

Description

Overhead conductor rail and overhead line system with overhead conductor rail

In order to be able to reach inner-city regions with local traffic trains, such as subways or light rail systems, or even with long-distance trains, railroad lines are frequently also laid in tunnels by necessity. In this context, the electric traction must also be ensured even in confined spatial conditions, for example in the case of small or narrow tunnel cross-sections. To this end, overhead conductor rails with low installation height are customarily used, which can be travelled over with one or also with multiple current collectors and which, depending on the design, can be used not only in tunnels, but also under bridges, on lifting bridges and in maintenance installations.

The overhead conductor rail is generally made of an extruded profile, in which a contact wire is clamped, via which the power transfer to the relevant vehicle takes place, as in the case of a conventional overhead line of an overhead line installation. The clamping connection must be electrically conductive in this case. Depending on the structural circumstances or requirements, different materials are used for the overhead conductor rails used and for the contact wire, which possibly have different electrode potentials, meaning that there is the threat of contact corrosion, whereby the overhead conductor rails are damaged, for example. In such cases, this is customarily countered by a defined application of a lubricating substance, for example a lubricant or a contact grease, between the different materials when the contact wire is pulled into the overhead conductor rail(s).

Customarily, a lubricant or contact grease of this kind generally acts as an insulator and obtains the necessary electrical conductivity through the addition of electrically conductive additives, in particular particles.

When transitioning to or from a tunnel, a transition takes place from normal, conventional overhead line operation to overhead conductor rail operation, or vice versa, in each case. Particularly when a vehicle travels out from a tunnel, when transitioning to a catenary system, i.e. when transitioning from overhead conductor rail operation to an overhead line operation with a conventional construction, tensile forces act on the contact wire outside of the tunnel, which can pull the contact wire out of the overhead conductor rail profile. Due to corresponding specifications due to increased safety requirements, as of now the overhead conductor rail or the overhead conductor rail profile must have a particular minimum clamping force, which withstands or resists a pull-out force of the contact wire out from the conductor rail, in particular overhead conductor rail, of 1.2 kN/m in the axial direction, wherein simultaneously the previous properties are not to be restricted. However, the use of overhead conductor rails with customary lubricating greases, for example contact greases in the situations for which this is necessary, with different materials, has a somewhat friction-reducing effect and thus reduces the minimum clamping force of the corresponding overhead conductor rails, meaning that in some circumstances this is no longer sufficient in order to withstand the required pull-out force of the contact wire out from the overhead conductor rail of 1.2 kN/m in the axial direction.

The object underlying the invention is to specify an overhead conductor rail with improved properties.

The object is achieved by the features of independent claim 1. Developments and embodiments of the invention are found in the features of the dependent claims.

To this end, an overhead conductor rail of an overhead line installation for guiding a contact wire with a lubricant is specified, wherein the lubricant is applied as a substantially complete, uninterrupted film at least between the contact points of the overhead conductor rail and the contact wire, and the lubricant has at least one additive, wherein the lubricant with the at least one additive causes a greater coefficient of friction with substantially unchanging electrical conductivity between the overhead conductor rail and contact wire.

By adding at least one additive to the lubricant under consideration, according to the invention the coefficient of friction between the overhead conductor rail and contact wire increases, whereby advantageously the pull-out force of the contact wire out from the conductor rail or overhead conductor rail in the axial direction increases. At the same time, despite the addition of the at least one additive, the electrical conductivity between the overhead conductor rail and contact wire remains substantially the same, whereby the quality of the conducting and/or transferring of power is kept to at least the same or comparable level and thus the quality thereof continues to be ensured.

Particularly preferably, the lubricant with the at least one additive has a greater adhesion compared to the overhead conductor rail and the contact wire. Due to the improved or

greater adhesion of the lubricant with the at least one additive compared to a lubricant without the at least one additive, the lubricant sticks to the overhead conductor rail and the contact wire in a longer-lasting manner, whereby advantageously contact corrosion due to different electrode potentials of the different materials between the overhead conductor rail and contact wire are suppressed in a long-lasting manner over a longer period of time. Moreover, the addition of the additive also influences the possibly different electrode potentials of the overhead conductor rail and the lubricant, or components, for example particles, of the lubricant, whereby corresponding potential differences are reduced, for example, and thus the formation of corrosion particles, which otherwise would engage on the material of the overhead conductor rail accordingly, is suppressed, whereby contact corrosion is also suppressed in a lasting manner in this regard. Furthermore, the resistance to environmental influences, for example the resistance to weather, in particular to humidity, also improves, whereby the corrosion protection overall during active operation extends far beyond the customary period of time.

According to a preferred embodiment of the invention, the at least one additive is/are aluminum oxide particles. Preferably, the lubricant has between 2 and 10% aluminum oxide particles. Particularly preferably, the lubricant has 5% aluminum oxide particles with a deviation of at most 10%. Due to the addition of aluminum oxide particles, for example between 2 and 10%, in particular the coefficient of friction between the conductor rail or overhead conductor rail and contact wire increases, whereby in particular the minimum clamping force of the overhead conductor rail can be improved accordingly on a successive basis, meaning that this reaches

the necessary pull-out force of the contact wire out from the conductor rail of at least 1.2 kN/m in the axial direction and can withstand this, despite the greasing, which in principle has a somewhat friction-reducing effect. With an addition of approx. 5% aluminum oxide particles with a maximum deviation in an order of magnitude of 10%, i.e. between 4.5 and 5.5%, even a minimum clamping force that corresponds to a pull-out force of the contact wire out from the overhead conductor rail of 1.5 kN/m is achieved. This far exceeds the required pull-out force, meaning that an accordingly large buffer is present during ongoing operation in order to ensure safety.

The electrically conductive connection between contact wire and conductor rail or overhead conductor rail continues to remain ensured in this context, without restriction. The adhesion improves slightly due to the addition of the aluminum oxide particles, whereby there is thus also corresponding improvement of the corrosion protection between the different materials which make up the overhead conductor rail, for example made of aluminum or an aluminum alloy, or the contact wire, for example made of copper or a copper alloy.

The threat of contact corrosion, due to the different electrode potentials of the different materials, here for example aluminum and copper, and additionally also due to the potential differences between the overhead conductor rail and lubricant, which would lead to degradation of the aluminum conductor rail or aluminum overhead conductor rail, is consequently decreased even further, in particular by means of the added aluminum oxide particles.

According to a further particularly preferred embodiment of the invention, the lubricant is applied at the contact points of the contact wire with the overhead conductor rail and to the part of the contact wire that runs within the overhead

conductor rail. As a result, the majority of the contact wire is reliably protected from weather conditions or from weather influences, whereby cost-intensive maintenance activities with interruptions to operation are at least only necessary after extended time intervals.

According to a further preferred embodiment of the invention, the lubricant applied to the contact wire has a thickness between 100 and 500 micrometers. With this, the lubricant layer is thick enough to avoid the threat of a tearing, at least in points, of the lubricant film or the contact grease, in particular on the contact points between the overhead conductor rail and contact wire, altogether or at least approximately fully. At the same time, the lubricant film is thin enough to have a disadvantageous effect, for example with regard to a significant reduction of the friction, and thus to decrease the pull-out force.

Particularly preferably, the overhead conductor rail is designed as an aluminum-alloyed extruded profile. These are particularly light and thus advantageous, in particular for installation in environments with space restrictions, for example in tunnels or under bridges, and moreover enable a high transfer of energy due to their large cross-section. They are also considered tear-proof, meaning that grounding is no longer required in the overhead line tear region. These also make it possible for only the contact wire to have to be replaced when the wear limit is reached.

Preferably, the contact wire guided by the overhead conductor rail is made of copper or a copper alloy. Due to the high electrical conductivity, this is particularly advantageous for the conducting and/or transferring of power.

Particularly preferably, an overhead line installation has at least one overhead conductor rail as claimed in one of claims 1 to 8.

In summary, the invention relates to an overhead conductor rail for guiding a contact wire as well as to an overhead line installation with at least one such overhead conductor rail, wherein the overhead conductor rail and the contact wire are made of different materials and the overhead conductor rail has a lubricant, which is applied as a, substantially complete, uninterrupted lubricant film or contact grease layer at least between the contact points of the overhead conductor rail and the contact wire, and the lubricant has at least one additive, for example aluminum oxide particles, whereby in particular the coefficient of friction between the overhead conductor rail and contact wire increases to the extent that the pull-out force of the contact wire out from the overhead conductor rail in the axial direction increases to at least 1.2 kN/m and there is a substantially unchanging electrical conductivity between the contact points of the overhead conductor rail and the contact wire. Furthermore, the corrosion protection also improves, as the adhesion of the lubricant also improves due to the addition of the at least one additive, for example aluminum oxide particles. In particular, contact corrosion between the overhead conductor rail and the contact wire due to the different materials thereof over a longer period of time is suppressed in a lasting manner as a result.

Furthermore, preferred exemplary embodiments of the invention are described in greater detail below with reference to the drawings, in which:

- Fig. 1 shows a profile of an overhead conductor rail according to the invention with clamped-in contact wire,
- Fig. 2 shows a cross-section of a contact wire with lubricant applied, and
- Fig. 3 shows an outline of an overhead line installation with the transition of a catenary system to an overhead conductor rail outside of a tunnel or an underpass.

In Figures 1 to 3, the same constituent parts are marked with the same reference numbers in each case.

Figure 1 shows a profile of an overhead conductor rail 2 according to the invention with clamped-in contact wire 3. The overhead conductor rail 2 shown in Figure 1 is made of an aluminum-alloyed extruded profile. The contact wire 3 is made of copper or a copper alloy and is clamped in the profile of the overhead conductor rail 2 by means of the clamping arms 5 and 6. Due to the different electrode potentials, which the two metals aluminum and copper have, there is normally the threat of contact corrosion, which in the present case would lead to a degradation of the overhead conductor rail 2 made of aluminum. This is prevented by the application of a lubricant 4 or contact grease, in particular at the contact points 13 and 14 between the overhead conductor rail 2 and contact wire 3, over the entire length thereof as a substantially complete, uninterrupted film when the contact wire 3 is pulled into the overhead conductor rail 2, whereby an effective corrosion protection is ensured. Moreover, in Figure 1 the lubricant 4

additionally also envelops the part of the contact wire 3 within the overhead conductor rail profile 2, above the contact points 13 and 14. This is shown in detail in Figure 2 for illustrative purposes. The lubricant or contact grease 4 shown in Figure 1 has a component of aluminum oxide particles of 5% +/- at most 10%, whereby according to the invention the coefficient of friction between the overhead conductor rail 2 and the contact wire 3 increases, and the overhead conductor rail 2, or the clamping arms 5 and 6, thus reaches/reach a minimum clamping force, which corresponds to a pull-out force of the contact wire 3 out from the overhead conductor rail 2 of 1.5 kN/m in the axial direction, meaning that the necessary or required pull-out force of the contact wire out from the conductor rail of at least 1.2 kN/m in the axial direction is exceeded by far. In line with this, an accordingly large buffer is present during ongoing operation of the overhead line installation 1 in order to ensure safety. The electrically conductive connection between contact wire 3 and conductor rail or overhead conductor rail 2 persists in this context, without restriction. The adhesion of the lubricant 4 is likewise improved by the addition of the aluminum oxide particles, whereby the corrosion protection thus correspondingly also improves further.

Figure 2 shows a cross-section of the contact wire 3 with applied lubricant 4 according to the statements from Figure 1. The contact wire 3 has the customary grooves 11 and 12 for the two clamping arms 5 and 6 of the overhead conductor rail profile 2 (which are not shown here for the sake of improved clarity), by means of which the contact wire 3 is clamped in the overhead conductor rail profile 2 according to Figure 1. By clamping the contact wire 3 by way of the clamping arms 5, 6, the contact points 13 and 14 are produced automatically, at

which the contact wire 3 and the overhead conductor rail 2 would touch directly without the lubricant or contact grease 4. As shown in Figure 2, the lubricant or contact grease 4 covers the contact wire 3, in particular over the entire length of the overhead conductor rail(s) 2 along the contact points 13 and 14, whereby contact wire 3 and overhead conductor rail 2 do not touch directly, but rather they are separated by the lubricant 4. It is thus ensured that the two different materials aluminum and copper do not touch and, accordingly, are also protected from contact corrosion. Moreover, the lubricant or contact grease 4 additionally covers the upper hemispherical subregion of the contact wire 3 between the contact points 13 and 14 and extends just slightly downwards beyond the contact points 13 and 14, whereby the majority of the contact wire 3 is also reliably protected against weather conditions or from weather influences and corrosion media, and as a result cost-intensive maintenance activities are at least only necessary after extended time intervals.

The lubricant 4 applied to the contact wire 3 has a thickness between 100 and 500 micrometers, whereby the lubricant layer 4 is thick enough in order to avoid a tearing, at least in points, of the lubricant film or the contact grease 4, in particular on the contact points 13 and 14 between the overhead conductor rail 2 and contact wire 3, but at the same time is also thin enough in order not to have any negative effects, for example with regard to a significant reduction of the friction, and thus in order not to decrease the pull-out force accordingly.

Figure 3 shows an outline of an overhead line installation 1 with the transition 20 of a catenary system 9 to an overhead

conductor rail 2 according to the invention in the region of a tunnel or an underpass 15.

Outside of the tunnel 15, the overhead line installation 1 shown by way of example in Figure 3 is designed with a conventional construction with a catenary system 9, support cable 8, which is guided at a height h above the contact wire 3, and the support cable 8 is connected to the contact wire 3 by means of a dropper 10. The transition region 20 for operation by means of overhead conductor rail 2 within the tunnel or an underpass 15 begins, by way of example, with the entry in front of it, and ends with the exit from it accordingly. Furthermore, the pull-out force F_{pull} is shown, which acts in the axial direction of the contact wire 3 and tries to pull the contact wire 3 out from the overhead conductor rail 2.

Claims

1. An overhead conductor rail (2) of an overhead line installation (1) for guiding a contact wire (3), wherein the overhead conductor rail has a lubricant (4) and wherein the overhead conductor rail (2) and the contact wire (3) are made of different materials,

c h a r a c t e r i z e d i n t h a t

the lubricant (4) is applied as a, substantially complete, uninterrupted film at least between the contact points (13, 14) of the overhead conductor rail (2) and the contact wire (3), and the lubricant (4) has at least one additive, wherein the lubricant (4) with the at least one additive causes a greater coefficient of friction with substantially unchanging electrical conductivity between the overhead conductor rail (2) and the contact wire (3).

2. The overhead conductor rail (2) as claimed in claim 1,

c h a r a c t e r i z e d i n t h a t

the lubricant (4) with the at least one additive has a greater adhesion compared to the overhead conductor rail (2) and the contact wire (3).

3. The overhead conductor rail (2) as claimed in claim 1 or 2,

c h a r a c t e r i z e d i n t h a t

the at least one additive is aluminum oxide particles.

4. The overhead conductor rail (2) as claimed in one of the preceding claims,

c h a r a c t e r i z e d i n t h a t

the lubricant (4) has between 2 and 10% aluminum oxide particles.

5. The overhead conductor rail (2) as claimed in one of the preceding claims,

c h a r a c t e r i z e d i n t h a t

the lubricant (4) has 5% aluminum oxide particles with a deviation of at most 10%.

6. The overhead conductor rail (2) as claimed in one of the preceding claims,

c h a r a c t e r i z e d i n t h a t

the lubricant (4) is applied at the contact points (13, 14) of the contact wire (3) with the overhead conductor rail (2) and to the part of the contact wire (3) that runs within the overhead conductor rail (2).

7. The overhead conductor rail (2) as claimed in one of the preceding claims,

c h a r a c t e r i z e d i n t h a t

the lubricant (4) applied to the contact wire (3) has a thickness between 100 and 500 micrometers.

8. The overhead conductor rail (2) as claimed in one of the preceding claims,

c h a r a c t e r i z e d i n t h a t

the overhead conductor rail (2) is designed as an aluminum-alloyed extruded profile.

9. The overhead conductor rail (2) as claimed in one of the preceding claims,

c h a r a c t e r i z e d i n t h a t

the contact wire (3) guided by the overhead conductor rail is made of copper or a copper alloy.

10. An overhead line installation (1) with at least one overhead conductor rail (2) as claimed in one of claims 1 to 9.