

Description

The invention relates to an arrangement for controlled guidance of a wheel set or of a bogie of a rail vehicle as it passes over a switch, wherein the conical wheels are each supported in a wheel contact point on the stock rails, and the stock rail of the main track and branch track, which form an angle, is rigid and the switch blades are pivotable.

In the region of switches, undesirable wear of the wheel flanges occurs, and hence there is associated abrasion of the flanks on the travel-edge sides of the leading ends of the blades. This in turn inevitably leads to intensive maintenance and frequent replacements of the corresponding parts, whose costs on the superstructure sector are considerable.

It would therefore be desirable to create, in the region of a switch, conditions as similar as possible to those on the track, whereby wear would be reduced, and simultaneously, travel comfort would be increased.

It is therefore the object of the present invention so to form an arrangement of the type described above that, in the transition region between the stock rail and the blade, a substantially pure rolling motion, but no abrasive motion, takes place between the wheel and the rail, and at the same time optimum travel comfort is to be ensured. This is to be achieved independently of the radius of the switch.

The object is substantially achieved according to the invention in that at least the course of one stock rail deviates from the basic course in the region of the

switch, in such a manner that the wheel contact point is actively modified for the controlled alignment of the wheel axis or bogie axis with the longitudinal axis of the track or the angle bisector extending between the main track and branch track, so that abrasive motion between the wheel and rail is substantially avoided. 'Basic course' refers in this case to the course of the stock rail in the case of conventional switch geometries and lay-outs. At least the stock rail, be it in the main or in the branch track, of the main direction of travel deviates from this. But preferably, both stock rails deviate from the basic course, which results in guidance away in an outward direction, i.e. away from the respective track axis.

The alignment of the wheel set with the longitudinal axis of the track or the angle bisector extending between the main track and branch track, depends on which direction of travel is given priority. If both the main track and the branch track are to be used equally, the change in course is so oriented that the wheel set is substantially adjusted to the angle bisector in such a manner, i.e. approximately perpendicular to said bisector, as to avoid abrasive motions to be prevented according to the object. By changing the stock rail course from the conventional basic course of a switch constructed according to the prior art, the advantage is gained that the wheel contact point is actively modified, in such a manner that conditions similar to those of the track are ensured for the wheels, so that the wheel contact points, which normally change during travel over a switch, and the resulting changes in the angular velocity, are avoided.

The bulges themselves may consist of rectilinear sections which describe angles relative to one another, and which pass continuously one into another.

By the arrangement according to the invention, the advantage is gained that switches can be passed over at high speeds without causing wear which may lead to premature damage. In particular, it is ensured that the wheel flange runs up against the blade as little as possible. Consequently, conditions similar to those on the track are established early in the transition region between the stock rail and the blade rail. The travel comfort is not affected in any way by the arrangement according to the invention, but rather, travelling conditions are created which correspond to those on a normal track. In this case, it is not important from which direction a switch is crossed, since there is a constant transition between the blade and the stock. Therefore, the arrangement according to the invention and the associated formation of the switch is not comparable with a blade known from the prior art. In a corresponding construction, as is known, a step is formed between the stock rail and the blade rail, so that not only in this region is there considerable wear, but also, problem-free travel is only possible from one direction. Additionally, this arrangement gives no controlled modification of the wheel contact point, so that furthermore, the wheel flange runs up against the blade for an undesirably long time.

The proposed solution according to the invention, which is distinguished by guidance of the stock rail away from the direction of the rail strand conventionally prescribed according to the prior art (basic course), and ensures that undesirable wandering of the wheel contact point, i.e. rotation of the wheel set relative to the track axis, is suppressed, is not comparable with a stub switch either, which is distinguished by a movable stock rail. Apart from the fact that such a construction is elaborate and expensive, it is not possible to support the blade well on the movable stock rail, so that the use of such stub switches is unsuitable for high speed lines in

particular. Furthermore, a butt joint is formed, which considerably impairs the travel comfort.

Also, the change of course of the stock rail is not comparable with the widening of track in switches of small radius. In order to ensure bogie mobility in this case, sufficient space must be available. Therefore, in switches of small radii, widening of the tracks must be carried out, which also continues into the switch, without thereby giving controlled modification of the wheel contact point. In other words, there is no controlled guiding of the axis, so that an abrasive motion still occurs between the wheel flange and the blade. Widening in this case has no controlled effect on the wheel contact point.

The teaching according to the invention duly provides an arrangement in which the wheel contact point is so modified that, in the centre, a right-angle is formed between the wheel axis and the desired track axis, whether the main track or branch track, or the angle bisector extending between these two, independently of the diameter of the switch. This ensures, independently of whether the rail vehicle is travelling on the main track or branch track, that the switch can be crossed at high speed without causing noticeable wear of the wheel flange and blade. Consequently, in the transition region between the stock rail and the blade rail, conditions are created which are similar to those on the track, and which are intended in particular for high-speed switches.

The invention is distinguished in particular in that the change of course of one of the stock rails always takes place substantially at the start of the curve of the switch. Thus in the case of large-arc switches with a radius of curvature $r_1 > 500\ 000$ mm, the change of course

of the branch track takes place in the start of the curve, and the change of course of the main rail takes place in or after the start of the curve, whereas in a small-arc switch with a radius of curvature $r_2 < 500\ 000$ mm, the change of course of the main track takes place in the start of the curve, and the change of course of the branch track takes place before the start of the curve.

Further, optimum travel conditions are created in the switch if the end x of the change of course in the main track is made after the start of the curve, as a function of the radius of curvature R and the head breadth F of the stock rail. Thus the end x of the change of course in a switch substantially following an arc is calculated according to the equation

$$x = \sqrt{R^2 - (R-y)^2}$$

where $y=c.F$, in which case $0.5 \leq c \leq 1$ should apply. From these equations, for example for a switch with a radius of curvature $R=7\ 000\ 000$ mm and a head breadth F of 72 mm with $c=1$, the end point x from the start of curvature is calculated as $x=31\ 749$ mm.

Alternatively to the change of course of the stock rail, the wheel contact point modification can be carried out in a controlled, purposeful manner in that the cross-section of at least one stock rail is so changed in the region of the switch relative to the cross-section outside the switch that the wheel contact point is actively modified for the controlled alignment of the wheel axis or bogie axis with the longitudinal axis of the track or angle bisector, in such a manner that an abrasive motion between the wheel and rail is substantially avoided. In particular, it is possible that, in a controlled manner, for changing the possible wheel contact point, the profile of the stock rail is flattened towards

the blade, or that for the controlled change of the wheel contact point the vertical axis of the stock rail is inclined.

Further details and advantage of the invention will appear from the claims and from the features to be deduced therefrom, either separately and/or in combination.

Further details, advantages and features of the invention will appear from the following description of examples to be deduced from the drawing, in which:

Fig. 1 shows a plan view of a detail of a switch according to the prior art,

Fig. 2, a section diagram along the line II-II in Fig. 3, enlarged,

Fig. 3, a detail of a first embodiment of a switch according to the invention,

Fig. 4 a section diagram along the line IV-IV in Fig. 3,

Figures 5 to 7, various embodiments or arrangements of a stock rail,

Figures 8 to 13, plan views of details of further embodiments of switches constructed according to the invention,

Fig. 14, a basic diagram of the course of a wheel axis in the transition region from the stock rail to the blade rail according to the prior art,

Fig. 15 a corresponding basic diagram according to the teaching of the invention,,

Fig. 16, stock rails formed according to the invention with adjacent switch blades,

Fig. 17 a large-arc switch, formed according to the prior art,

Fig. 18, a large-arc switch, formed according to the invention,

Fig. 19, a small-arc switch according to the prior art and,

Fig. 20, a corresponding switch formed according to the invention.

Fig. 1 shows a detail of a switch known from the prior art, comprising stock rails (10), (12), with associated blades (14) and (16), which optionally abut one of the rigidly- formed stock rails (10) and (12), according to whether the main track (18) or the branch track (20) is to be used. It is not necessary to go into further details of the switch in the present case, since hitherto known structural features concerning, e.g. the slide chair or the cross frog tip can be used.

In the embodiment, the main track (18) is to be used by a rail vehicle. The example shows a wheel set (22) with wheels (24) and (26), which in turn each have a wheel flange (28) and (30). It can be further seen that the wheels (24) and (26) are conically formed, i.e. decrease in diameter towards their ends. The wheel (24) touches the stock rail (10) in the wheel contact point (46), whereby an active diameter of the wheel D_1 becomes noticeable. The wheel (26) located in the transition region between the stock rail (12) and the blade rail (16) touches the stock rail (12) in a wheel contact point (44) in order to be supported on the blade rail (16) during

further motion in the direction of the main track (18). The wheel contact point (44) has an active diameter D_2 . Since D_1 and D_2 differ from one another, the axis (22) makes a pivoting motion, which inevitably causes the wheel flange (30) to rest abrasively on the inner flank of the blade rail (16), causing considerable wear. Due to this, travel conditions occur which do not correspond to those of the normal track. In addition, the travel conditions depend on whether the switch is to be travelled over in the main track or the branch track (18) and (20) respectively.

It is therefore proposed according to the invention, so to form the stock rails (10) and (12) that a change in the wheel contact point is produced in a controlled manner, such that the wheel axis is adjusted substantially perpendicular to the axis of the main track or the branch track. Consequently, abrasive sliding of the wheel flange along the blade rail is suppressed. This not only improves travel comfort, but at the same time, switches formed in this manner can be travelled over at relatively high speeds. Consequently, conditions similar to those on the track are present within the transition region between the stock rail and the blade rail.

Fig. 3 shows a first embodiment of a switch arrangement according to the invention. In this case elements - as in the description below - corresponding to those in Figures 1 and 2 are provided with the same reference numbers. The blade rails (14) and (16) are associated with stock rails (32) and (34), which are guided outwards, away from the original direction in the region of the blade leading edges (38) and (36) of the blade rails (14) and (16), i.e. in the region of the blade leading edges. The stock rails (32) and (34) consequently have bulges in their regions (40) and (42), in which the blade leading edges (36) and (38) respectively abut the stock rails (32)

and (34) and pass continuously into these. Due to the bulges (40) and (42), the wheel contact point (48) is modified in a controlled manner on the stock rail (32) while the rail vehicle is passing over the region (40), in such a manner that an active rolling diameter D_3 is produced. With an equal diameter D_3 , the wheel (26) rests on the stock rail (12) (reference 50), so that it is thereby ensured that the axis (22) runs substantially perpendicular to the longitudinal axis (52) of the track. This in turn has the effect that the wheel (26) rolls only on the stock rail (34) and then on the blade rail (16) without grinding laterally against the latter.

To be precise, the axis (22) does not remain constantly at a right-angle to the main longitudinal axis (52) of the track during passage through the region (40) and (42). Rather, it produces a kind of sinusoidal motion, i.e. the angle is temporarily larger and temporarily smaller than 90° , without any abrasion of the lateral flank of the blade.

To clarify the facts described in Figures 1 and 2, respectively 3 and 4, it is shown in a simplified manner in Figures 14 and 15 how the wheel (24) or (26) runs with the wheel flange (28) or (30) relative to the stock rails (10) and (12) or (32) and (34) and the right-hand blade rail (16) to be passed over subsequently. Fig. 14 in this case corresponds to the diagram according to Fig. 1. It can be seen that, due to the normally extending stock rail (12), the wheel contact point (46) of the wheel (26) on the stock rail (10) is changed, bringing about pivoting of the axis (22) relative to the longitudinal axis (52) of the main track. This has the result that the wheel flange (30) grinds along the blade rail (16) (indicated with broken lines).

In contrast to this, according to Fig. 15, the stock rail (32) or (34) respectively is guided outwards away from the blade rails (14) and (16), so that by controlled modification of the wheel contact point (48) and (50) respectively the axis (22) remains in the centre perpendicular to the longitudinal axis (52) of the main track (18), thus producing an almost rectilinear motion of the wheel flange (28) and (30) respectively relative to the normal direction of the stock rail (32), and hence to the blade rail (16). Consequently, the wheel flange (30) does not abrade, or only causes negligible abrasion to, the side flank of the blade rail (16), so that signs of wear are suppressed and conditions which are almost entirely similar to those on the track are created in the transition region.

Although in Fig. 3 and 15 respectively the controlled modification of the wheel contact point (48) and (50) respectively is achieved by local guidance away from the normal direction specified in front of and behind the blade end (36), (38), other structural means are provided for achieving the same effect. Thus, according to Fig. 5, it is possible that the rail head (54) of a stock rail (56) be so formed that the travel surface is reduced, and hence the area of the wheel contact point is narrowed. This also ensures that the wheel axis runs substantially perpendicular to the line axis to be travelled along, i.e. to the longitudinal axis of the main track or the branch track.

According to Fig. 6, the travel surface is limited by inclining one stock rail (58). This may optionally be achieved by a special formation of the rail foot or of the base. In this case also, the wheel contact point can be made to remain substantially unchanged on the stock rail (58), so that due to the unchanged wheel diameter during rolling, pivoting of the wheel set is suppressed.

Fig. 7 shows that, according to Figures 3 and 15 respectively, a stock rail (60) is guided away outwards in the region of the blade leading edge.

Figures 8 to 13 show further embodiments of switch regions formed according to the invention, whereby conditions similar to those on the track are formed in the transition region from the stock rail to the blade rail, which ensure that the wheels (24) and (26) substantially perform a pure rolling motion and do not abrade the flanks of the associated blade rails (14) and (16) respectively with their wheel flanges (28) and (30) respectively. Thus in Fig. 8, stock rails (62) and (64) are guided outwards, away from the normal direction in the region of blade leading edges (70) and (72) indicated by dot-dash lines (66) and (68), i.e. before and after the blade leading edges (70) and (72) the stock rail (62) and (64) respectively has the conventional direction indicated, as mentioned, by the lines (66) and (68). In this case, the bulges (74) and (76) are formed symmetrically to the centre line running between the stock rails (62) and (64).

In Fig. 9, the bulge (74) of the stock rail (62) corresponds to the one in Fig. 8, whereas the stock rail (64) has a bulge (78) whose longitudinal extension is greater than the bulge (74). The associated blade rail (80) is correspondingly matched.

Fig. 10 again shows a symmetrical formation of bulges (82) and (84) of stock rails (86) and (88). The same applies to the example of Fig. 13, in which case the bulges (90) and (92) are brought forward to the start of the switch and the associated blade leading edges (94) and (96) begin shortly after the start of the switch, in order that the controlled modification of the wheel contact point can be carried out as early as possible.

In Figures 11 and 12, bulges (102) and (104), or (106) and (108) respectively are asymmetrical relative to the centre line running between the stock rails (98) and (100), in order to take into account desirable conditions, e.g. in terms of the switch radius, the line guiding or the speed at which the switch is to be crossed.

Finally, it should be mentioned that the features according to the invention described above can, and are, realised accordingly in passage through the branch track.

The essential features characterising the invention are to be described again with the aid of Figures 16 to 20, which partly give a comparison with the known constructions according to the prior art.

Fig. 16 shows the stock rails (150) and (152) formed according to the invention, which blade switches (154) and (156) respectively abut. In this case, in the upper part of the diagram the rail vehicle is to travel on the branch track, and in the lower part, on the main track. It can be seen that the front end (158) and (160) respectively of the switch blade (154) to (164) rests in a bulge (162) and (164) respectively in the stock rail (150) and (152) respectively. The bulge, i.e. the deviation from the basic course of the stock rail (150) and (152) respectively indicated by the straight line (166) and (168) respectively ensures that the wheels substantially effect in the switch region a pure rolling motion, and not an abrasive motion, whereby undesirable wear, leading to high costs, would take place on the track material and the wheels. These differences are clearly visible from Figures 17 and 19 (prior art) compared with the diagrams in Figures 18 and 20. It should be noted here that the diagrams are purely elementary, without indicating conditions corresponding even approximately to the actual embodiments.

Fig. 17 shows a detail of a large-arc switch (R being preferably larger than 500 000 mm) according to the prior art. In this case, the rail vehicle is to travel over the main track, which is specified by the stock rail (170) and the switch blades (174) abutting the opposite stock rail (172). The opposite switch blade (176) is thus spaced from the stock rail (170). If a rail vehicle with wheels (178) and (180) is then to travel over the main track, the wheel axis (182) tends to deviate from the position in front of the switch describing a right-angle to the main axis (184) of the main track, i.e. to assume an angle α , where $\alpha < 90^\circ$. Consequently, the wheel flange (182) of the wheel (180) grinds along the switch blade (174). This abrasion is at first increased, since the wheel contact point of the wheels (178), (180) is so altered on the travel surfaces of the stock rail (170) and the stock rail (172) and the switch blade (174) respectively that the active rolling diameter of the wheel (178) increases relative to that of the wheel (180) and thus covers a greater distance.

According to the invention, therefore, the stock rail (170) is preferably guided outwards away from the basic course in or after the start of curvature of the switch, in order to form a bulge (188), which ensures that the axis (182) tends to describe a right-angle relative to the longitudinal axis (184) in each case in front of and in the region of the switch. This produces a modification of the wheel contact point, such that the wheel flange (186) exerts no abrasive motion along the switch blade (174). Rather, a pure rolling motion is substantially carried out in the region of the switch formed according to the invention.

The stock rail (172) of the branch track also has a corresponding bulge (190) in order to ensure that, when the rail vehicle is travelling on the branch track, a

substantially pure rolling motion and no abrasive motion of the wheel flange (192) takes place along the switch blade (176).

In case of the large-arc switch shown, the change of course of the stock rail (170) of the main track preferably starts in or after the beginning of curvature, whereas the change of course of the stock rail (172) of the branch track is to take place in the beginning of the bulge.

Figures 19 and 20 show a detail of a small-arc switch with a radius of curvature R_2 of preferably $R_2 < 500\,000$ mm. In the prior art (Fig. 19), abrasive motion of the wheel flange (192) obviously takes place at the moment when the wheels move on to the branch track, since the wheel axis (182) further tends to adopt a substantially right-angle to the longitudinal axis (184) of the main track. According to the invention, a change of course takes place from the basic course shown by the course of the stock rails (170) and (172) according to Fig. 19, in that the stock rails (170) and (172) are guided locally away in an outward direction. This causes the change of course of the stock rail (170) of the main track in the start of the curve and the change of course of the stock rail (162) of the branch track before the start of the curve, which is indicated by the arrow referenced R_2 . By corresponding changes in course, it is ensured that the wheel flange (192) makes no abrasive motion relative to the switch blade (176), but effects a substantially pure rolling motion. This is effected by the changes in course (bulges (194) and (196)) of the stock rails (170) and (172), whereby again a controlled modification of the wheel contact points of the wheels (178) and (180) takes place, in such a manner that the wheel axis (182) tends to describe an angle β relative to the longitudinal axis (198) of the branch track, where β is approximately

equal to 90°. Obviously, the deviations from the basic course of the stock rails can be so selected that the wheel axis (182) is set substantially on the angle bisector between the axes (184) and (198), according to whether one track is to have priority or both tracks are to have equal priority.



Claims

1. Arrangement for controlled guidance of a wheel set or of a bogie of a rail vehicle as it passes over a switch, wherein the conical wheels (24, 26) are each supported in a wheel contact point (44, 46) on the stock rails, and the stock rail (10, 12) of the main track and branch track (18, 20), which form an angle, is rigid and the switch blades (14, 16) are pivotable, characterised in that at least the course of one stock rail deviates from the basic course in the region of the switch, in such a manner that the wheel contact point (44, 46) is actively modified for the intended alignment of the wheel axis or bogie axis with the longitudinal axis of the track or the angle bisector extending between the main track and branch track, so that abrasive motion between the wheel and rail is substantially avoided.
2. Arrangement according to claim 1, characterised in that the change of course of the stock rail is effected by guiding out of the track axis.
3. Arrangement according to claim 1, characterised in that the change of course (190, 194) of one stock rail (172, 170) is effected in the start of curvature (R) of the switch.
4. Arrangement according to claim 3, characterised in that, in the case of a large-arc switch (Fig. 18) with a radius of curvature r_1 , where $r_1 > 500\,000$ mm, the change of course (190) of the stock rail (172) of the branch track takes place in the start of the curve, and the change of course (188) of the stock rail (170) of the main branch takes place in or after the start of the curve.



5. Arrangement according to claim 3, characterised in that, in the case of a small-arc switch (Fig. 20) with a radius of curvature r_2 where $r_2 < 500\ 000$ mm, the change of course (194) of the stock rail (170) of the main track takes place in the start of the curve, and the change of course (196) of the stock rail (172) of the branch track takes place before the start of the curve.

6. Arrangement according to claim 1, characterised in that the end x of the change of course in the main track after the start of the curve depends on the radius of curvature R and the head breadth F of the stock rail of the main track.

7. Arrangement according to claim 6, characterised in that the end x of the change of course is calculated according to

$$x = \sqrt{R^2 - (R-y)^2}$$

where $y=c.F$, and $0.5 \leq c \leq 1$.

8. Arrangement for controlled guidance of a wheel set or of a bogie of a rail vehicle as it passes over a switch, wherein the conical wheels (24, 26) are each supported in a wheel contact point on the stock rails (10, 12), and the stock rails of the main track and branch track (18, 20), which form an angle, are rigid and the switch blades (14, 16) are pivotable, characterised in that the cross-section of at least one stock rail is so changed in the region of the switch relative to the cross-section outside the switch that the wheel contact point is actively modified for the controlled alignment of the wheel axis or bogie axis with the longitudinal axis of the track or angle bisector extending between the main track and branch track, in such a manner that an abrasive motion between the wheel and rail is substantially avoided.



9. Arrangement according to claim 8, characterised in that in order to change the wheel contact point, the profile of the stock rail (56) is flattened towards the point.

10. Arrangement according to claim 8, characterised in that for the controlled modification of the wheel contact point, the vertical axis of the stock rail (58) is inclined.

11. Arrangement according to claim 8, characterised in that the blade leading edges (70, 80) interact with the stock rails (62, 64) in spaced cross-sectional faces of the switch.

12. Arrangement according to at least claim 1, characterised in that the bulges are formed by rectilinear track sections describing angles relative to one another.

13. Arrangement according to at least claim 1, characterised in that the depth of the bulge moves between 5 and 30 mm.