

The invention is based on a rope haulage installation, particularly an aerial ropeway according to the preamble to patent claim 1.

A chair life or suspended cabin railway of this type is described in US-A-4 563 955.

The condition whereby the length of the friction plate must be longer than the distance between two friction wheels which are constructed for example as pneumatic-tired wheels, arises from the requirement that both during acceleration and also during deceleration, a vehicle must always be controlled by at least one friction wheel so that there must always be a reliable engagement between the friction plate and this friction wheel.

By reason of the fact that in the case of a cable railway of this type, two adjacent friction wheels on the acceleration path or deceleration path necessarily have to have divergent peripheral speeds, the repeated simultaneous engagement of two friction wheels with a friction plate results in marked wear and tear and the involuntary friction work also has to be paid for by a corresponding energy cost.

It is true that a rope haulage installation which avoids these disadvantages is known from FR-A-2 340 848. All the friction wheels in one set run at the same speed and this speed can be increased by a variable drive controlled by a control arrangement to accelerate the vehicles or reduced in order to decelerate them. This installation is certainly expensive and since sensors are also required which have to be tripped by the vehicles, malfunctions are likely to occur.

The object on which the invention is based is that of safeguarding the simplicity of the drive of the friction wheels while reducing friction abrasion and the corresponding friction work.

This problem is resolved by the features in the characterising part of claim 1.

Friction wheels equipped with freewheeling devices are known per se from EP-A-0 114 129 which likewise relates to a rope haulage installation. In the stations of this installation a clock generator portions follows on from a deceleration portion which is fitted with friction wheels. Distributed along this clock generator portion there are on the one hand further friction wheels driven at a first speed while on the other there also extends, carrying entraining means, a timing chain which is driven at a second speed which is higher than the first speed. By virtue of the freewheeling devices on these further friction wheels, the entraining means, when they encounter vehicles within the clock generator portion, entrain these and accelerate them to the speed of the chain and at the preset timing interval.

In the case of the solution according to the invention, if two pneumatic-tyred wheels of different peripheral speeds simultaneously engage a friction plate, then whichever is the trailing friction wheel in the direction of movement of the vehicle determines the speed thereof, while the leading friction wheel in the direction of movement is able briefly to assume the same speed, by reason of the freewheel clutch. Since the turn between friction wheel and driving wheel which is permitted by the free-wheel clutch is peripherally restricted, a torque between

friction wheel and driving wheel can also be transmitted in the opposite direction of rotation after passage through the freewheeling zone.

According to the invention, the freewheel clutch can be inexpensively constructed in that it comprises entraining members which engage the friction wheel with peripheral clearance, for instance spring means being provided to maintain the entraining means in a normal position in relation to the friction wheel or to restore them to the normal position following a bottleneck situation.

By way of example, the object of the invention is explained in greater detail hereinafter with reference to the accompanying drawings, in which:

Fig.1 is a diagrammatic view of a rope haulage installation at one station;

Fig.2 is a sectional view through a pneumatic-tyred wheel with a V-belt drive and restoring springs, said pneumatic-tyred wheel engaging a friction plate of a vehicle;

Fig.3 is a side view of a plurality of pneumatic-tyred wheels of which the tow adjacent wheels are in engagement with the friction plate of the vehicle;

Fig.4 is a sectional view of the restoring spring inserted in the hub recess of the pneumatic-tyred wheel and in an angularly rotated position;

Fig.5 is a sectional view of the restoring spring inserted in a hub recess of the pneumatic-tyred wheel, in the normal position.

The drawings show an aerial ropeway as the rope haulage installation. However, the rope haulage installation can

also for example be used in foundries, for pallet conveyance, etc.

Fig. 1 shows a haulage rope 1 of the suspended aerial ropeway which in operation is constantly circulating, connecting a downstream station designated A and an uphill station, not shown. The suspended cable railway further comprises a plurality of vehicles one of which is shown at 2, the vehicles being coupled to and suspended from the haulage rope 1 for transportation between the stations.

At the stations, the vehicles 2 are supported by means of chassis 7 thereof on a transfer rail 4 leading from an arrival region B through a 180° arcuate portion C to a departure region D. Associated with the arrival region B and the departure region D are sets of pneumatic-tyred wheels 5a and 5b which comprise a plurality of pneumatic-tyred wheels disposed one after another in the direction of movement.

As can be seen from Figs. 1 and 3, the chassis 7 of each vehicle 2 has in addition to running wheels 7a which are supported on the transfer rail 4, two serially disposed clamps 3 which permit of coupling to the haulage rope 1. Each chassis 7 is finally equipped with a friction plate 8 extending in its longitudinal direction and rigidly connected to it and which extends parallel with the transfer rail. The length of the friction plate 8 is somewhat greater than the distance between two adjacent pneumatic-tyred wheels 5a, 5b, so that in the region of the wheel sets, the friction plate is constantly engaged with one of the pneumatic-tyred wheels. In the arrival region B, the pneumatic-tyred wheels 5a have the task of decelerating the vehicle which is arriving at rope speed,

by engaging the friction plate, while in the departure region D, the pneumatic-tyred wheels 5b accelerate the vehicle to rope speed. To this end, the individual pneumatic-tyred wheels 5a, 5b of each set are driven at speeds which diverge from each other in a manner which is to be described in greater detail hereinafter. In any case, in the arrival region B of the station, pneumatic-tyred wheels which follow one another in the direction of movement of the vehicles run at diminishing speeds, while in the departure region D, pneumatic-tyred wheels which follow one another in the direction of the rope run at increasing speeds.

Each wheel 5a is connected to a driving member in the form of a V-belt drive 6. Each wheel 5a comprises a hub 10 with a recess 13, a rim 11 and a tyre 12. Each wheel 5a is rotatably mounted on an axle 15 through two rolling bearings 13, the axle 15 likewise rotatably supporting two V-belt pulleys 6a and 6b. All axles 15 of the set of wheels 5a are mounted in a common plane parallel with one another on a bearer 20 which in turn extends parallel with the transfer rail 4 in the arrival region B. The belt pulleys 6a and 6b which are of different diameters are connected to one another by two diametrically disposed bolts 16 fitted with nuts 9 and of which the heads 16a engage diametrically disposed pockets 13a in the recesses 13 in the hub 10. Also inserted into the recess 13 or into one of the pockets 13a is a pretensioned restoring spring 14. As emerges clearly from Figs. 4 and 5, the restoring spring 14 forms two loops 14a, 14b of which the smaller loop 14a engages around the head 16a of one of the two bolts 16. The larger loop 14b of the restoring spring 14 engages at a distance around the axle 16 of the pneumatic-tyred wheel 5a, its end 14c being braced on the hub 10 at 10a.

According to the invention, the driving members or V-belt transmissions 6 with their wheels 5a are connected by in each case a freewheel clutch formed by the pockets 13a and the bolt heads 16a. As Figs. 4 and 5 show, bolts 16 which act as drive members have their heads 16a engaging with clearance in the pockets 13a of the hub 10 and allow the wheels 5a to turn through the angle α (Fig. 5) in relation to the driving members. Such a turn or twist out of the normal position shown in Fig. 5 into the extreme position shown in Fig. 4 is certainly possible in only one direction of rotation and only against the action of the pretensioned spring 14.

The aforescribed arrangement for the wheels 5a of the arrival region B likewise applies to the wheels 5b in the departure region D of the station.

The pneumatic-tyred wheels 5a and 5b of the two wheel sets of station A are driven by a driving motor designated M which also drives the haulage rope 1 via a rope pulley 1a around which the haulage rope 1 passes. For this purpose, the motor M is connected via a gearbox G and transmission shafts T to the rope pulley 1a and the wheels 5a' and 5b', these being the first wheel 5a of the arrival region B and the last wheel of the departure region D. As a result of the gearbox G, these two wheels 5a' and 5b' assume a peripheral speed which is the same as the peripheral speed of the rope pulley 1a and thus the speed of the haulage rope 1.

As can also be seen from Fig. 3, each V-belt transmission comprises a V-belt 6c which connects the smaller diameter belt pulley 6a of a wheel 5a or 5b to the larger diameter belt pulley 6b of the next wheel 5a or 5b to the left.

Correspondingly, a vehicle 2 arriving at the station A is gradually decelerated by the action of the wheels 5a on the friction plate 8. On the other hand, the wheels 5b gradually accelerate a vehicle 2 in the departure region D until this vehicle has reached rope speed as a result of the effect of the last wheel and can then be coupled in jolt-free fashion to the rope 1 by closure of the clamps 3.

The mode of action of the freewheel clutch will be explained hereinafter with reference to Figs. 3, 4 and 5 on a basis of the example of the departure region D, i.e. during acceleration of a vehicle 2 by reason the wheels 5b engaging its friction plate 8.

From the portion of the departure region D at which only one of the wheels 5b is acting on the friction plate 8 of a vehicle 2, accelerating this to a running speed corresponding to its peripheral speed, the vehicle is conveyed in the direction of the arrow 20' arriving thereby at the position shown in Fig. 3. At this stage, the friction plate 8 has its friction surface 8a engaging a second wheel 5b which follows on in the direction of movement and which is driven at a higher peripheral speed than the preceding wheel. At this latter wheel, the parts of the freewheel clutch are in the normal position shown in Fig. 5 and so the second wheel is rigidly entrained upon an anti-clockwise rotation of the V-belt transmission 6 or the bolt heads 16a. By a frictional connection with the friction surface 8a, the said wheel entrains the chassis on the transfer rail 4 at the higher peripheral speed at which it is rotating. At the same time, the friction plate 8 exerts a frictional force on the preceding wheel 5b which is driven at a lower peripheral

speed by its V-belt transmission 6. Thanks to the free-wheeling arrangement, then, the corresponding preceding pneumatic-tyred wheel is able to accelerate to the speed of movement of the friction plate 8 and thus lead its V-belt drive with a rotation of the parts against the action of the restoring spring 14 in the direction of the extreme position shown in Fig. 4. However, as soon as the friction plate 8 becomes disengaged from this preceding wheel, the restoring spring 14 turns it back into the position in which the parts of the clutch assume the normal position shown in Fig. 5.

Therefore, thanks to the freewheel clutch, frictional wear and tear is substantially reduced by the simultaneous action on the same friction plate of two pneumatic-tyred wheels which are driven at different speeds, since the described process is repeated on all the wheels 5b of the departure section.

On the wheels 5a of the arrival section B, the freewheel clutches have the same function. Once again, the free-wheel clutch is so incorporated that the following wheel, in the direction of movement - in this case the wheel which is being driven at the lower peripheral speed - determines the speed of the leading wheel which is in engagement with the same friction plate. Upon a deceleration by the trailing wheel, the (in the direction of movement) leading wheel is likewise decelerated until such time as it is no longer engaged with the friction plate. During this time, the V-belt drive leads its wheel.

The angle α is chosen as a function of the amount by which the engagement path of the friction plate 8, determined by

length and design, is greater than the distance between two wheels or their axles. It has been found that an angle α of about 10° is sufficient to terminate simultaneous engagement of two wheels before they reach the extreme position shown in Fig. 4. The extreme position in Fig. 4 is only reached when for example in the case of a breakdown, the pneumatic-tyred wheels have to be driven in a reverse direction in order to move vehicles backwards. The friction plate 8 may consist of a synthetic plastics material and the friction surface may be provided with raised portions, for example transversely extending ribs.

Generally, some of the wheels 5a at the end of the arrival region B and at the beginning of the departure region D are driven at the same speed as one another. Correspondingly, no freewheel clutch is required between these wheels and their driving members.



PATENT CLAIMS

1. A rope haulage installation, particularly an aerial ropeway, comprising a haulage rope (1), circulating between two stations and vehicles (2) which are uncoupled from the rope in the stations, a transfer rail (4) provided in each station and forming an arrival region (B) and a departure region (D), friction wheels (5a, 5b) which are arranged along the transfer rail in the arrival and departure regions and are coupled to driving members, and which co-operate with friction plates (8) of vehicles supported on the transfer rail, in which at least some of the friction wheels in the arrival and departure regions run at different peripheral speeds compared with immediately adjacent friction wheels, in order gradually to decelerate incoming vehicles and to accelerate outgoing vehicles gradually and in which the friction plates are of a length which is greater than the distance between adjacent friction wheels which run at different peripheral speeds, characterised in that the friction wheels (5a, 5b) of different peripheral speed are connected via freewheel clutches (13, 16a) to their driving members (6) which are so installed as to permit a lag in the arrival region (B) and a lead in the departure region (D) of the friction wheels in relation to their driving members and each of which comprises means to limit the turning of the friction wheel (5a, 5b) relative to the driving member (6) as well as further means (14) to restore friction wheel and driving member to a predetermined position.



2. A rope haulage installation according to claim 1, characterised in that the further means comprise a return spring (14).
3. A rope haulage installation according to claim 2, characterised in that entraining members (16a) which engage with clearance pockets (13a) in a hub (10) of the pneumatic-tyred wheel (5a, 5b) are provided on the driving member which comprises V-belt pulleys (6a, 6b) and in that the restoring spring (14) is clamped between the hub and the V-belt pulleys.
4. A rope haulage installation according to claim 3, characterised in that the pneumatic-tyred wheel (5a, 5b), through its hub (10) and V-belt pulleys (6a, 6b) is mounted to rotate on a common axle (15) and in that the restoring spring (14) which is disposed in a recess (13) in the hub (10) forms two loops (14a, 14b) of which a larger loop (14b) engages around the axle (15) while a smaller loop (14a) engages around a bolt (16) provided as an entraining member on the V-belt pulleys (6a, 6b).
5. A rope haulage installation according to claim 4, characterised in that the bolt (16) connects the two V-belt pulleys (6a, 6b) in rotationally rigid fashion and has a bolt head (16a) around which the smaller loop (14a) engages.

Four sheets of drawings