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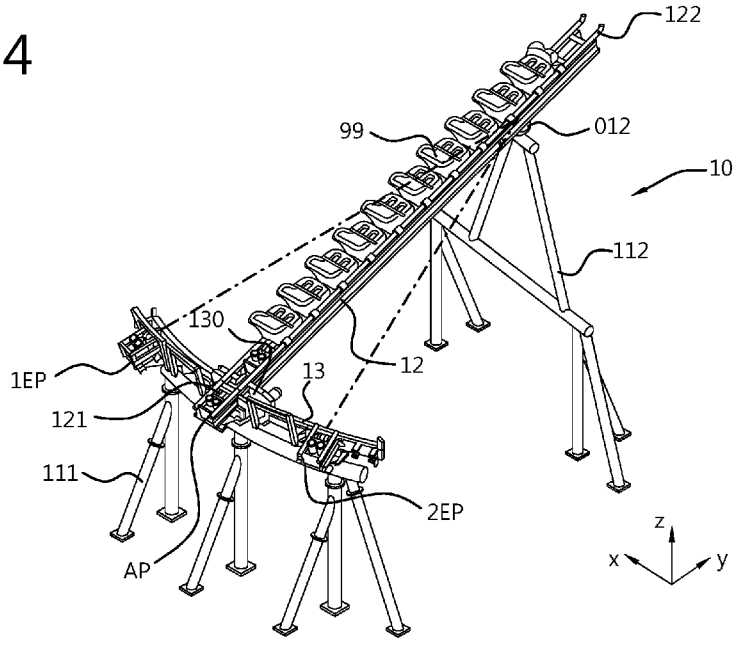
(54) **Title:** ROLLERCOASTER SWITCH BACK FOR A REVERSE RIDE ON TRAJECTORY SEGMENT TRACK.

Fig. 4



(57) **Abstract:** Rollercoaster comprising a reverse track switch device including a dead-end track section which is movable between at least three switch positions. The three switch positions include an entrance position and at least two exit positions. The exit positions are in alignment with a first and second trajectory segment. On one trajectory segment, passengers enjoy a backwards ride, whilst on the other trajectory segment a forward ride is made. The separate two exit positions are beneficial in that a single reverse track switch device may suffice to obtain a spectacular rollercoaster trajectory including a reverse riding trajectory segment.

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Title: Rollercoaster switch back for a reverse ride on trajectory segment track.

The invention relates to a reverse track switch device, a so called switchback, for reversing a riding direction of a ride vehicle of a rollercoaster on a trajectory. The trajectory includes a trajectory segment along which the ride vehicle travels in an initial riding direction. To reverse the riding direction, the switchback comprises a dead end track section which is configured to receive and return the ride vehicle. The dead-end track section is movable from an entrance position to an exit position to receive the ride vehicle coming from a first trajectory segment to subsequently let the ride vehicle run onto a second trajectory segment in the reverse riding direction.

EP3265193B1 discloses an embodiment of such a track switch device including a pivotable dead end track section having a first end and a second end. The dead end track section communicates with an entry rail section in a first position and is pivotable about a horizontal axis to an exit rail section in a second position.

CN103505878 discloses a so called track-changing aligning structure for an amusement system including a rotatable track with a drive device, a first and second fixed track. The driving device is arranged to provide a connection of the movable track to one of the fixed tracks. The movable track is rotationally supported by a pillar. The movable track has an open end allowing a vehicle to enter or exit the rotatable track and a closed end including a pair of stoppers. In operation, a vehicle originating from the first fixed track enters and stops on the rotatable track. Subsequently, the rotatable track rotates about 90° to couple to the second fixed track. Thereafter, the vehicle leaves the rotatable track in a reverse manner to continue the ride on the second fixed track.

EP3171952 B1 discloses in fig. 2 a motivating portion of a ride attraction path. The motivating portion includes a fixed dead-end track, a fixed entrance track, and a fixed launch track. A track switch is provided including a curved transfer track, and a straight transfer track. In operation, a ride vehicle approaches via the entrance track and drives onto the dead-end track. A braking system causes the ride vehicle to stop and park on the dead-end track. While being parked, the track switch is operated to switch from the entrance track to the launch track. Once the straight transfer track is in place, a launch room vehicle starts propelling the ride vehicle backwards to launch the ride vehicle on the launch track. From here, the ride vehicle continues the ride.

In addition to this track switch, another arrangement is needed to reverse the ride direction of the ride vehicle for a second time to get the ride vehicle back in the initial ride direction and ready for a next ride with a next group of passengers. Such a reversal can for example be carried out by a reverse track section including a switch in the trajectory close to the a passenger station.

A backwards ride along a trajectory segment contributes to a thrill experience of the passengers, but has a technical disadvantage in that it may require costly arrangements to obtain the required reversals. These arrangements may necessitate a serious initial capital investment and increase operational complexity of the rollercoaster attraction.

Regarding the above-mentioned prior art, it is remarked that any discussion of documents, acts, materials, devices, articles or the like included in the present specification is for the purpose of providing a context for the present invention, and is not to be taken as an admission that any such matters form part of the prior art or were before the priority date of each claim of this application common general knowledge in the field relevant to the present invention.

The general object of the present invention is to at least partially eliminate the above mentioned drawback and/or to provide a usable alternative. More specific, it is an object of the invention to provide a rollercoaster attraction having a trajectory segment in which a ride vehicle travels in a backwards riding direction in which the rollercoaster attraction has an arrangement which requires a relative simple installation and operation.

This object is achieved by a reverse track switch device and rollercoaster according to claim 1.

According to the invention, a reverse track switch device, also called a switchback, is provided. The reverse track switch device is configured to be installed in a trajectory of a rollercoaster. The reverse track switch device is to be aligned with at least two trajectory segments of the trajectory. The whole trajectory may be formed by a rollercoaster track, but in a variant the trajectory may also include a water ride section. The reverse track switch device is arranged to reverse an initial riding direction of a ride vehicle before running along a next trajectory segment.

The reverse track switch device comprises a dead-end track section for reversing the initial ride direction of a received ride vehicle. A proximal end of the dead-end track section is arranged to allow an entry of the ride vehicle from a trajectory segment onto the dead-end track section. The dead-end track section is arranged to receive the ride vehicle at the proximal end and

arranged to allow the ride vehicle to leave the dead-end track section at the same proximal end. The dead-end track section has an entrance at a proximal end.

The dead-end track section may be provided with a stopper at a distal end. The stopper may be a hard stopper which is fixed to the distal end to prevent a passage of a ride vehicle. Generally, such a stopper may be arranged as just an emergency safety measure, because in operation, typically no abutting engagement of the ride vehicle with such a fixed stopper will occur as a length of the dead-end track section and/or a presence of a brake unit is typically configured to smoothly reduce a speed of an arriving ride vehicle.

The reverse track switch device comprises a framework. The framework is arranged to support the dead-end track section.

Further, the reverse track switch device comprises a drive. The drive is arranged to move the dead-end track section to and fro at least three switch positions. Typically, a switch lock is provided at each switch position to lock the dead-end track section at a switch position.

The at least three switch positions may include at least one entrance position and at least a first and second exit position. The at least three switch positions are situated at the proximal end of the dead-end track section. The dead-end track section is movable between the at least one entrance position and the first and second exit position. The entrance position of the reverse track switch device is to be installed in alignment with an entry trajectory segment of a rollercoaster trajectory. The first exit position of the reverse track switch device is to be installed in alignment with a first trajectory segment of the rollercoaster trajectory, and the second exit position is to be installed in alignment with a second trajectory segment of the rollercoaster trajectory.

In a possible operation, a ride vehicle arriving from the entry trajectory segment moves in an initial riding direction onto the dead-end track section and leaves the dead-end track section in a reverse riding direction to the first trajectory segment at the first exit position. As a matter of a preference of the operator, the initial riding direction may be a forward or backward riding direction. Along the first trajectory segment, passengers will then enjoy a thrill by the reverse ride. An end of the first trajectory segment is aligned with an entrance position of the reverse track switch device. After travelling along the first trajectory segment, the ride vehicle will return back on the dead-end track section. Subsequently, the dead-end track section may move to the second exit position, and the ride vehicle leaves and rides along the second trajectory segment in the initial riding direction.

In another possible operation, a ride vehicle arriving from the entry trajectory segment moves onto the dead-end track section in an initial riding direction and leaves the dead-end track section in a reverse riding direction to the first trajectory segment at the first exit position. Along the first trajectory segment, passengers will then enjoy a thrill by the reverse ride. An end of the first trajectory segment is aligned with an entrance position of the reverse track switch device. After travelling along the first trajectory segment, the right vehicle will return back on the dead-end track section. Subsequently, the dead-end track section may move again to the first exit position, and the ride vehicle leaves and rides again along the first trajectory segment, but now in the initial riding direction. Herewith, the first trajectory segment may be passed twice. A first time in the reverse riding direction and a second time in the initial riding direction. After passing one, two or more times along the first trajectory segment, the ride vehicle returns back on the dead-end track section and leaves via the second exit position. The ride vehicle leaves and rides along the second trajectory segment in the initial or reverse riding direction. Beneficially, multiple passages via a same exit position of the reverse track switch device may extend a ride duration by for example 30% including different passenger experiences, but without an extension of the trajectory.

The reverse track switch device according to the invention may also be called a multiple exit switchback. According to the invention, an improvement is provided in that multiple reversals can be carried out at the same arrangement for at least two trajectory segments. All reverses of the riding direction in the trajectory can be carried out on the multiple exit switchback. The switchback allows a configuration of a trajectory in which no additional and separate reverse arrangement at another location in the trajectory is necessary to bring the ride vehicle back again to the initial riding direction. The same reverse track switch device is used to serve as a reversal arrangement for multiple trajectory segments. The same reverse track switch can be switched from an entry trajectory to at least two trajectory segments. One reverse track switch device can be used to couple multiple trajectory segments along which the ride vehicle runs.

Instead of a placement of a first and second reverse track device as shown in CN103505878 to guide a ride vehicle to a next trajectory segment, one multiple exit reverse track switch device may suffice to provide a ride along the at least two separate trajectory segments. The reverse track switch device according to the invention can be used to both run the ride vehicle in the reverse direction along the first trajectory segment and to subsequently return and run the ride vehicle in the initial direction to travel along another or the same trajectory segment. An installation of only a single reverse track switch device according to the invention is sufficient to obtain the possibility for a reverse riding along a trajectory segment which may strongly reduce building and exploitation costs.

In addition, it is a benefit that the reverse track switch device may contribute in a reduction of an area footprint of a rollercoaster attraction. Due to the reversals enabled by the multiple exit reverse track switch device, the rollercoaster attraction having a certain trajectory length may be built on a relative compact floor area. This may especially be beneficial in revising an existing rollercoaster attraction to increase a passengers excitement by including a backwards riding event.

Preferably, the at least one entrance position is positioned in between the first and second exit position. The first and second exit are laterally positioned aside the at least one entrance position. During operation, the dead-end track section moves away from the entrance position while supporting a ride vehicle to an exit position. After the ride vehicle has left the dead-end track section, the dead-end track section returns to the entrance position to receive the ride vehicle again from a trajectory segment. So, for each launch, the dead-end track section moves away and back to the entrance position. A positioning of the entrance position in between the exit positions is beneficial in obtaining a short stroke of movement of the dead-end track section. Herewith, a quick operation of the reverse track switch device can be achieved.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section only has a single entrance position. The single entrance position is in alignment with a common track of the first and second trajectory segment. In operation, the single entrance position is used to receive a ride vehicle from each trajectory segment by the common track. Preferably, the single entrance position is positioned in between the first and second exit position.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section is rotatable about a pivot axis. The reverse track switch device is a swingable reverse track switch device. In particular, the dead-end track section is swingable from an initial mid-position forming the at least one entrance position to a left and right side position forming the first and second exit position. Preferably, the pivot axis is positioned at the distal end of the dead-end track section. Preferably, the swingable reverse track switch device includes a swing angle of at most 30°, in particular at most 15°, in between neighbouring switch positions. The positioning of the pivot axis at the distal end of the dead-end track section is beneficial in that it allows a sufficient large lateral displacement, a so called sweep, at the proximal end of the dead-end track section by only a relative small swing angle. Advantageously, a relative small sized drive can be installed at the proximal end to laterally move the dead-end track section. In addition, the positioning of the pivot axis at the distal end of the dead-end track section causes hardly or no lateral swing at the distal end. Only a relative small volume may suffice to enclose

a ride vehicle positioned at the distal end of the dead-end track section. This is beneficial in that only a narrow building space may be required at the distal end. Especially at a great height level at the distal end, it is an advantage when a relative small structure suffices to provide for instance a scene room, an attraction or a screen.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section is supported by a guidance at the proximal end. Preferably, the guidance is a guidance rail mounted onto the framework. The guidance rail is preferably arc-shaped to guide the rotational motion of the dead-end track section. Preferably, a drive for driving the dead-end track section, in particular a driven carriage for supporting the dead-end track section is positioned at the proximal end and supported by the guidance rail. Beneficially, the positioning of the drive at a large distance from the pivot axis of the dead-end track section provides a large arm for executing a mechanical momentum to swing the dead-end track section. The large arm allows an operation by a less powerful drive which allows a compact configuration of the drive at the proximal end of the dead-end track section.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section is arranged in an inclined orientation. The dead-end track section is sloped about a slope angle. In particular, the slope angle is at least 5°, more in particular at least 10°. Preferably, the slope angle is about 15º. The slope angle of the dead-end track section is beneficial in launching the ride vehicle at least partially under gravity. Rest energy provided by the ride vehicle when being decelerated and received on the dead-end track section can be re-used in launching the ride vehicle along a next trajectory segment.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section may comprise a launch unit for launching a ride vehicle. Preferably, the launch unit comprises a motor, in particular a hydraulic or electric boostermotor, a LIM or LSM motor. Additional booster drives may be installed along a trajectory segment. Advantageously, a sloped dead-end track section and/or a dead-end track section including an own launch unit may reduce a required total amount of booster drives along a trajectory segment.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section comprises a brake unit for stopping a ride vehicle at the dead-end track section. In particular, the dead-end track section comprises a trim brake for braking a speed of a ride vehicle arriving at the dead-end track section.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section may comprise a operable stopper for temporarily blokking the ride vehicle on the dead-end track section. The operable stopper is controlled by a control unit of the reverse track switch device. The operable stopper is operable in a stop-position and a go-position to respectively keep the ride vehicle on the dead-end track section and to launch the ride vehicle from the dead-end track section. The operable stopper is preferably positioned at the entrance at the proximal end of the dead-end track section.

In an embodiment of the reverse track switch device according to the invention, the dead-end track section comprises a locker for locking the ride vehicle in its position to the dead-end track section. The locker is arranged to keep the ride vehicle in a stand-still position during a lateral movement. The locker has a locking member which is arranged to engage with one of the respective ride vehicle or dead-end track section. The locking member may for example be a locking pen or a locking hook mounted to the ride vehicle to engage with a locking aperture, e.g. a hole or ridge, at the dead-end track section or vice versa. In operation, the locker is released to allow the ride vehicle to run from the dead-end track section.

Further, the invention relates to a rollercoaster comprising a reverse track switch device according to the invention. The reverse track switch device is positioned in a trajectory and is operable to reverse a ride direction of a ride vehicle.

According to a next aspect of the invention, the invention relates to a reverse track switch device for reversing an initial riding direction of a ride vehicle on a trajectory, wherein the reverse track switch device comprises:

- a movable dead-end track section for receiving the ride vehicle, wherein the dead-end track section has an entrance at a proximal end and in particular a stopper at a distal end;
- a framework for supporting the dead-end track section;
- a drive for moving the dead-end track section to and fro at least two switch positions including at least one access position and at least a first exit position, such that a ride vehicle can leave the dead-end track section in a reverse riding direction to a first trajectory segment at the first exit position, and can return thereafter onto the dead-end track section via the at least one access position.

In an embodiment according to this aspect, the reverse track switch comprises a passenger station which is located at a bottom region of the reverse tack switch device. Preferably, the passenger station is positioned right below the reverse track switch. Herewith, a reversal of the

riding direction is carried out above the passenger station which may render excitement to waiting passengers and may increase the overall experience of the rollercoaster.

In an embodiment according to this aspect, the dead-end track section is rotatable about a pivot axis, wherein in particular the pivot axis is positioned at the distal end of the dead-end track section.

In an embodiment according to this aspect, the dead-end track section is slidably supported at the proximal end by an arc shape guidance rail mounted to the framework.

In an embodiment according to this aspect, a switch lock is provided at each switch position to lock the dead-end track section in position.

In an embodiment according to this aspect, the dead-end track section is sloped about a slope angle of at least 5°, in particular at least 15º.

In an embodiment according to this aspect, the dead-end track section is swingable about a swing angle of at most 30°, in particular at most 15°, in between neighbouring switch positions. In operation, a swing angle between an exit position EP and the access position of at most 30°, in particular at most 15°, is beneficial to obtain a quick return of the dead-end track section to the access position during a ride of the ride vehicle along a trajectory segment.

In an embodiment according to this aspect, the dead-end track section comprises a launch unit for launching a ride vehicle, wherein in particular the dead-end track section comprises a linear motor for accelerating and/or braking a ride vehicle by a magnetic induction force.

In an embodiment according to this aspect, the dead-end track section comprises a brake unit for stopping a ride vehicle at the dead-end track section.

In an embodiment according to this aspect, the dead-end track section comprises a locker for locking the ride vehicle to the dead-end track section, wherein in particular one of the ride vehicle and the dead-end track section includes a locking member, in particular a locking pen or locking hook, to engage with the respective other of the ride vehicle and dead-end track section.

Further, the invention relates to a rollercoaster comprising such a reverse track switch according to this aspect of the invention.

As described above, according to the invention as defined in claim 1, the reverse track switch device has a dead-end track section for reversing the ride direction of the ride vehicle. The dead-end track section is operable between at least three switch positions. The switch positions are situated at the proximal end of the dead-end track section. The at least three switch positions include at least one entrance position. The trajectory of the rollercoaster according to the invention includes multiple trajectory segments. The trajectory of the rollercoaster includes an entry trajectory segment having an segment end which is in alignment with the at least one entrance position of the reverse track switch device. The at least three switch positions include at least two exit positions. The trajectory of the rollercoaster further includes a first trajectory segment and a second trajectory segment having each a segment start in alignment with respectively the first and second exit position of the reverse track switch device. The rollercoaster including the reverse track switch according to the invention is beneficial in that multiple trajectory segments of the trajectory are connectable to a single reverse track device. The same reverse track device can be used to let the ride vehicle run along several trajectory segments.

The rollercoaster may have a fully tracked trajectory, or may have a hybrid trajectory in which the trajectory includes at least one water ride section. Such a rollercoaster may also be called a boat coaster. The rollercoaster is arranged to provide a passenger ride along such a trajectory having a trajectory segment in which during operation a ride vehicle moves in a reverse direction.

It is remarked that in this context a ride vehicle should be understood in a broadest sense of a coaster carrying passengers along a rollercoaster trajectory. A ride vehicle may comprise a single carriage, but may also include a train of several carriages. A ride vehicle may have any appearance. Such an appearance may be complementary to an expressed theme of an environment of the rollercoaster attraction. The ride vehicle may for example look like a flying space object, e.g. an UVO, an animal, like a bird or dragon, a boat or a plane.

In an embodiment, the rollercoaster trajectory may further include at least one water ride. The water ride may be formed by a water channel in which a coaster, in particular a boat coaster, passes a distance. During the water ride, the ride vehicle may continuously remain attached to a track, but alternatively may also be floating for a while, whereafter the ride vehicle couples again to a track of the trajectory.

The trajectory of the rollercoaster is formed by at least two trajectory segments which is beneficial in that one of the trajectory segments can be exclusively configured for a reverse

riding experience while another one of the trajectory segments can be exclusively configured for a riding experience in an opposed direction. Each of the trajectory segments can be designed to a particular riding direction, e.g. a forwards trajectory segment or a backwards directory segment, and no concessions need to be made to allow a ride in both directions along the trajectory segment. A forwards trajectory segment may be designed to be more spectacular e.g. by including some loops than a backwards trajectory segment. A forwards trajectory segment may have a longer length than a backwards trajectory segment which is up to the rollercoaster designer. Herewith, advantageously, the trajectory of the rollercoaster can be designed in a more adventurous and exciting manner, whilst only an implementation of one reverse track switch device according to the invention suffices to ride multiple trajectory segments.

The rollercoaster comprises a passenger station to allow people to enter and exit the ride vehicle. Another advantage is that the passenger station can be situated in the second trajectory segment which forms the final trajectory segment of a trajectory. In the passenger station, passengers can enter a ride vehicle which is directed in a preferred initial riding direction and at the end of the ride, the passengers can leave the ride vehicle which is oriented in the same initial riding direction. At a start and finish of the trajectory, a ride vehicle is remains positioned in an initial riding direction and no separate reverse track close to the passenger station is necessary to reverse a riding direction of the ride vehicle.

In an embodiment of the rollercoaster according to the invention, the reverse track switch device comprises a single entrance position. The first and second trajectory segments are coupled to each other by a pass track switch, in particular a high-speed track switch, to guide a ride vehicle from one of the trajectory segments onto a common track. The common track is in alignment with the single entrance position of the reverse track switch device to allow the ride vehicle to enter the dead-end track section of the reverse track switch device.

Further, the invention relates to a method for operating a rollercoaster, in particular for operating a reverse track switch device as defined in claim 1. The method comprises a step of providing a rollercoaster including a reverse track switch device according to the invention, wherein the reverse track switch device is operable in at least three switch positions. In a step of the method, a dead-end track section is moved to an entrance position for receiving a ride vehicle on the dead-end track section. Particularly, the ride vehicle is locked in position on the dead-end track section. In a step, the dead-end track section is moved from the entrance position to a first exit position while supporting the ride vehicle. In particular, the dead-end track section is swung about a pivot axis. At the first exit position, the ride vehicle is launched onto the first trajectory

segment in a reverse riding direction. In a step, the dead-end track section is moved from the first exit position to an entrance position for receiving the ride vehicle from the first trajectory segment back on the dead-end track section. Preferably, a single entrance position is provided, wherein the dead-end track section is moved back along a common track to this entrance position after a launch of the ride vehicle from the first exit position. In a step of the method, the dead-end track section is moved from the entrance position to a second exit position whilst supporting the ride vehicle. At the second exit position, the ride vehicle is launched onto the second trajectory segment in a forwards riding direction. In a next step, the dead-end track section is moved back to an entrance position. Herewith, the dead-end track section is moved back to an entrance position during a ride of the ride vehicle on the first or second trajectory segment.

Thus, a reverse track switch device is provided comprising a dead-end track section which is movable between at least three switch positions. The three switch positions include an entrance position and at least two exit positions. The exit positions are to be positioned in alignment with a first and second trajectory segment of a rollercoaster trajectory. On one trajectory segment, passengers enjoy a backwards ride, whilst on the other trajectory segment a forward ride is made. The separate two exit positions are beneficial in that a single reverse track switch device on which at least two reversals are made may suffice to obtain a spectacular rollercoaster trajectory including a reverse riding trajectory segment.

The invention will be explained in more detail with reference to the appended drawings. The drawings show a practical embodiment according to the invention, which may not be interpreted as limiting the scope of the invention. Specific features may also be considered apart from the shown embodiment and may be taken into account in a broader context as a delimiting feature, not only for the shown embodiment but as a common feature for all embodiments falling within the scope of the appended claims, in which:

Fig. 1 shows a trajectory of a rollercoaster including a switchback according to an aspect of the invention;

Fig. 2 shows another embodiment of a rollercoaster including a trajectory provided with the switchback as shown in Fig. 1 and another track switch located near a passenger station;

Fig. 3 shows another embodiment of a rollercoaster including a three-fold switchback having three switch positions;

Fig. 4 shows an embodiment a three-fold switchback in which a dead-end track section is positioned at an entry position;

Fig. 5 shows the switchback of fig. 4 pivoted to a first exit position;

Fig. 6 shows a top view of the switchback of fig. 4;

Fig. 7 shows a side view of the switchback of fig. 4;

Fig. 8 shows a switchback having a dead-end track section positioned above a passenger station;

Fig. 9 shows an embodiment of a trajectory including a switchback in which the switchback has a dead-end track section for reversing a vehicle ride, wherein the dead-end track section has a distal end which is connectable to a trajectory segment to allow a ride vehicle to pass along the dead-end track section.

Identical reference signs are used in the drawings to indicate identical or functionally similar components. To facilitate comprehension of the description and of the claims the words vertical, horizontal, longitudinal, cross-sectional and a coordinate system X,Y, Z shown in the drawings – with reference to gravity and common placement of the reverse track switch device – are used in a non-limiting way.

Fig. 1 shows a rollercoaster 1 having a passenger station 98 in a trajectory 90. The trajectory is formed by an enclosed rollercoaster track. Departing from the passenger station 98, a ride vehicle 99 may start a ride in an initial riding direction. The ride vehicle 99 runs along an entry trajectory segment ETS to arrive at an access position AP of a reverse track switch device 10, also called a switchback, which is located in the trajectory 90. The switchback is configured to reverse the initial riding direction of the ride vehicle to a reverse riding direction.

As in further detail shown in fig. 4-7 and described hereafter, the reverse track switch device 10 has a movable dead-end track section 12 supported by a framework 11. The dead-end track section 12 is pivotable about a pivot axis 012 in a sidewards direction. By pivoting the dead-end track section 12, a proximal end is movable to and fro several switch positions SW. At each switch position, the dead-end track section is locked by a switch lock 15. The switch positions SW include an access position AP to allow a ride vehicle to enter the dead-end track section 12 from the entry trajectory segment ETS and an exit position EP to allow the ride vehicle to leave the dead-end track section 12 to continue a ride along another trajectory segment 1TS, 2TS.

The dead-end track section 12 is configured to receive the ride vehicle in a standstill position before moving from an access position AP to an exit position EP. A park zone is provided on the dead-end track section for holding the ride vehicle during a sidewards motion from one switch position SP to another. At least one locker 125 is positioned at the parkzone to lock the ride vehicle to the dead-end track section.

After a switch motion of the dead-end track section 12, the ride vehicle runs back onto the trajectory 90 and continues its ride in a reverse riding direction. Here, as shown in Fig. 1, the ride vehicle may pass the passenger station 98 to run for a second time along the trajectory, such that at the end of the ride, the ride vehicle is oriented in a same direction again at the passenger station 98 for a next ride.

Fig. 2 shows an alternative embodiment of a trajectory of the rollercoaster 1 including the reverse track switch device 10 as shown in Fig. 1. Here, the trajectory is designed to be travelled only a single time to complete a ride. A first reversal R1 of the riding direction is made at the reverse track switch device 10 and a second reversal R2 is made at a trajectory section located beyond a track switch 96. At the trajectory section, the ride vehicle reverses its riding direction after which the ride vehicle travels in the initial riding direction back to the passenger station 98.

Fig. 3 shows an alternative embodiment of the reverse track switch device 10 in another trajectory. The switchback is a multi-exit switchback. Here, the dead-end track section 12 of the reverse track switch device 10 is switchable between a first and second exit position EP1, EP2 and has a single access position AP. The trajectory 90 includes a track switch 97, in particular a high speed track switch, to guide a ride vehicle 99 to a common track CT to reach an access point. The common track forms an entry trajectory segment ETS along which the ride vehicle travels towards the access point to enter the dead-end track section 12 of the reverse track switch device 10. After receiving the ride vehicle on the dead-end track section 12, the dead-end track section 12 swings about the pivot axis 012 to the first exit position 1EP. After a locking of the dead-end track section 12 at the exit position EP1 to a segment start SS of a first trajectory segment 1TS, the ride vehicle leaves the dead-end track section and runs along the first trajectory segment 1TS in a reverse riding direction.

A segment end SE of the first trajectory segment 1TS is connected to the track switch 96. After passing the track switch 96, the ride vehicle arrives for a second time on the common track CT to enter the dead-end track section 12 for a second time. While the ride vehicle travelled along the first trajectory segment, the dead-end track section 12 was moved back to the access

position AP. For this, in operation, a swing angle between an exit position EP and the access position AP of at most 30°, in particular at most 15°, is beneficial to obtain a quick return of the dead-end track section 12 to the access position AP during a ride of the ride vehicle along a trajectory segment.

Then, the ride vehicle is received for a second time on the dead-end track section 12 to obtain a second reversal R2. Here, both the first reversal R1 and the second reversal R2 occur on the reverse track switch device 10. After a release of the ride vehicle at the second exit point 2EP, the ride vehicle travels along a second trajectory segment 2TS to return to the passenger station 98.

As shown in Fig. 1-3, an entry trajectory segment ETS of the trajectory 90 is arranged in alignment with the access position AP. The entry trajectory segment ETS has a segment end SE at the entrance position AP. The first trajectory segment 1TS is in alignment with the first exit position 1EP. A segment start SS of the first trajectory segment 1TS is positioned at the first exit position 1EP. The second trajectory segment 2TS is in alignment with the second exit position 2EP. A segment start SS of the second trajectory segment 2TS is positioned at the second exit position 2EP.

Figures 4-7 show an embodiment of the reverse track switch device 10 in further detail. The reverse track switch device 10 has a framework 11 for supporting a dead-end track section 12. The framework 11 is structured by pillars and linking beams. The dead-end track section 12 is supported at a proximal end by a first sub-frame 111 and at a distal end by a second sub-frame 112. Here, the first sub-frame is separately arranged at a distance from the second sub-frame. The second subframe 112 supports the dead-end track section at a higher level than the first sub- frame 111. The dead-end track section 12 is sloped about a slope angle α of at least 5°, in particular at least 15°.

A guidance rail 13 for laterally guiding the dead-end track section 12 is mounted on top of the first sub-frame 111. The guidance rail 13 extends in a substantially horizontal plane and is arc-shaped. The proximal end of the dead-end track section 12 is supported by a carriage 130 which is slidable connected to the guidance rail 13. A drive 14 is coupled to the carriage 130 to drive the carriage along the guidance rail 13. Here, the carriage 130 is provided with a first and second drive 141, 142 for driving the proximal end of the dead-end track section 12 along the guidance rail 13.

A distal end of the dead-end track section 12 is pivotally coupled to the second sub-frame 112 about a pivot axis 012. The pivot axis 012 is provided to allow the dead-end track section to swing about the pivot axis. Typically, the pivotable dead-end track section 12 is swingable about a swing angle of at most 15º in between neighbouring switch positions SW.

At the proximal end, the dead-end track section 12 has an entrance zone, simply called an entrance 121 for receiving a ride vehicle 99. Here, at the distal end, a stopper 122 is mounted to the dead-end track section 12 to prevent the ride vehicle to pass along the dead-end track section. Instead of a hard stop, an alternative stopper like an elongated run out section of the dead-end track section might also be possible. After receiving the ride vehicle 99 on the dead-end track section 12, the dead-end track section 12 is swingable to a switch position SP to transfer the ride vehicle to another track.

The dead-end track section 12 of the reverse track switch device 10 is movable between at least three switch positions SP. The at least three switch positions include an entrance or a so-called access position AP and at least a first and second exit position 1EP, 2EP. Here, the access position AP is situated in between the first and second exit position 1EP, 2EP which is beneficial to obtain a quick return of the dead-end track section 12 during operation of the rollercoaster.

Fig. 6 shows a top view of the reverse track switch device 10. Adjacent to the entrance zone 121 at the proximal end, the dead-end track section 12 has a park zone for holding a ride vehicle 99 in position. The dead-end track section 12 comprises a vehicle locker 125, simply called a locker, for locking the ride vehicle in position at the dead-end track section. The locker 125 includes a locking member, like a locking pen or hook which is mounted to the ride vehicle or the dead-end track section to engage with a complementary locking member for holding the ride vehicle in position.

The dead-end track section 12 comprises a launch unit 123 at the park zone for launching the ride vehicle. The launch unit 123 may comprise a kicker wheel, a tyre launch or a linear motor, a LIM or LSM, for accelerating the ride vehicle.

Here, the dead-end track section 12 comprises a brake unit 124 for braking a speed of a ride vehicle. In particular, the launch unit 123 may be controlled by a control unit to operate as a brake unit 124 for an incoming ride vehicle.

Fig. 6 shows the guidance rail 13 in further detail. The guidance rail 13 is provided with a carriage 130 which carries the dead end track section 12. The carriage 130 includes a drive 14 to drive the carriage along the guidance rail 13. Here, as further shown in fig. 6, a first and second drive 141, 142 are laterally positioned at the carriage 130.

The carriage 130 further comprises a switch lock 15 to lock the dead-end track section 12 at a switch position SP. Here, the switch lock 15 includes a linear actuator for actuating a switch lock pen into an aperture to engage the carriage 130 to the guidance rail 13.

Fig. 7 shows a side view of the reverse track switch device in which the dead-end track section 12 is inclined under a slope angle α of about 15°.

Fig. 8 shows an embodiment of the reverse track switch device 10 in which the passenger station 98 is located at a bottom region of the reverse track switch device. The dead-end track section 12 is located above the passenger station 98. Herewith, a reversal of the riding direction is carried out above the passenger station 98 which may render excitement to waiting passengers and increase the overall experience of the rollercoaster 1.

Fig. 9 shows an alternative embodiment of a rollercoaster 1. The rollercoaster 1 has a trajectory 90 including a common track CT forming an entry trajectory segment ETS to guide a ride vehicle to an access point. Here, the trajectory has a trajectory segment in alignment with a distal end of the dead-end track section 12. The aligned trajectory segment allows a ride vehicle to pass along the dead-end track section 12 without a reversal being carried out. The reverse track switch device allows a travel by of a ride vehicle in a particular stage of a ride and may serve to carry out a reversal of the riding direction in another stage of the ride. The ride vehicle may for example first pass along the reverse track switch device and thereafter reverse on the reverse track switch device to subsequently run along a second trajectory segment 2TS in a reversed riding direction.

Although the present invention has been described in detail, it will be apparent to those skilled in the art that various changes and modifications can be made without departing from the scope of the invention as hereinafter claimed. It is intended that all such changes and modifications be encompassed within the scope of the present disclosure and claims.

Further, it is remarked that any feature of the rollercoaster who according to the invention which is described in the embodiments and/or mentioned in the dependent claims is in itself considered patentable without any dependency to another presented feature. In particular, any

measure presented in a dependent claim is also considered patentable without dependency of the independent claim.

Thus, the invention provides a rollercoaster including a reverse track switch device comprising a reverse track switch device including a dead-end track section which is movable between at least three switch positions. The three switch positions include an entrance position and at least two exit positions. The exit positions are in alignment with a first and second trajectory segment. On one trajectory segment, passengers enjoy a backwards ride, whilst on the other trajectory segment a forward ride is made. The separate two exit positions are beneficial in that a single reverse track switch device may suffice to obtain a spectacular rollercoaster trajectory including a reverse riding trajectory segment.

Reference signs list:

1 rollercoaster

99 ride vehicle
90 trajectory
98 passenger station
97 track switch (high-speed)
96 track switch

10 reverse track switch device; switch back
11 framework
111 first sub-frame
112 second sub-frame

12 dead-end track section
012 pivot axis
α slope angle
121 entrance
proximal end
122 stopper
distal end
123 launch unit;linear motor
124 brake unit

125 locker; vehicle locker
locking member; locking pen or hook

13 guidance rail
130 carriage

14 drive
141 first drive
142 second drive
15 switch lock

SP switch position
AP access / entrance position
ETS entry trajectory segment

1EP first exit position
1TS first trajectory segment
SS segment start
SE segment end

2EP second exit position
2TS second trajectory segment

CT common track

CLAIMS

1. Reverse track switch device (10) for reversing an initial riding direction of a ride vehicle (99) on a trajectory, wherein the reverse track switch device (10) comprises:
- a movable dead-end track section (12) for receiving the ride vehicle, wherein the dead-end track section has an entrance (121) at a proximal end and in particular a stopper (122) at a distal end;
- a framework (11) for supporting the dead-end track section (12);
- a drive (13) for moving the dead-end track section to and fro at least three switch positions (SW) including at least one access position (AP) and at least a first and second exit position (1EP, 2EP), such that a ride vehicle can leave the dead-end track section (12) in a reverse riding direction to a first trajectory segment (1TS) at the first exit position (1EP), can return thereafter onto the dead-end track section (12) via the at least one access position (AP) and subsequently can leave the dead-end track section (12) in the initial riding direction to a second trajectory segment (2TS) at the second exit position (2EP).

2. Reverse track switch device (10) according to claim 1, wherein the at least one access position (AP) is positioned between the first and second exit position (1EP, 2EP).

3. Reverse track switch device (10) according to claim 1 or 2, wherein the dead-end track section (12) is movable between a single access position (AP) and the at least two exit positions (1EP,2EP).

4. Reverse track switch device (10) according to any of the preceding claims, wherein the dead-end track section (12) is rotatable about a pivot axis (012), in particular about a swing angle of at most 30º in between neighbouring switch positions (SW), wherein in particular the pivot axis (012) is positioned at the distal end of the dead-end track section.

5. Reverse track switch device (10) according to claim 4, wherein the dead-end track section (12) is slidably supported at the proximal end by a guidance rail (13) mounted to the framework (11), wherein a switch lock (15) is provided at each switch position (SW) to lock the dead-end track section in position.

6. Reverse track switch device (10) according to any of the preceding claims, wherein the dead-end track section (12) is sloped about a slope angle of at least 5°.

7. Reverse track switch device (10) according to any of the preceding claims, wherein the dead-end track section (12) comprises a launch unit (123) for launching a ride vehicle.

8. Reverse track switch device (10) according to any of the preceding claims, wherein the dead-end track section (12) comprises a brake unit (124) for stopping a ride vehicle at the dead-end track section.

9. Reverse track switch device (10) according to any of the preceding claims, wherein the dead-end track section (12) comprises a locker (125) for locking the ride vehicle to the dead-end track section, wherein in particular one of the ride vehicle and the dead-end track section includes a locking member, in particular a locking pen or locking hook, to engage with the respective other of the ride vehicle and dead-end track section.

10. Rollercoaster (1) to provide a passenger ride along a trajectory comprising a reverse track switch device (10) according to any of the preceding claims which reverse track switch device has a dead-end track section (12) for reversing a ride direction of a ride vehicle (99) which dead-end track section is operable between at least three switch positions (SW) including at least one entrance position (AP) and at least two exit positions (1EP;2EP), and wherein the rollercoaster further comprises:
- a first trajectory segment (1TS) and a second trajectory segment (2TS) having each respectively a segment start (SS) in alignment with respectively the first and second exit position (1EP; 2EP) of the reverse track switch device, and
- an entry trajectory segment (ETS) having an segment end (SE) in alignment with the at least one entrance position (AP) of the reverse track switch device.

11. Rollercoaster (1) according to claim 10, wherein the reverse track switch device comprises a single entrance position (AP), wherein the first and second trajectory segments (1TS;2TS) are coupled to each other by a track switch (97), in particular a high speed track switch, to guide a ride vehicle (99) from the first or second trajectory segment (1TS;2TS) onto a common track (CT) being in alignment with the single entrance position (AP) to enter the dead-end track section of the reverse track switch device.

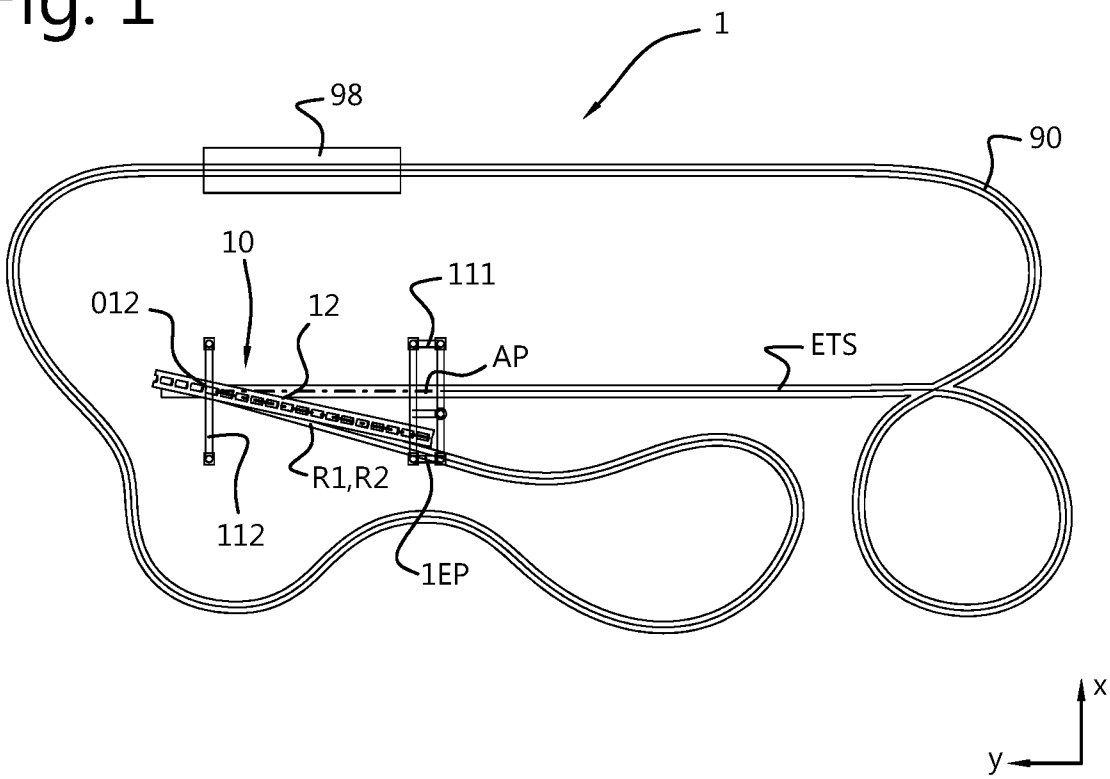
12. Rollercoaster (1) according to any of the claims 10 or 11, wherein the rollercoaster comprises in its trajectory a passenger station (98) to allow passengers to enter or exit a ride vehicle (99) which passenger station (98) is in particular located at a final trajectory segment of the trajectory being in alignment with an exit position (EP) of the reverse track switch device.

13. Rollercoaster according to any of the claims 10-12, wherein the first trajectory segment being in alignment with the first exit position (1EP) and being arranged for a reverse riding direction differs in length from the second trajectory segment (2EP) being in alignment with the second exit position which is arranged for an initial riding direction.

14. Method for operating a rollercoaster, in particular a reverse track switch device of the rollercoaster, comprising the steps of:
- providing a rollercoaster according to any of the claims 10-13 including a reverse track switch device which is operable in at least three switch positions;
- moving a dead-end track section to an entrance position for receiving a ride vehicle in an initial riding direction on the dead-end track section;
- moving the dead-end track section from the entrance position to a first exit position to launch the ride vehicle onto a first trajectory segment in a reverse riding direction;
- moving the dead-end track section from the exit position to an entrance position, in particular the same previous entrance position, for receiving the ride vehicle from the first trajectory segment again on the dead-end track section;
- moving the dead-end track section supporting the ride vehicle from the entrance position to a second exit position to launch the ride vehicle onto a second trajectory segment in the initial riding direction.

15. Method according to claim 14, wherein the dead-end track section is moved to a single entrance position of the reverse track switch device after a launch of a ride vehicle from the dead-end track section.

Fig. 1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98
90
10
012
12
111
AP
ETS
R1,R2
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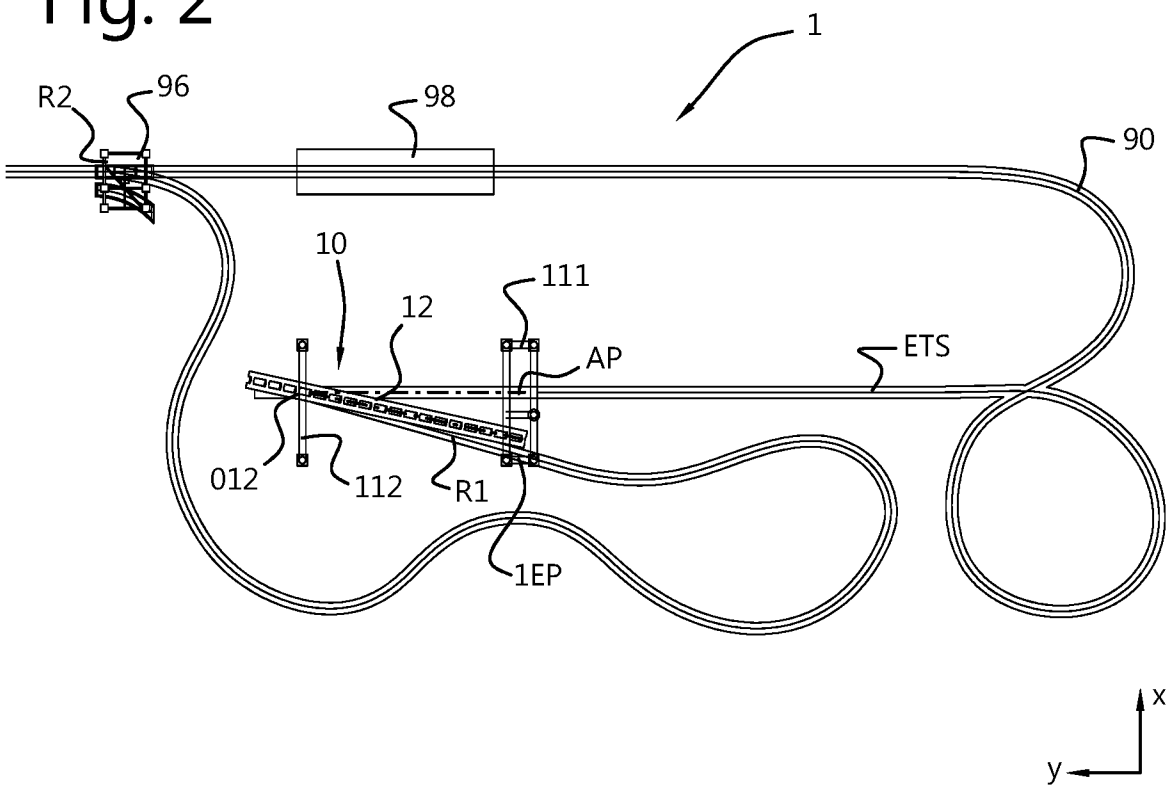
1EP
x
y

Fig. 2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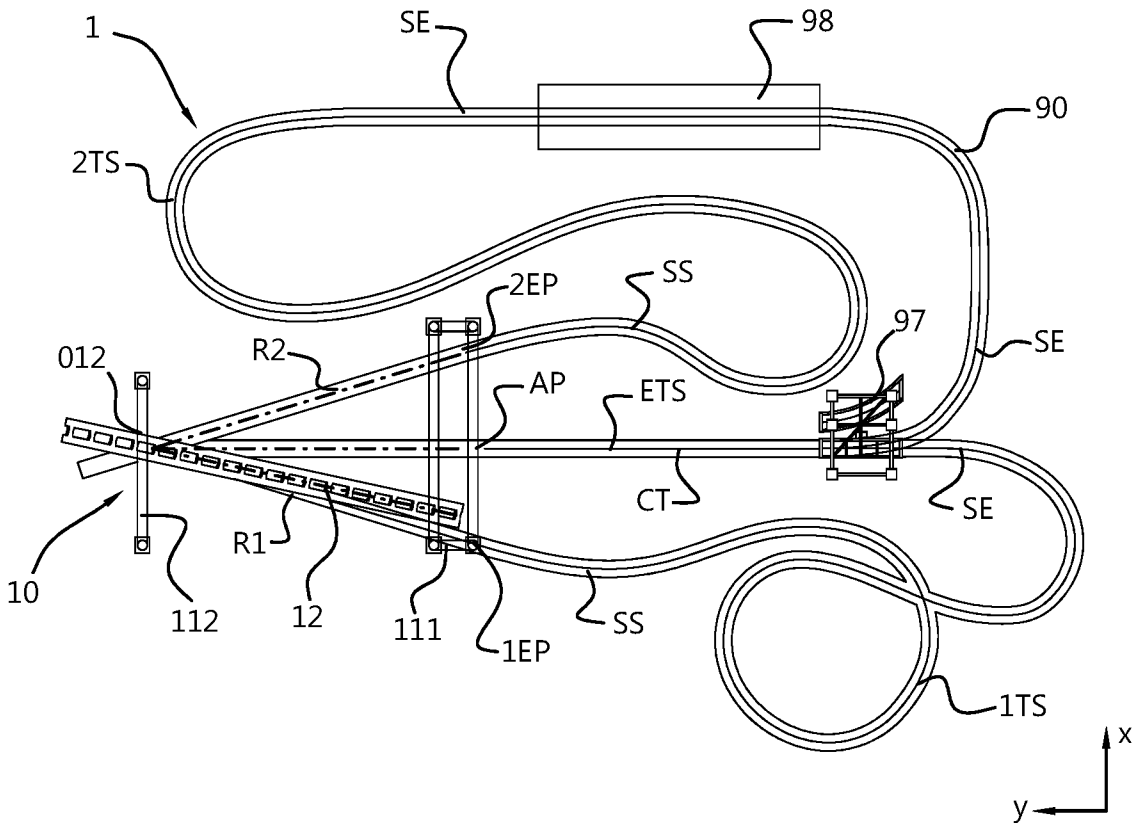
y

Fig. 3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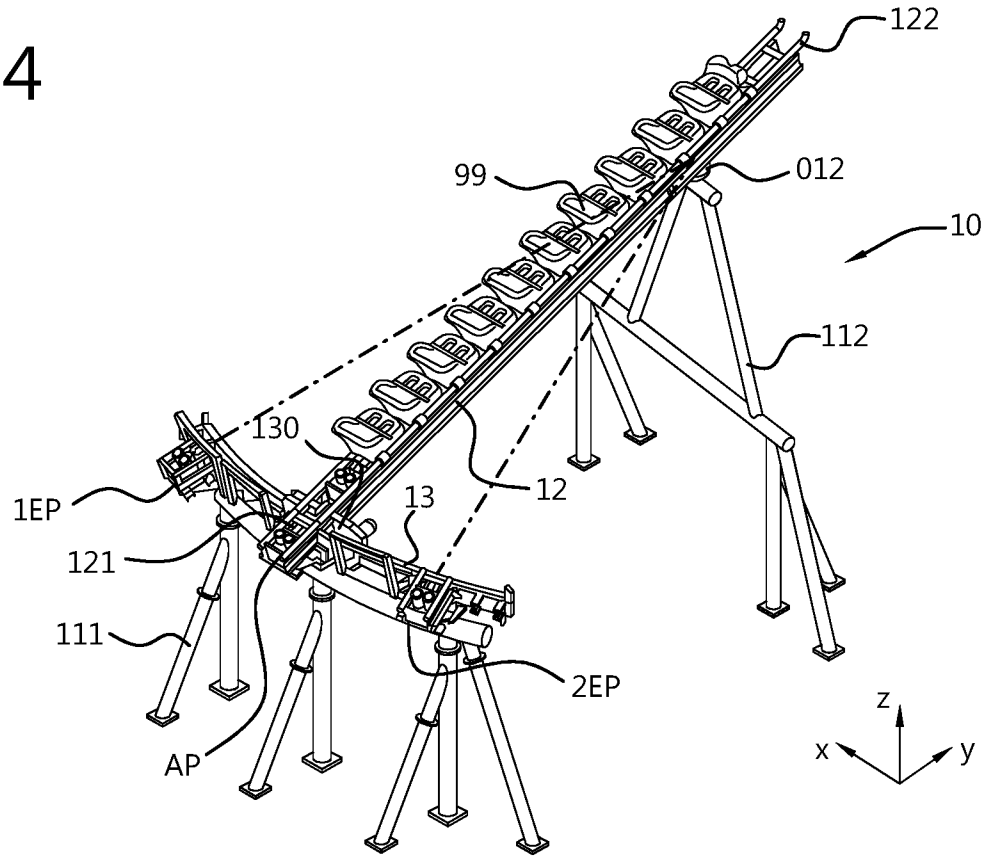
x
y

Fig. 4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AP
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x
y

Fig. 5

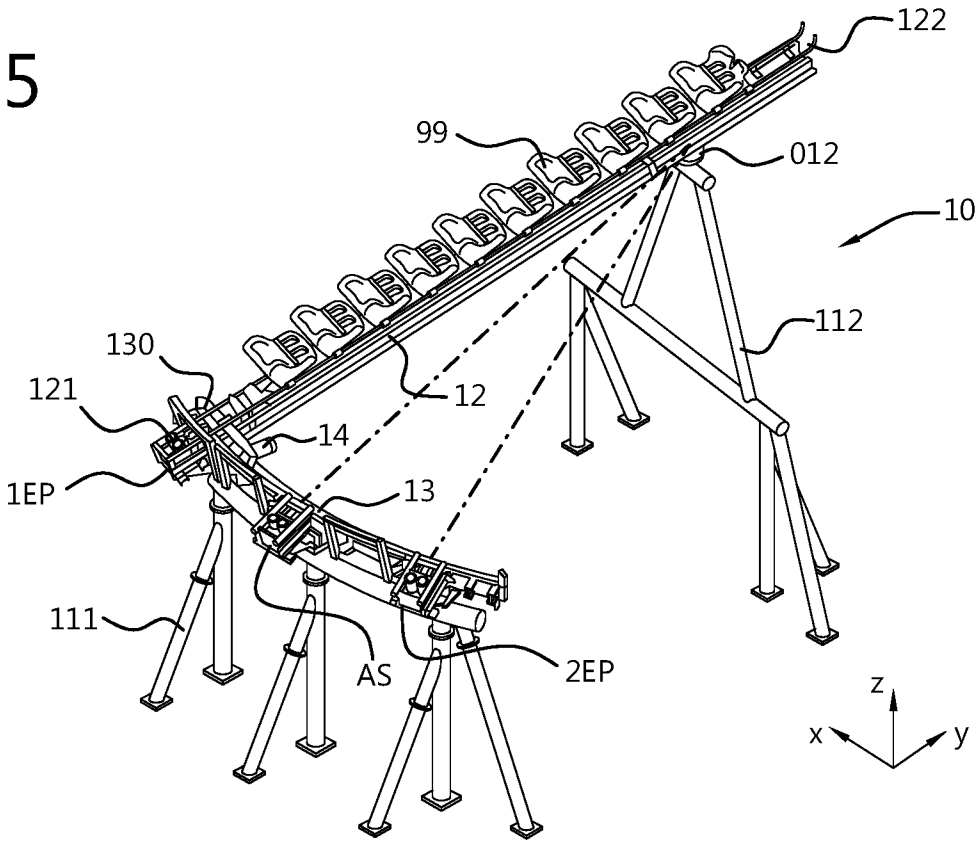
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Fig. 6

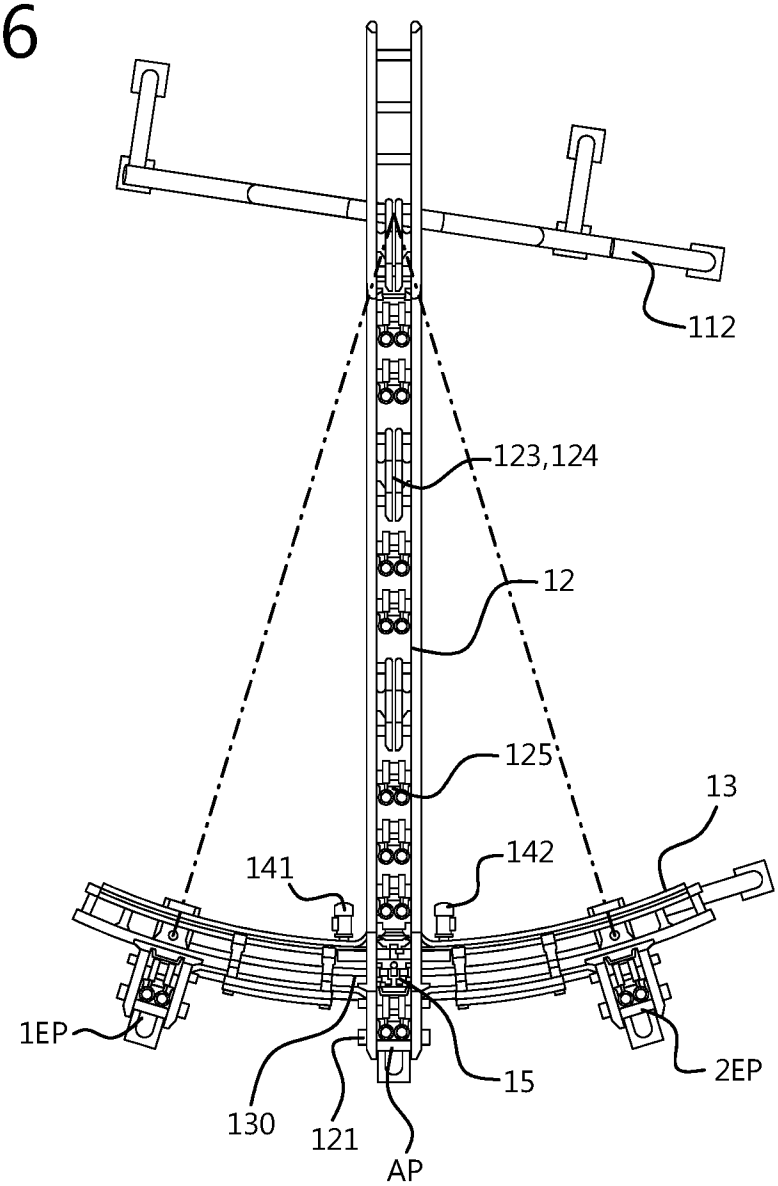
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Fig. 7

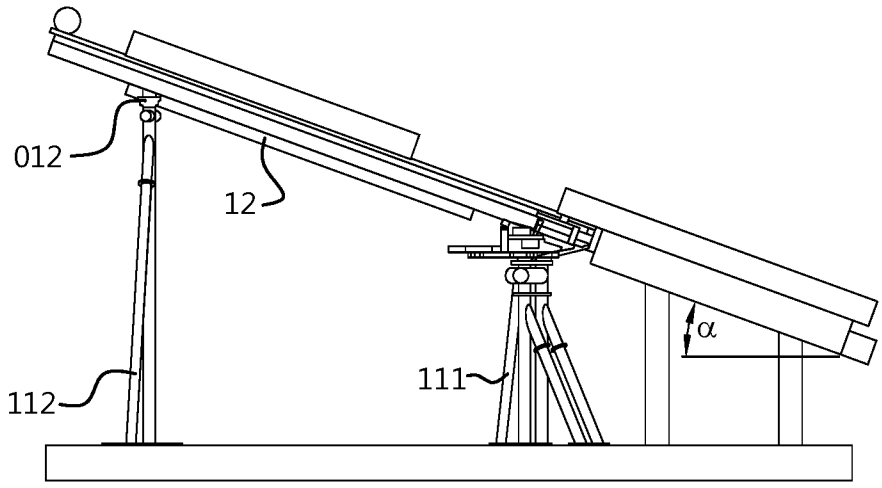
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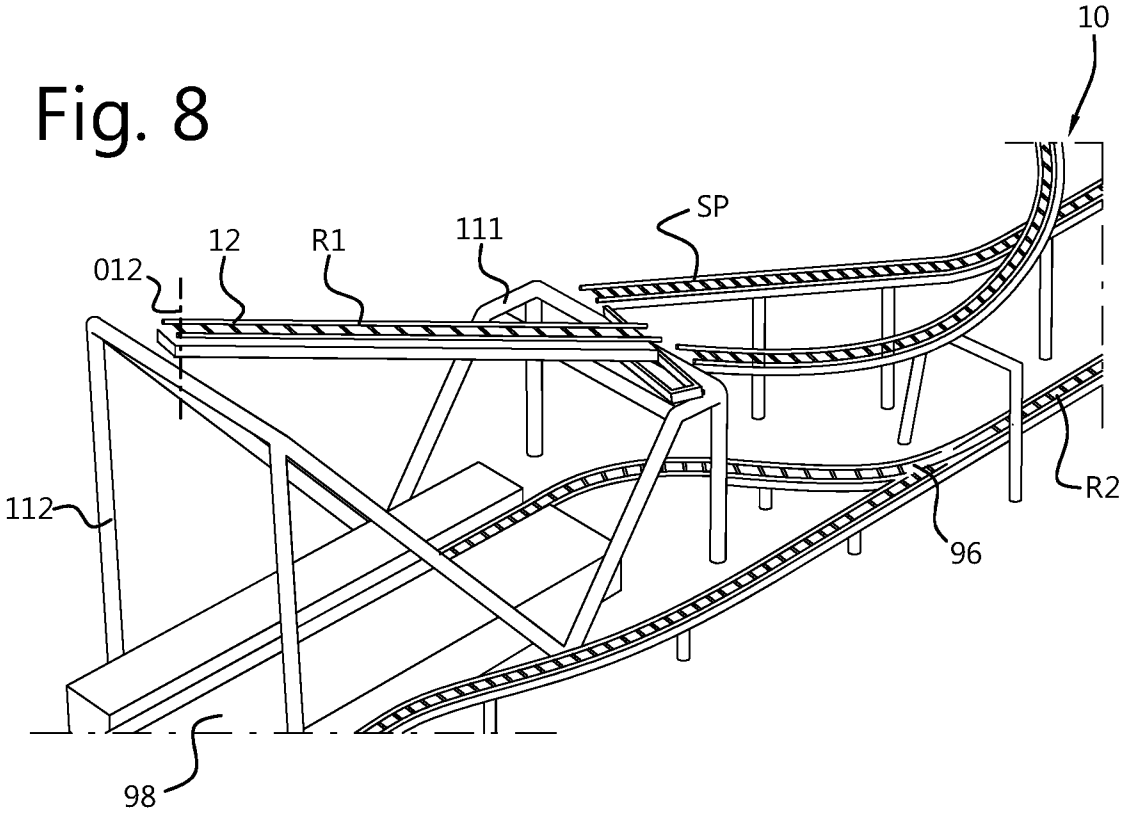
Fig. 8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SP
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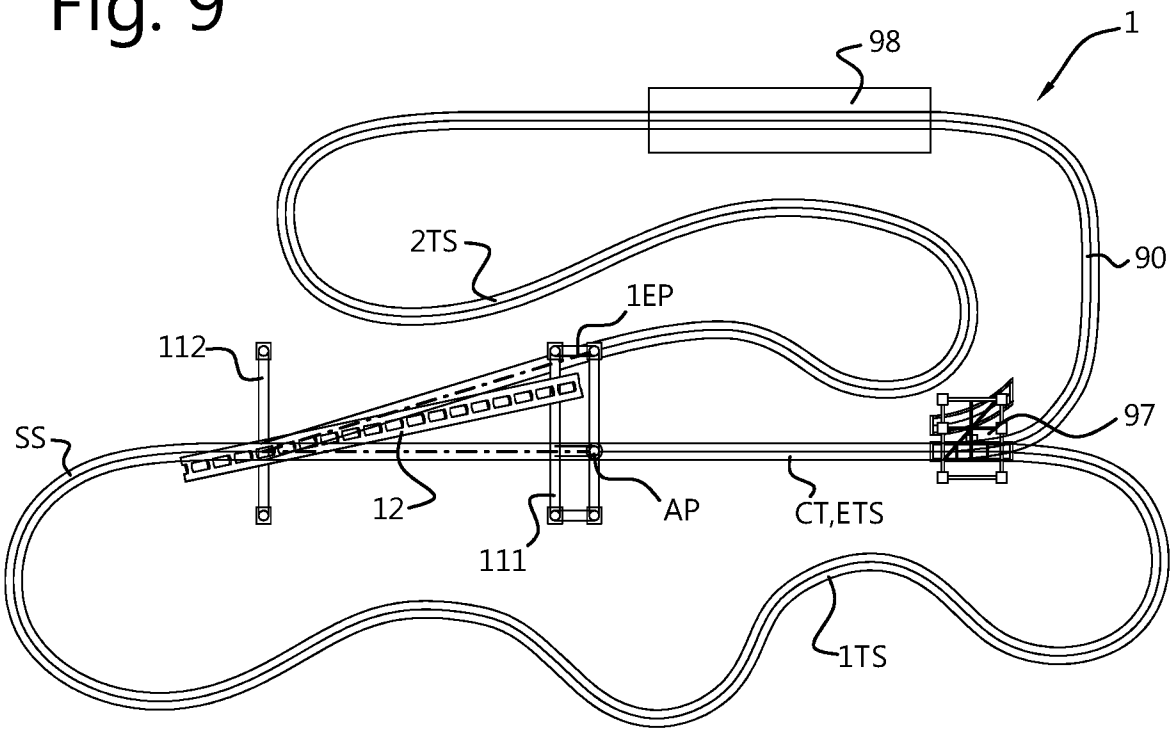
R2
96
98

Fig. 9


98
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2TS
90
1EP
112
97
SS
12
AP
CT,ETS
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2023/060709

A. CLASSIFICATION OF SUBJECT MATTER
INV. A63G7/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A63G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10 2019 130956 A1 (MACK RIDES GMBH & CO KG [DE]) 20 May 2021 (2021-05-20) paragraph [0094]; figures	1-12
A	EP 3 171 952 B1 (UNIVERSAL CITY STUDIOS LLC [US]) 10 October 2018 (2018-10-10) cited in the application paragraph [0015] - paragraph [0019]; figures	1-15
A	CN 103 505 878 A (GOLDEN HORSE AMUSEMENT EQUIPMENT CO LTD) 15 January 2014 (2014-01-15) cited in the application the whole document	1-15

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[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 July 2023	19/07/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lucas, Peter

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2023/060709

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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1

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Information on patent family members

International application No
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