the fluid bath along the travelling direction of the rail. As the discharge from pressure compensated trickle valves at parts of the rail at lower locations does not (or not significantly) increase with the higher pressure, this does not lead to spill of fluid at such locations.

[0038] The trickle valves may be arranged at the discharge ducts.

[0039] According to an eighth embodiment of the inven-

tion, a moistening device according to claim 8 is provided.

[0040] By forming the conduit from a plurality of hollow conduit bodies, it is possible to connect the plurality of discharge channels to the plurality of discharge ducts at a production location instead of at the rail. At the rail the first plurality of hollow conduit bodies can be connected to each other and the second plurality of sections can be placed in series along the travelling direction of the rail. This way, at the rail, both the conduit and the member can be given a desired dimension parallel to the travelling direction. Advantageously the length of the first plurality of hollow conduit bodies corresponds to the length of the second plurality of sections.

[0041] According to a ninth embodiment of the invention, a moistening device according to claim 9 is provided.

[0042] Because the first plurality of hollow conduit bodies is from flexible material, it is easy to install the moistening device at the rail even when it has a large length, i.e. a large dimension in the travelling direction. Because the hollow conduit bodies are from flexible material, a part of the moistening device may be positioned against the rail for use whereas another part may not be positioned against the rail. As a hollow conduit body may flex, a hollow conduit body from the first plurality of hollow conduit bodies in the part that is positioned against the rail may be connected to a hollow conduit body from the first plurality of hollow conduit bodies in the part that is not positioned against the rail.

[0043] To allow even larger flexibility, the first plurality of hollow conduit bodies may be connected to each other using rotatable connectors. Such rotatable connectors are well available, for instance as hose connectors. By using rotatable connectors, a first hollow conduit body of the first plurality of hollow conduit bodies and a second hollow conduit body of the first plurality of hollow conduit bodies may rotate with respect to each other around an axis running in the direction in which the conduit is arranged to transport fluid. This is convenient when installing the first plurality of hollow conduit bodies.

[0044] According to a tenth embodiment of the invention, a moistening device according to claim 10 is provided.

[0045] To prevent slipping of railroad vehicle wheels at cold weather conditions, for instance because of ice, rails, such as rails of railroad switches, are sometimes heated. To increase the effectiveness, the rails are best thermally insulated, i.e. it is advantageous to keep the heat flow from the rail to its environment as low as possible. As the complete surface of the rail may contribute to the heat flow, thermally insulating any surface of the rail may reduce the heat flow.

[0046] By using a member of thermally insulating material, no additional parts are needed to reduce the heat flow as the member abuts the rail.

[0047] The member may for instance be from polystyrene, which is a cheap product with good thermal insulation qualities and may easily be formed into a desired shape. In addition, polystyrene is very well suited for re-

cycling. The polystyrene member may be protected from damage caused by blows. The protection may be achieved by a compact, dense skin integrally formed with the polystyrene.

[0048] The member may also be arranged to insulate a body of the rail in use extending between the head of the rail and the foot of the rail. Alternatively or additionally the member may be used to insulate a foot of the rail.

[0049] According to an eleventh embodiment of the invention, a moistening device according to claim 11 is provided.

[0050] Because the member in use houses the hollow conduit body in the recess, the conduit is partially insulated. In addition, it is easy to produce and install the moistening device, as the hollow conduit body can simply be placed in the recess before the member is installed at the rail. Maintenance is simple, as the hollow conduit body and discharge channels can be reached through the open side. When installing a moistening device out of different segments, the open side also provides access to connect a plurality of hollow conduit bodies to form a conduit.

[0051] According to a twelfth embodiment of the invention, a moistening device according to claim 12 is provided.

[0052] As the hollow conduit body is arranged to conduct heat from the fluid to the rail, the moistening device may be used to heat the rail in cold weather conditions, or cool the rail in hot weather conditions. Cooling the rail may be advantageous as at increasing temperatures, the length of the rails, i.e. the dimension in the travelling direction, increases. This may cause the rails to buckle. To prevent this, the rails are very tightly fixed to sleepers. By cooling the rail, the tight fixing becomes less important or the buckling decreases.

[0053] Cooling or heating the rail is possible without large losses of the fluid, by operating the moistening device such that the hollow conduit body is supplied with a fluid at a pressure below the pressure where the pressure compensated trickle valves open. At such pressure, the pressure compensated trickle valves stay closed and the fluid does not flow to the fluid bath.

[0054] According to a thirteenth embodiment of the invention, a rail system according to claim 13 is provided.

[0055] In the rail system of this embodiment, the member does not only abut, but is connected to the rail, preferably directly. Being connected to the rail is advantageous, as it will follow the shape of the rail as much as possible even when the rail deforms under the influence of heat or cold or when supporting a railroad vehicle. The member may abut the rail by applied pressure. The pressure may be exerted by clamps attached to the rail (in which case there is an indirect connection) or by the member itself when formed around the rail including the foot of the rail. Alternatively, the member may be kept connected to the rail by glue or other means.

[0056] According to a fourteenth embodiment of the invention, a rail system according to claim 14 is provided.

[0057] The rail and further rail form a pair of rails and may in use be part of a railroad. The moistening device advantageously abuts a side of the rail that faces away from the further rail. This is because the wheels of rail road vehicles have flanges. The flanges are arranged to be between the rail and the further rail. As the member abuts the rail on a side facing away from the further rail, the member and the flanges do not touch each other.

[0058] Examples of embodiments the invention will now be described with reference to the accompanying schematic drawings. Corresponding reference symbols in the schematic drawings indicate corresponding parts. The schematic drawings are not necessarily to scale and certain features may be exaggerated to better illustrate and explain the present invention. Further, the examples are not intended to be exhaustive or otherwise limit or restrict the invention to the precise configurations shown in the drawings and disclosed in the following detailed description.

[0059] For the purpose of explaining the invention, use is made of an x-direction, a y-direction and a z-direction, which are all perpendicular and chosen in right-handed orientation. A corresponding Cartesian coordinate system is used as well.

[0060] In the following examples of the invention, the positive z-direction is a vertical upward direction, i.e. the negative z-direction is the direction of the force of gravity.

[0061] Herein "overpressure" is the positive difference between the pressure within the conduit and within the fluid bath.

[0062] Herein "travelling direction" refers to a direction in which vehicles may travel along the rail.

[0063] Herein "length" relates to the travelling direction or a dimension in the travelling direction (for instance when in use).

[0064] Figure 1 depicts a cross section of a moistening device according to the invention placed against a rail and oriented as in use, thereby forming a rail system.

[0065] An example of a moistening device (1) according to the invention comprises a member (2) of polystyrene (see figure 1). Figure 1 shows the moistening device (1) in use. The member (2) is placed against a rail (3) comprising a foot (4), a body (5) and a head (6). The head (6) comprises a contact surface (7) for contacting the wheels of a railroad vehicle such as a train. In figure 1, the locations of edges of the contact surface are indicated by dotted lines. In use, the contact surface (7) is the surface in the cross section of the rail (3) with the highest z-coordinate, i.e. it is the surface in the cross section with the highest level compared to sea level. Here, the cross section is perpendicular to the y-direction, i.e. perpendicular to a direction in which rail road vehicles may travel (a travelling direction). Obviously rail road vehicles they may also travel in the opposite direction.

[0066] Together with a further rail, the rail (3) forms a railroad. The further rail substantially runs parallel to the rail (3). The rail (3) and the further rail are fixed to sleepers that are positioned at regular distances in the y-direction.

[0067] The rail is mirror symmetric with respect to a mirror plane perpendicular to the x-direction. The contact surface (7) is part of a top surface (8) of the rail head (6). The top surface (8) is curved such that the further away from the mirror plane, the smaller the z-coordinate of the top surface (8), i.e. the further away from the mirror plane, the lower the level of the top surface (8).

[0068] The head (6) also comprises a side surface (9) facing away from the further rail. The member (2) is placed against the side surface (9), i.e. it abuts the side surface. The member (2) houses a conduit (10) that extends along the travelling direction of the rail (3). The conduit (10) comprises a hollow conduit body (11) of flexible material that is thermally conductive. The hollow conduit body (11) comprises a plurality of discharge ducts (12). At each discharge duct (12) there is a pressure compensated trickle valve (14) and the output side of each pressure compensated trickle valve (14) is connected to a discharge channel (15).

[0069] The member (2) comprises a top member surface (13) that in use faces upward (i.e. in positive z-direction).

[0070] The discharge channels (15) each lead via a separate connection duct (16) in the member (2) to a separate opening (17) in the top member surface (13) from which it may or may not protrude. The discharge channel (15) shown in figure 1 protrudes from the top member surface (13) but remains below the contact surface (7), which determines the maximum fluid level in the fluid bath (20).

[0071] The member (2) also comprises a strip (18) made from a flexible material, such as rubber. The strip (18) runs along the travelling direction of the rail (2) at an edge (19) of the top member surface (13). The top member surface (13) is positioned slightly lower than the contact surface (7). The strip (18) however extends above the contact surface (7) at a distance from the rail (3) in the direction away from the further rail, i.e. in the x-direction.

[0072] The top surface (8) of the rail (2), the top member surface (13) and the strip (18) all form walls of a fluid bath (20). A further wall of the fluid bath is formed by a side wall (21) of the member (2).

[0073] For providing a leak tight connection with the member (2), the strip (18) has a mounting part (24) that is pressed in a recess in the member (2) along the travelling direction of the rail (3).

[0074] The member (2) is pressed against the head (6) of the rail (3) with a number of clamps (not shown). It therefore abuts the side surface (9). At each sleeper one or two clamps may be placed.

[0075] A part of the side wall (21) of the member (2) perfectly fits against the side surface (9) as it has an opposite shape. The side wall (21) comprises a recess (22) housing a seal strip (23). The seal strip (23) is made from flexible material, here compriband. When the moistening device (1) is not pressed against the rail (3), the seal strip protrudes out of the recess (22). In use the seal

strip (23) is pressed against the side surface (9) of the rail (9) to provide a leak tight seal to the fluid bath (20).

[0076] The conduit (10) is also placed in a recess (24) of the member (2). The recess (24) has an open side (25) that in use faces the body (5) of the rail (3) and the head (6) of the rail (3).

[0077] To facilitate easy installation, the moistening device (1) is build from different sections that are coupled together along the rail (3). The conduit (10) comprises a first plurality of hollow conduit bodies (11) made from flexible material each forming a hose extending in transport direction. The first plurality of sections is connected to each other with rotatable connectors such as those known from gardening applications.

[0078] The rotatable connectors allow two connected hoses of the first plurality of hollow conduit bodies to rotate with respect to each other around the transport direction.

[0079] The member (2) is formed from a second plurality of sections. The second plurality of sections have flat end walls such that they may easily be placed in series along the travelling direction of the rail. Neighbouring sections of the second plurality of sections are sealed with kit or compriband.

[0080] The conduit (10) is connected to a pump that provides pressurized water at a desired pressure. Depending on the number of pressure compensated trickle valves (14) and their threshold pressure, the pump may be adjusted to bring the water above the threshold pressure.

[0081] In summer the moistening device (1) may be provided with cool water, where as in winter the moistening (1) may be provided with warm water. In the period at which there is a risk for the rail (3) becoming contaminated, the water may be water of any temperature and may be warmed to prevent solidification.

Claims

1. Moistening device (1) for a rail (3) having a top rail surface (8) comprising a contact surface (7) for supporting railroad vehicles travelling along a travelling direction of the rail (3), the moistening device (1) comprising a hollow conduit body (11) arranged to transport a fluid along the travelling direction of the rail (3) and comprising a plurality of discharge ducts (12);

characterized by the moistening device (1) comprising:

- a member (2) arranged to in use abut the rail (3) sideways such that a fluid bath (20) is formed wherein a part of the top rail surface (8) forms a wall;
- a plurality of discharge channels (15) connected to the plurality of discharge ducts (12) arranged to transport the fluid from the conduit (10)

to the fluid bath (20).

2. Moistening device (1) according to claim 1, comprising a top member surface (13) arranged to in use face upwardly and to form a wall of the fluid bath (20), wherein the plurality of discharge channels (15) runs via a corresponding plurality of connection ducts (16) in the member (2), the connection ducts (16) each having an opening (17) in the top member surface (13).
3. Moistening device (1) according to claim 2, arranged to fill the fluid bath to a maximum level, wherein the plurality of discharge channels (15) protrudes out from the top member surface (13) with a corresponding plurality of discharge openings (26) arranged to in use be above the top member surface (13) and below the maximum level.
4. Moistening device (1) according to claim 1, 2 or 3, wherein the member (2) comprises a strip (18) made from flexible material, the strip (18) in use extending along the travelling direction of the rail (3) and arranged to form a side wall of the fluid bath (20).
5. Moistening device (1) according to claim 4, wherein the strip (18) is arranged to in use extend above the rail (3).
6. Moistening device (1) according to any of the claims 1 to 5, comprising a seal strip (23) of flexible material arranged to in use provide a leak tight seal between the member (2) and the rail.
7. Moistening device (1) according to any of the claims 1 to 6, wherein the plurality of discharge channels (15) comprises a corresponding plurality of pressure compensated trickle valves (14).
8. Moistening device (1) according to any of the claims 1 to 7, wherein a conduit (10) is formed from a first plurality of hollow conduit bodies (11) that are connected to each other and the member (2) is formed from a corresponding second plurality of sections arranged to be placed in series along the travelling direction of the rail (3).
9. Moistening device (1) according to claim 8, wherein the first plurality of hollow conduit bodies (11) is from flexible material.
10. Moistening device (1) according to any of the claims 1 to 9, wherein the member (2) is made from thermally insulating material.
11. Moistening device (1) according to claim 10, wherein the member (2) comprises a recess (22) arranged to house the hollow conduit body (11), the recess

(22) having an open side arranged to face the rail (3).

12. Moistening device (1) according to claim 11 and claim 7, wherein the hollow conduit body (11) is arranged to conduct heat from the fluid to the rail (3). 5
13. Rail system comprising the moistening device (1) according to any of the claims 1 to 12 and the rail (3), wherein the member is connected to the rail. 10
14. Rail system comprising a moistening device according to any of the claims 1 to 12 or a according to claim 13, wherein the rail (3) forms a pair of rails with a further rail and wherein the moistening device abuts the rail on a side of the rail (3) facing away from the further rail. 15

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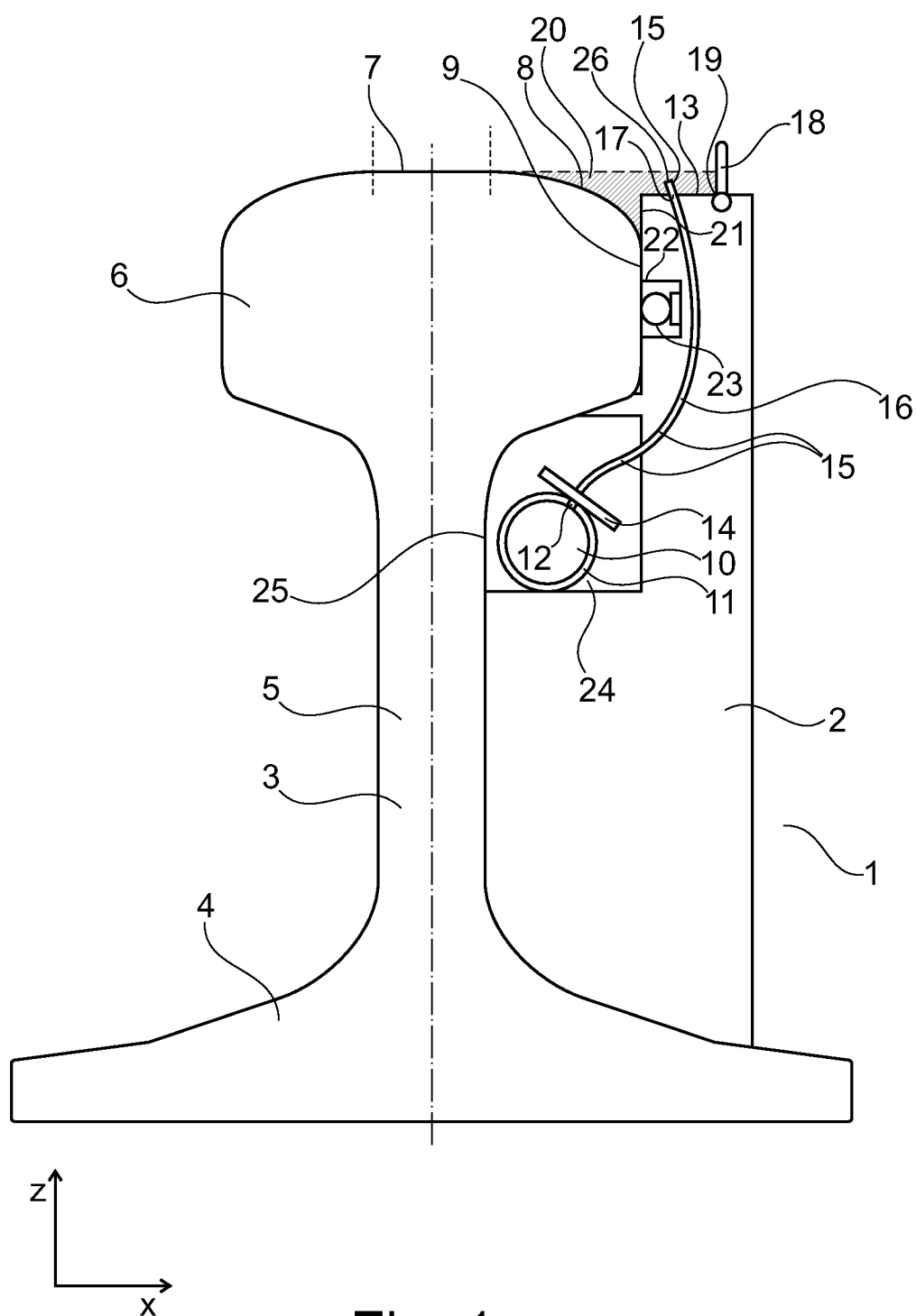
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EUROPEAN SEARCH REPORT

 Application Number
EP 14 15 6065

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A,D	----- WO 2013/184002 A1 (NS REIZIGERS B V [NL]) 12 December 2013 (2013-12-12) * figure 3a *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		29 July 2014	Schwertfeger, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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

EP 14 15 6065

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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29-07-2014

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REFERENCES CITED IN THE DESCRIPTION

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