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[54] **TRANSPORTATION INSTALLATION**

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[52] **U.S. Cl.** **104/105,** 104/130, 198/185

[51] **Int. Cl.** **E01b 25/26**

[58] **Field of Search** ..... 104/23 FS, 88, 89, 104/96, 105, 130, 134, 165, 172; 198/185; 214/38 CB, 42 R

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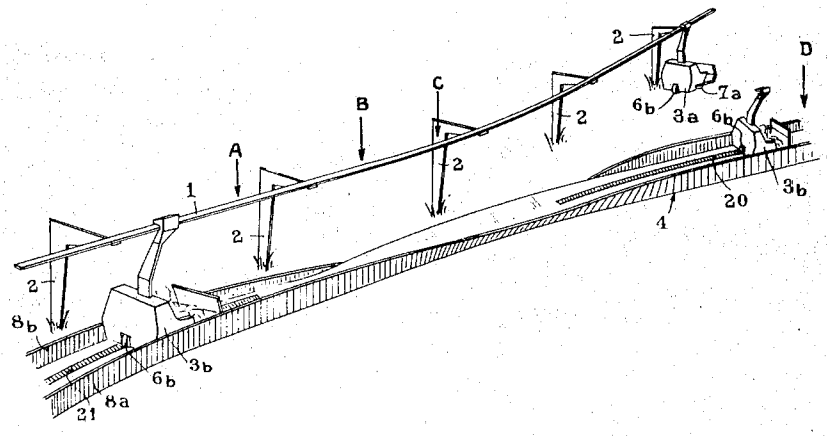
[57] **ABSTRACT**

A transportation installation having an overhead conveyor means including a main conveyor, a substantially ground level loading and unloading loop having a decelerator conveyor for receiving cars from the main conveyor and moving them, while slowing their speed relative to the decelerating conveyor, to a loading and unloading station of the loop, and an accelerator conveyor for moving the cars from the station to the main conveyor while accelerating their speed to the speed of the main conveyor. The cars of the transportation installation each have at least one lower carrying wheel movable vertically relative to the car for engaging the accelerating and decelerating conveyors of the loop to cause the car to be supported and moved thereby, and an overhead shoe mounted on the car for vertical movement relative thereto and for engaging the main conveyor and thus suspending the car therefrom. The car also has a hydraulic means for moving the shoe between its lower operative position and upper inoperative position relative to the car, for moving the carrying wheel between its lower operative and upper inoperative position relative to the car, and for automatically operating a braking means of the wheel.

16 Claims, 6 Drawing Figures



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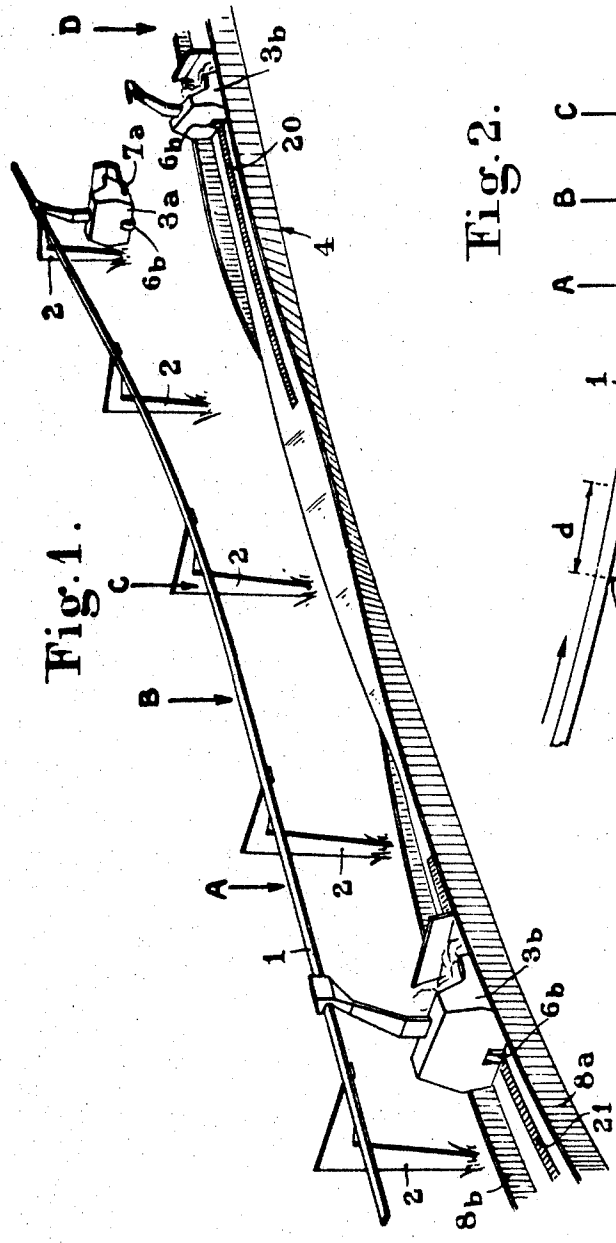

Fig. 1.

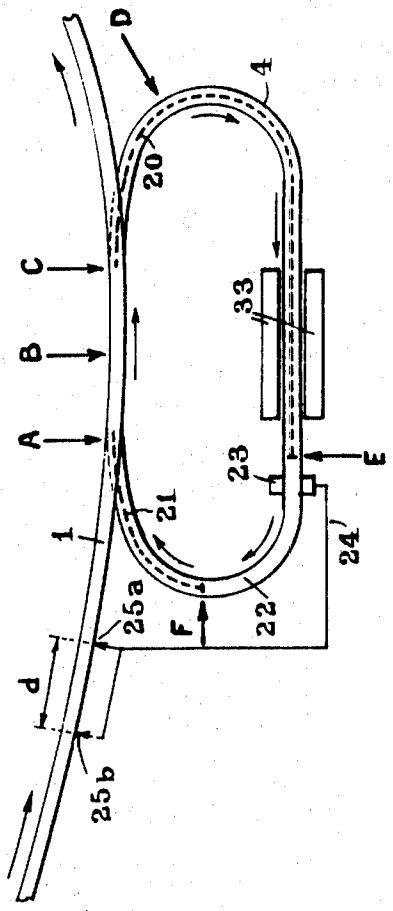

Fig. 2.

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Fig. 3.

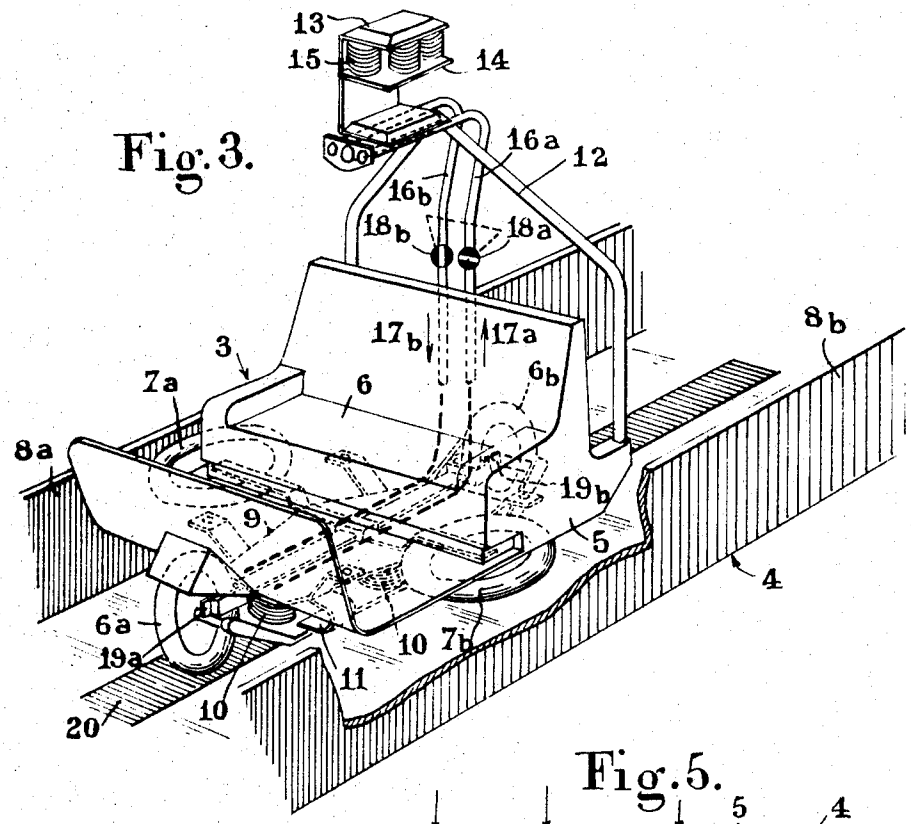


Fig. 5.

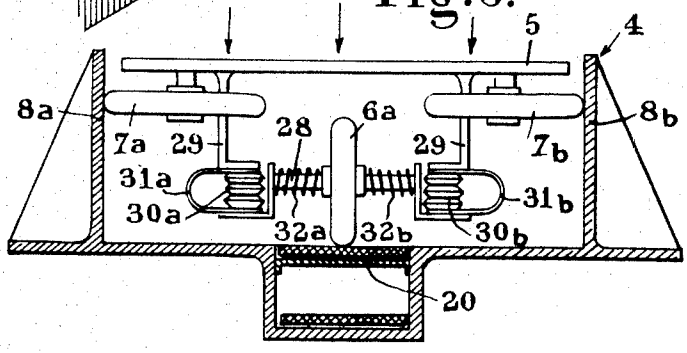
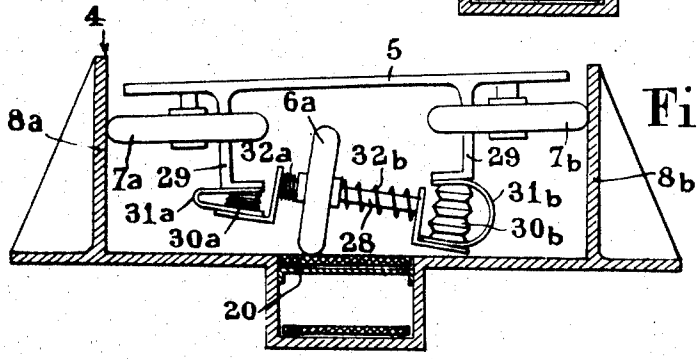


Fig. 6.



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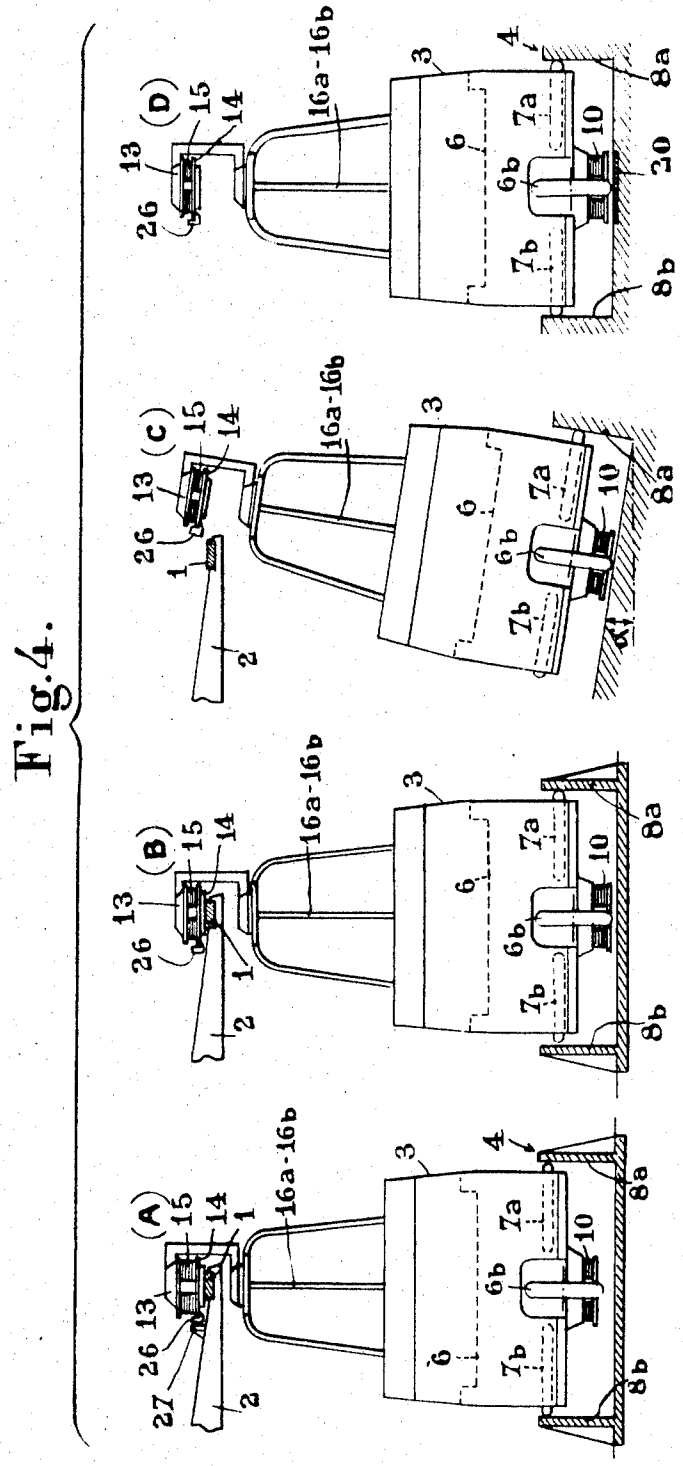

Fig.4.

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TRANSPORTATION INSTALLATION

The present invention relates to a transportation installation, particularly for passengers.

There are numerous applications for transportation installations, in particular for passengers, making it possible to serve a relatively large number of stations situated at average distances from one another; as non-limiting examples of such applications there are urban and suburban transportation systems, the service of various pavilions at an exposition, or the various parts of the premises of a technical or administrative center, etc. All these applications necessitate transportation installations with high traffic capacity, high frequency of service of each of the stations, and the possibility of selective service of each station in the installation from any other station. The latter condition is particularly difficult to meet because, at any given moment and in any given station of the installation, the number of passengers wishing to go to another station of the installation is relatively small in direct proportion to the number of stations in the installation, provided the traffic is distributed in a substantially uniform manner among them. This problem can be solved by equipping the passenger transportation installation with a large number of vehicles, each of small capacity, and capable of being taken from any station of the installation toward another station selected at will. But, although the use of small-capacity vehicles, i.e., designed, for example, for two or four passengers only, offers the great advantage of a substantial reduction in the time necessary to unload and reload each vehicle in each station, this is incompatible with the obtention of high traffic capacity, except insofar as the vehicles, independently of one another (i.e., not "coupled") follow one another on the main track of the said installation at very short intervals, corresponding, for example, to a period of several seconds. The embodiment of a transportation installation of the type mentioned, having high traffic capacity, therefore raises the problem, which is technically very difficult to solve, of temporary and selective stopping at selected stations because of the many vehicles following one another at very short intervals on the main track of said installation. If each station in the installation is served, for example, by a special secondary or side track connected to the main track, the said problem is one of selective switching or shunting, toward some of the secondary or side tracks of the installation, of some of the many vehicles following one another at very short intervals on the main track; in other words there is a problem of selective switching or shunting at a very fast rate. A technical solution of this problem cannot be conceived of unless the instantaneous positions of the various vehicles on the main track of the installation are defined with very great precision, i.e., in particular with an error much smaller than the anticipated interval between the various successive vehicles, which imples also equally high precision as to the instantaneous speeds of the various vehicles. Moreover, the use of vehicles of small capacity, hence of relatively small size, does not make it easy to equip them with a self-contained source of energy, which would very substantially increase their bulk, weight and cost.

The transportation installation according to the present invention makes it possible to solve all the problems, and meet all the conditions indicated above, under the best conditions of technical simplicity and of profitability. It is characterized in that it comprises, essentially, a conveyor of known type, supported above the ground so as to be substantially-parallel thereto; running tracks, each of which connects an ingoing switching or shunting zone and an outgoing switching or shunting zone, is placed below the conveyor, and passes through one of the various stations of the installation, situated at a distance from the said conveyor; passive vehicles, each equipped at the bottom with at least one vertical wheel and at the top with a shoe by means of which it can be suspended from the conveyor; and means, when a vehicle passing through a switching zone is supposed to stop at the corresponding station, for changing the said vehicle from one to the other of its two positions of suspension from the conveyor by its upper shoe and of running on the track with its train of lower wheels.

Since the main track of the transportation installation according to the present invention is constituted essentially by a conveyor which can be of a known type, in particular a belt, cable, chain or other suitable type, the speed of which can be easily kept constant, and largely independent of the load on the said conveyor, the instantaneous positions and speeds of the vehicles which it entrains are always defined with sufficiently high precision to eliminate any error in the selective switching of the vehicles from the said conveyor toward the running tracks serving the various stations of the installation, even in the event the said vehicles follow one another on the conveyor at intervals small enough to obtain a high capacity of traffic. The transportation installation according to the present invention can therefore be equipped with a relatively large number of vehicles of low capacity, hence of small size, whose stopping times at the stations can therefore be brief. The use of a conveyor to form the main track of the transporation installation according to the present invention provides the supplementary advantage of the use of passive vehicles exclusively without any self-contained source of energy which could increase the size, weight and cost of each vehicle.

The use of passive vehicles in the transporation installation according to the present invention does, however, raise the problem of controlling them on the running track serving each station, with a view in particular to stopping them at the corresponding station, then starting them up again and accelerating them toward the outgoing switching zone where they must reach the speed of the conveyor in order to be switched toward the latter; this problem is solved in a particular advantageous manner in a preferred form of embodiment of the transportation installation according to the invention, in which the wheel train of each vehicle is equipped with brakes, making it possible, in particular, to slow the vehicle down just beyond the ingoing switching zone of each secondary or side track, while means are provided just before the outgoing switching zone of each secondary or side track to accelerate the vehicle up to the speed of the conveyor. The last-mentioned means preferably consists of a starting conveyor belt moving at the speed of the conveyor on leaving the corresponding station. The vehicle which is to leave this station, and whose brakes are released, begins to move on this belt, then stops with respect to it by braking its wheels and is moved by the belt up to the outgoing switching zone, in which the vehicle is entrained at the speed of the conveyor by the said starting belt. These various means permit a gradual stop and re-

start of each vehicle in the stations, so as to avoid exposing the passengers to unpleasant decelerations and accelerations. The same means also permit avoidance of the use, for slowing and accelerating the vehicles, of suitably inclined ramps, the embodiment of which would necessitate structures of great height even for an average speed of the conveyor.

In a preferred form of embodiment of the transporation installation according to the invention, the means for changing a vehicle in a switching zone from one to the other of its two positions, of suspension from the conveyor and of running on the track, are arranged so as to make th vertical distance between the bottom parts of the shoe and the train of wheels of the said vehicle optionally larger or smaller than the vertical distance between the upper faces of the conveyor and of the running track. Although the means last mentioned may be embodied in diverse ways, some of them purely mechanical, they are preferably designed according to the patent application entitled "Transportation Installation, Particularly For Passengers" filed the same date as this application by Francois Giraud and assigned to the same assignee as this application. In this case, the shoe and the wheel train of each vehicle are suspended from its upper and lower parts respectively by two sets of bellows with controllable communication, containing a total volume of fluid smaller than the sum of their maximum volumes, and means are provided to open, temporarily, the communication between the two sets of bellows in a switching zone, so that the weight of the vehicle will then cause the partial emptying of the fuller set of bellows into the emptier set of bellows, and consequently the two positions of the vehicle, suspension from the conveyor by its shoe and running on the track with its train of wheels, will be exchanged. The latter form of embodiment of the vehicles of the transportation installation according to the present invention can be improved as follows: the brakes of the wheel train of each vehicle, of the hydraulic or pneumatic type, are fed from the set of bellows which is the fuller, by ducts in which retarder means can be inserted. Thanks to the latter arrangement, the action of the brakes of each vehicle engaged on a running track is always proportional to the pressure prevailing in the fuller set of suspension bellows, that is to say, in the present case, the engaging bellows of the wheel train; in other words, the braking power of the vehicle wheels is always proportional to the weight of the loaded vehicle, so that both decelerations and accelerations of the vehicle on the running track can be made largely independent of the useful load of the said vehicle.

According to another optional and advantageous characteristic of th transportation installation according to the present invention, the wheel train of each vehicle comprises at least one vertical carrying wheel mounted in the median, longitudinal plane of the vehicle, and at least two horizontal guide wheels mounted on either side of the said median plane so as to roll on vertical guide surfaces placed on either side of the running track.

By way of example, a form of embodiment of a passenger transportation installation according to the present invention has been described below and illustrated diagrammatically in the attached drawing.

FIG. 1 represents, schematically, in perspective, one of the zones of the transportation installation in which a running track, serving a station and forming a closed loop, passes below the conveyor constituting the main track.

FIG. 2 is a plan view of the running track forming a closed loop, a part of which is represented in FIG. 1.

FIG. 3 represents, in perspective, one of the vehicles of the transportation installation in position for running on a running track.

FIG. 4 represents, in a plane transverse to the running track in FIG. 2, the various phases of switching a vehicle from the conveyor toward the said running track.

FIG. 5 represents, schematically, in a plane transverse to the running track, a particular form of embodiment of the wheel train of a vehicle of the transportation installation, as well as its system of suspension.

FIG. 6 represents, schematically, the configuration of the wheel train in FIG. 5, and of its system of suspension, in the case where the corresponding vehicle is loaded dissymmetrically with respect to its median plan.

The passenger transportation installation according to the present invention, comprises, essentially, a main track, formed by a conveyor (FIG. 1) which is supported above the ground, so as to be substantially parallel thereto, by suitably spaced pylons 2. The conveyor 1 can be of a suitable known type; it can, in particular, be a belt, cable, chain, or a conveyor of some other suitable type. Along the main track 1 of this transportation installation, and somewhat removed from this main track, are disposed stations (33 in FIG. 2), each of which is served, from the said main track, by a secondary track, in particular a running track 4; in the considered form of embodiment of the invention, each of the running tracks 4 forms, as can be seen in the plan view in FIG. 2, a closed loop which passes through station 33 and which runs below conveyor 1 in a zone A-B-C, best seen in FIG. 1, that serves for switching between the main track 1 and the secondary track 4 under consideration. The passenger transportation installation according to the present invention also includes passive vehicles which are adapted to cooperate some times with the conveyor 1 of the main track (such as vehicle 3*a* in FIG. 1), and sometimes with one of the running tracks 4 (such as vehicle 3*b* in FIG. 1). Each of the vehicles 3 of the said installation is of the "passive" type, i.e., it has no self-contained source of energy; since it is also made with low capacity (the vehicle illustrated in FIG. 3, for example, can carry only two passengers), each vehicle can be of relatively small size and low weight, and hence of relatively low cost, which is particularly advantageous in the embodiment of transportation installations with high traffic capacity and comprising a large number of small vehicles of this type. In the form of embodiment illustrated in FIG. 3, each of the vehicles 3 of the said transportation installation is constituted essentially by a chassis 5 which carries a bench 6 that permits, for example, two passengers to sit side by side, and which is equipped underneath with a train of wheels allowing the vehicle 3 to run on running track 4; in the said form of embodiment, this wheel train has two vertical carrying wheels, 6*a* and 6*b*, grouped in the longitudinal median plane of the vehicle, and two horizontal wheels 7*a*, 7*b*, mounted on either side of the said median plane so as to roll on the vertical guide surfaces, 8*a*and 8*b* placed on either side of the running track 4. While the horizontal guide wheels 7*a*, 7*b* are mounted directly on the chassis 5 of

the vehicle **3**, the two vertical carrying wheels **6***a*, **6***b* are mounted on a support **9**, for example in the shape of a plate, which is itself suspended below chassis **5** of the vehicle by a set of communicating bellows **10** filled with a fluid under pressure; in the said form of embodiment, this set of communicating bellows comprises a first pair of bellows aligned in the direction of movement of the vehicle, and a second pair of bellows aligned in the direction perpendicular thereto, and chokes can be provided, in known fashion, in the communications between the various bellows (these communications as well as the corresponding chokes have not been represented in order not to complicate the figures) Spring leaves such as **11** are mounted between the chassis **5** of the vehicle and the support **9**, so as to compress bellows **10**. As seen in FIG. **3**, toward the rear of vehicle **3**, a vertical structure **12** extends from chassis **5** and rises well above the heads of the passengers seated on bench **6**. The upper end of structure **12** supports a sort of fork, from the upper branch **13** of which there is suspended a shoe **14**, which can work with the upper face of conveyor **1** (FIG. **1**). Suspension of the shoe **14** from the branch **13** is by a set of communicating bellows **15**, similar to the lower set of bellows **10** and filled, like it, with a fluid under pressure. According to the patent application already cited, means are provided to produce communication, temporarily and at will, between the two sets of suspension bellows **10** and **15** with which each vehicle **3** of the said transportation installation is equipped. These means of communcation can be embodied and controlled in any one of various ways described in the patent application just cited; in FIG. **3**, these same means have been diagrammatically shown as two ducts **16***a* and **16***b* inserted between the two sets of bellows **10** and **15** and in series, respectively, with two check valves (not shown) having mutually opposed directions of passage as indicated by arrows **17***a* and **17***b*. Control valves **18***a*, **18***b* respectively, are inserted in the two ducts **16***a*, **16***b*, and coupled to one another in such a way that one of the two is always in open position and the other in closed position, as represented in FIG. **3**. The means of coupling the two control valves **18***a* and **18***b* have not been shown because they can be embodied in diverse ways, well known to the man skilled in the art; one of them, described in the Applicant's patent application just cited, consists in grouping the two two-way control valves in a single control valve with at least three positions. The two sets of bellows **10** and **15** contain a total volume of fluid under pressure which is less than the sum of their maximum volumes. Furthermore, the vertical carrying wheels, **6***a*, **6***b* aare provided with brakes, for example disc brakes **19***a* and **19***b*, with hydraulic or pneumatic control, actuated from the pressure prevailing in the lower set of bellows **10**.

In the form of embodiment of the transportation installation according to the invention under consideration, each running track **4**, in the form of a closed loop, includes the following four successive zones: switching zone A-B-C (already mentioned), an arrival zone, a departure zone, and a waiting zone. Within the switching zone A,B,C, at least one of the vertical guide surfaces **8***a* and **8***b* is eliminated, or at least greatly lowered (see FIG. **1**). The arrival zone (FIG. **2**) extends substantially from the lower end C of the said switching zone to the vicinity of the outlet E from station **33** served by running track **4**; in this arrival zone of the running track **4** there is disposed, along the longitudinal axis of the said running track, an arrival conveyor belt **20** (dotted lines in FIG. **2**) moving at a slow speed, at most equal to walking speed, from C to E, hence passing all the way through the corresponding station **33**, at this low speed. Between a point F situated beyond the outlet from station **33** and the upstream end of switching zone A, the running track **4** has a departure zone in which it is equipped, along its longitudinal axis, with a conveyor belt **21** (dotted lines in FIG. **2**) moving at the speed of the conveyor **1**; finally, between points E and F of the running track, i.e., between the end of the arrival conveyor belt **20** and the beginning of the departure conveyor belt **21**, running track **4** has the waiting zone, of which there are various possible embodiments. One of these forms of embodiments of the waiting zone comprises a conveyor belt, displaced by known means **23** from E toward F when they receive, over line **24**, respective signals coming from two pickups **25***a* and **25***b* which are disposed along conveyor **1** at a distance *d* from one another equal to twice the normal interval of the vehicles transported by conveyor **1**, so as to detect the passage of the various vehicles.

The passenger transportation installation according to the present invention, just described, works as follows:

Between two successive stations of the installation, the vehicles **3** are suspended at regular intervals, (equal to *d*/2) from conveyor **1**, which entrains them at uniform speed and on the upper face of which each one of them rests by the lower face of its shoe **14**. The upper set of bellows **15** is not at maximum extension, because it is the fuller; and duct **16***b* which would allow the upper bellows set **15** to drain into the lower set of bellows **10** is cut off by control valve **18**b, which is in its cut-off position (different from that represented in FIG. **3**). Meanwhile the lower set of bellows **10** is the emptier, with the result that the vertical carrying wheels **6***a* and **6***b* are partially retracted under vehicle **3**, as seen at the bottom of FIG. **4**A. For the same reason, the brakes **19***a*, **19***b* of carrying wheels **6***a*, **6***b* are released. The pitching and rolling movements of vehicle **3** are damped, respectively, by chokes inserted in the communicating ducts of the pairs of bellows in the upper set of bellows **15** which are aligned respectively in the direction of movement of vehicle **3** and perpendicular thereto. When a vehicle **3**, entrained by conveyor **1**, reaches the upstream end A of the switching zone of a running track **4** serving a station **33**, a comparator **26** (FIG. **4**A), fixed, for example, to shoe **14**, compares the coded indicator of station **33** which is borne by a suitable means **27** fixed, for example, on a pylon **2** with a coded indication of the destination of vehicle **3** selected, for example, by its passenger or passengers when they have taken their places, thanks to known means which it is not necessary to describe. If the code of the destination selected by the passengers and the code of station **33** coincide, comparator **26** will produce a signal, for example, an electrical one, which is transmitted to a control device, which can be electromagnetic, for valves **18***b*, **18***a* coupled to one another, so as to bring them into their open and closed positions respectively, represented at FIG. **3**; thanks to the opening of duct **16***a*, the upper set of bellows **15** empties partially and gradually into the lower set of bellows **10**, under the influence of the weight of the vehicle **3** and its load. The result is on the one hand a gradual com-

pression of the upper set of bellows **15** and consequently a drop in the center of gravity of vehicle **3**, and, on the other hand, a gradual expansion of the lower set of bellows **10** and hence the descent of vertical wheels **6***a*, **6***b* below chassis **5** of vehicle **3**; these two simultaneous movements concur to bring the lower edges of vertical wheels **6***a*, **6***b* toward the upper face of running track **4** above which the said vehicle **3** is now passing (FIG. **4**A which corresponds to the passage of vehicle at the level of point A in FIGS. **1** and **2**). FIG. **4**B, which corresponds to the passage of vehicle **3** at the level of point B in FIGS. **1** and **2**, illustrates the situation at the instant when the upper and lower sets of bellows **15** and **10**, respectively, have reached their minimum and maximum volume, respectively, and where, consequently, the lower edges of vertical wheels **6***a* and **6***b* will come in contact with running track **4**. Although the maximum pressure is now prevailing in the lower set of bellows **10** from which brakes **19***a*, **19***b* of the carrying wheels **6***a*, **6***b* are fed, these brakes remain released, thanks to retarding means not shown, inserted in the ducts feeding these brakes, so that vehicle **3** begins to run on running track beyond point B. FIG. **4**C, which corresponds to the passage of the vehicle at the level of point C in FIGS. **1** and **2**, which point is toward the downstream end of the switching zone considered, shows that at this level the running track is banked at an angle α, and in the proper direction to pivot the median plane of the vehicle **3** so that its shoe **14** will cease to be above conveyor **1**; the cooperation between horizontal wheel **7***a* and the corresponding vertical guide surface **8**a now prevents vehicle **3** from upsetting. It is, of course, this same cooperation between horizontal wheels **7***a* and **7***b* on the one hand, and vertical guide surfaces **8***a* and **8***b* on the other hand, which insure the stability of vehicle **3** as soon as it begins to run on running track **4**, and which also insures automatic guidance on the curves of this running track. Furthermore, during this running phase of vehicle **3**, the compensation for the effects of pitching and rolling due to irregularities in the running track is effected by the two pairs of bellows in the lower set **10**, under the conditions described above in reference to the upper set of bellows **15**. Beyond point C, running track **4** becomes horizontal again, as seen in FIG. **4**D, and vehicle **3** begins to run, by means of its carrying wheels **6***a* and **6***b* on the conveyor belt **20** which is moving with a low speed, less than walking speed; but brakes **19***a* and **19***b* begin to be fed from the lower set of bellows **10**, and to gradually brake the carrying wheels **6***a* and **6***b* of vehicle **3** so as to gradually diminish its relative speed with respect to the conveyor belt **20**. This braking phase is arranged in such a way that brakes **19***a* and **19***b* of wheels **6***a* and **6***b* of vehicle **3** will be fully applied before the latter has reached the entrance to station **33**, so that the said vehicle is then entrained at walking speed through the said station by conveyor belt **30** on which it is fixed, the low speed at which the vehicle **3** is passing through station **33** allows passengers to step out of the vehicle and any new passengers to get in without trouble. These two operators of unloading and reloading the vehicle can optionally take place simultaneously on the two opposite sides of the vehicle. In the form of embodiment of the installation illustrated in FIG. **2**, described above, the passage of each vehicle **3** from the end E of the arrival conveyor belt **20** to the corresponding origin of the conveyor belt in the waiting zone **22**, causes for example, a limited advance of the latter belt, particularly over a distance just sufficient to clear the necessary space at the origin of the waiting zone for the following vehicle. The various vehicles brought successively onto the waiting zone conveyor belt **22** are thus gradually transferred toward the end F of the said waiting zone, as other vehicles emerge from the station **33**. But, as soon as pick-ups **25***a* and **25***b* have determined, between two successive vehicles entrained by conveyor **1**, an interval at least equal to twice the minimum established interval, line **24** transmits a suitable release signal to the entrainment device **23** of the waiting zone conveyor belt **22**, causing a rapid transfer to the end F of the said waiting zone **22** of the first of the vehicles waiting in this zone. Automatic means, of which there are various possible embodiments, that simultaneously shift this first waiting vehicle from the end of the conveyor belt in zone **22** to the head of the departure conveyor belt **21**, on the one hand, and release brakes **19***a*, **19***b* of the carrying wheels **6***a*, **6***b* of this vehicle **3** on the other hand. The vehicle **3** then begins to run on conveyor belt **21** at a relative speed equal to the difference between the speed of the said conveyor belt **21**, which is equal to that of conveyor **1**, and the fast-advance speed of the conveyor belt in waiting zone **22**; the automatic means already mentioned then cause a gradual reapplication of the brakes **19***a*, **19***b* and the vehicle **3** is gradually accelerated by the conveyor belt **21**, the speed of which is finally reached by the said vehicle when its brakes **19***a* and **19***b* are fully applied. This vehicle is then entrained by the departure conveyor belt **21** toward the upstream end A of the switching zone of running track **4** at a speed that is practically equal to that of conveyor **1**. The automatic means already mentioned then cause the inversion of the positions of the control valves **18***a* and **18***b* and consequently, under the influence of the weight of loaded vehicle **3**, the partial and gradual emptying of the lower set of bellows **10** into the upper set of bellows **15**, through duct **16***a*. Toward point B (FIGS. **1** and **2**), the lowering of the center of gravity of vehicle **3**, still resting on running track **4** by means of carrying wheels **6***a* and **6***b*, and the increasing expansion of the upper set of bellows **15**, concur to bring shoe **14** in contact with the upper face of conveyor **1**; the retraction of carrying wheels **6***a*, and **6***b* continues, and vehicle **3** ceases to run on the running track and is entrained by conveyor **1** beyond point C. This shunting is carried out in a particularly gentle fashion because vehicle **3** was already animated with the same speed as the conveyor when its shoe **14** came in contact with the upper face of the said conveyor. The emptying of the lower set of bellows also produced, with a certain amount of delay, the release of brakes **19***a* and **19***b* of carrying wheels **6***a* and **6***b*. The other vehicles waiting on the conveyor belt of zone **22** are inserted into the train of vehicles entrained by the conveyor **1** when pickups **25***a* and **25***b* establish other gaps in this train of vehicles.

The form of embodiment of the transportation installation according to the present invention, which has just been described, can be varied in numerous ways, some of which are obvious to the man skilled in the art and all of which come within the scope of the invention. Some of these variants will be mentioned below. The running tracks serving the various stations of the installation do not necessarily form closed loops, as illustrated in FIG. **2**; it is sufficient that each of these

running tracks joins an ingoing switching zone and an outgoing switching zone, both placed below the conveyor; these two switching zones, instead of being merged into a single zone A - B - C as in FIG. **2**, can be at points on the main line, formed by conveyor **1**, more or less spaced from one another. The wheel train with which each vehicle of the installation according to the present invention is equipped can comprise a variable number of vertical carrying wheels. In the event that it comprise only one vertical carrying wheel, placed in the median plane of the vehicle, the wheel train of this vehicle must also comprise at least two horizontal and lateral guide wheels, as illustrated in FIG. **3**, but other means can be provided to guide each vehicle on the running track; the latter can comprise, for example, one or more rails. In the case of two rails, the lateral guidance by horizonal wheels naturally becomes unnecessary. And just as the deceleration of each vehicle just after the ingoing switching zone of each secondary track can be caused by other means than brakes mounted on the vehicle, particularly by track brakes, the means for accelerating each vehicle, just before the outgoing switching zone of the side track, up to the speed of the conveyor can differ from those described above and illustrated in FIG. **2**; among these other means, mention has already been made of the ramps in the running track, with suitable inclinations. Other equivalent means are well known in the art. These means can, of course, be arranged in such a way as to cause a complete stop of the vehicles in the stations of the installation. The brakes of the carrying wheels of each vehicle can also be embodied in a manner different from that described above and can be, in particular, powered by other sources of energy than the fluid under pressure contained in the sets of suspension bellows of the vehicle. The waiting zone with which each running track is equipped, and where each vehicle emerging from the corresponding station is stored before it can be reintroduced into the train of entrained vehicles by the conveyor forming the main track of the installation, can be embodied in diverse ways different from the one described above; it can, for example, comprise a group of short, parallel waiting tracks on which the various vehicles coming from the station are stored, thanks to two sets of multiple switches, automatically controlled. A description was given above of a form of embodiment, according to the patent application already cited, of means with which each vehicle is provided in order to shift it from one to the other of its two positions (i.e. of suspension from the conveyor and of running on the running track); in a broader sense, each vehicle of the installation according to the present invention can be provided with means for causing, at will, in a switching zone, the vertical distance between the bottom parts of the shoe and of the wheel train of the said vehicle to be larger or smaller than the vertical distance between the upper faces of the conveyor and of the running track. The latter means can be embodied in particular by purely mechanical or, optionally, electromechanical means not interfering with the means of suspension of the vehicle itself in its position of suspension from the conveyor and in its position of running on the track. But in the case of the embodiment described, each of the two sets of upper and lower communicating bellows can be embodied in diverse ways differing from one another chiefly by the number and arrangement of the bellows as well as by the embodiment of means for putting the upper and lower sets of bellows temporarily in communication in a shunting zone.

FIGS. **5** and **6** illustrate a particular advantageous form of embodiment of the wheel train of a transportation vehicle according to the present invention and of the suspension device for this wheel train; in these figures only the chassis **5** of the vehicle has been represented, on the lower face of which chassis are mounted, on either side, the two horizontal guide wheels, **7***a* and **7***b* designed to insure the stability of the vehicle about its longitudinal axis by rolling on the vertical guide surfaces **8***a* and **8***b*. In FIG. **5**, a vertical carrying wheel **6***a* is also shown, which wheel is applicable to the conveyor belt **20** of running track **4**. This vertical wheel is mounted to slide on a transverse axle **28** which is suspended by its two ends from chassis **5** of the vehicle by means of vertical pieces **29** and elastic suspension means constituted, in the form of embodiment considered, by two communicating bellows, **30***a* and **30***b* filled with a fluid under pressure and inserted between the parts **29** and the corresponding ends of the said transverse axle **28**. Each of the bellows **30***a* and **30***b* is subjected to the action of a compression spring **31***a* or **31***b* so that axle **28** will be horizontal and parallel to the chassis of the vehicle when the load on the latter, symbolized by the descending arrows in FIG. **5**, is distributed symmetrically in relation to the median plane of the vehicle; the carrying wheel **6***a*, mounted to slide on the transverse axle **28**, is also subjected on each side to return forces produced by helical springs **32***a*, **32***b* disposed on the ends of the transverse axle **28** in such manner that the said sliding wheel **6***a* will be returned toward the median plane of the vehicle when its load is distributed symmetrically (FIG. **5**).

FIG. **6** illustrates the position of the various parts represented in FIG. **5** when the resultant of the loads of the vehicle is applied at a point on its chassis **5** that is eccentric to the median plane of the said vehicle; the compression of the bellows **30***a* and spring **31***a*, as well as the compression of helical spring **32***a* and the expansion of helical spring **32***b* allow chassis **5** and transverse axle **28** to assume positions inclined in opposite directions to the horizontal plane, the carrying wheel **6***a* being repelled toward the end of the said axle, situated on the side where the resultant of the loads is applied; at the same time, the cooperation between guide wheel **7***a* and the corresponding vertical guide surface **8***a* prevents the vehicle from overturning. This form of embodiment is particularly suited to reinforce the stability of the transportation vehicle in zones where the running track is banked (FIG. **4C**).

While only one embodiment of the invention, together with modifications thereof, has been described in detail herein and shown in the accompanying drawings, it will be evident that various further modifications are possible in the arrangement and construction of its components without departing from the scope of the invention.

What is claimed is:

1. Transportation installation, particularly for passengers, characterized in that it comprises passive vehicles, a conveyor of known type supported above the ground so as to be substantially parallel thereto and extending throughout the length of a course through which the vehicles are to be carried, running tracks, each of which tracks connects an incoming switching or shunting zone and an outgoing switching or shunting

zone, placed below the conveyor and passing through one of the various stations of the installation that is situated at a distance from the said conveyor, each of the passive vehicles being equipped on its bottom with at least one vertical wheel and having mounted on its top a shoe by means of which it can be suspended from the conveyor, and means for selectively moving the vehicle, when it is passing through a switching or shunting zone, between one position in which its shoe rests on top of and suspends the vehicle from the conveyor and another position in which the entire shoe is spaced from the conveyor and the vehicle is supported on the track by its at least one wheel, the conveyor and the track being spaced apart by one uniform distince throughout the region of track in which the switching function takes place.

2. Installation according to one of claim **1** characterized in that the at least one wheel train of each vehicle is equipped with brakes, in particular for decelerating the vehicle just beyond the incoming switching or shunting zone of each secondary or side track, and that means are provided, just before the outgoing shunting zone of each side track to accelerate the vehicle up to the speed of the conveyor.

3. Installation according to claim **2,** characterized in that at least one of the running tracks includes an arrival conveyor belt moving at a speed at the most equal to a walking pace and extending from the incoming switching or shunting zone through the corresponding station.

4. Installation according to claim **2,** characterized in that at least one of the running tracks comprises a departure conveyor belt moving at the speed of the conveyor and extending from the outlet of the corresponding station to the outgoing switching or shunting zone.

5. Installation according to claim **4,** characterized in that at least one of the running tracks comprises, between the arrival and departure conveyor belts, a waiting zone constitued by another conveyor belt, and that means are provided for shifting a vehicle from the waiting zone to the departure conveyor belt each time a sufficient interval has been determined between two vehicles suspended from the conveyor for insertion therebetween a vehicle from said at least one of the running tracks.

6. Installation according to claim **1,** characterized in that the means for selectively moving the vehicle comprise means for selectively varying the vertical distance between the under parts of the shoe and of the at least one wheel of the vehicle, while the vehicle is passing through the shunting zone, between a distance larger and a distance smaller than the vertical distance between the upper face of the conveyor and the running track.

7. Installation according to claim **6,** characterized in that the shoe and the at least one wheel of each vehicle are suspended from the respective top and bottom parts of the vehicle by two sets of bellows with controllable communication and containing a total volume of fluid smaller than the sum of their maximum volumes, and that means are provided for temporarily opening the communication between the two sets of orifices while the vehicle is in a shunting zone, whereby the weight of the vehicle causes the partial emptying of the fuller set of bellows into the emptier set of bellows and a consequent change of the position of the vehicle between its said one and another positions.

8. Installation according to claim **1** characterized in that at least one of the running tracks forms a closed loop which passes through the corresponding station and passes below the conveyor in a single zone, serving both as incoming and outgoing switching or shunting zone.

9. Installation according to claim **1,** characterized in that vertical guide surfaces are located on each side of the running track and in that each vehicle has a longitudinal median plane and at least two horizontal guide wheels mounted on either side of the said median plane and positioned for running on the vertical guide surfaces, the vehicle having a transverse axle which extends across the longitudinal median plane and on which said at least one vertical wheel is mounted.

10. Transportation installation according to claim **9,** characterized in that the at least one vertical wheel is slidably mounted on the transverse axle, which axle is suspended at its two ends from the chassis of the vehicle by means of elastic parts, and there being provided means for biasing the vertical wheel toward a position in which it lies in the median plane.

11. Transportation installation according to claim **10,** characterized in that the elastic parts suspending the transverse axle are constituted by two mutually communicating bellows filled with a fluid under pressure, and in that each bellows is provided with means resiliently urging it toward a compressed condition.

12. A transportation installation comprising: a plurality of cars; means for conveying the cars including an overhead main conveyor; means for switching the cars from the main conveyor; a loading and unloading loop having an upwardly facing support surface and positioned for receiving cars switched from the main conveyor by the switching means and for feeding cars onto the main conveyor, the loop including a loading and unloading station, means for decelerating a car received from the main conveyor and carrying the car to the station, and means for accelerating a car to substantially the speed of the main conveyor while carrying the car from the station to the main conveyor, each of said cars having overhead means for engaging said main conveyor to cause said car to be suspended therefrom and carried thereby, and means for supporting said car during its movement in said loading and unloading loop and including at least one vertical wheel, the overhead means having an engaging means movable vertically relative to said car between a lower, operative position in which said support means is engaged with said main conveyor and an upper, inoperative position wherein said engaging means is disenagageable from said main conveyor and wherein said at least one vertical wheel is movable vertically relative to said car between an upper, inoperative position and a lower, operative position in which said wheel is engageable with said upwardly facing support surface of said loop.

13. The installation of claim **12,** wherein each car has fluid-operated means for moving the at least one vertical wheel from its inoperative to its operative position when the engaging means is moved from its operative to its inoperative position and for moving the engaging means from its inoperative to its operative position when the at least one vertical wheel is moved from its operative to its inoperative position, the fluid-operated means being operably associated with the engaging means and the at least one vertical wheel, and there

being provided control means for controlling the functioning of the fluid-operated means.

14. The installation of claim **13,** and brake means for braking rotation of said wheel means and operable by said hydraulic means for gradually releasing the brake means to permit free rotation of the wheel means when said support means is released for movement from its operative to its inoperative position and for gradually and increasingly releasing said wheel means against rotation when said wheel means is released for movement from its operative to its inoperative position.

15. A car for a transportation installation having a conveyor means including an overhead main conveyor and a loading and unloading loop operatively associated with said main conveyor and providing an upwardly facing support, said car having a chassis and including: an overhead means mounted on and extending upwardly from said chassis for engaging the main conveyor of the transportation installation to cause said car to be suspended therefrom and carried thereby, and at least one wheel supporting said car during its movement over said loading and unloading loop, said overhead means including a support means movable vertically relative to said car between a lower, operative position in which said support means is engageable with the main conveyor of the transportation installation and an upper, inoperative position wherein said support means is disengageable from the main conveyor, and wherein said at least one vertical wheel is movable vertically relative to said car between an upper, inoperative position and a lower, operative position in which said wheel is engageable with said upwardly facing support of said loop.

16. The car of claim **15,** and fluid-powered means operatively associated with said support means and said at least one vertical wheel and operable by the weight of the car, and control means for said fluid-powered means for causing the fluid-powered means, when said support means is moved from its operative to its inoperative position, to move said at least one vertical wheel from its inoperative to its operative position and to cause said fluid-powered means to move said support means from its inoperative to its operative position when said at least one vertical wheel is moved from its operative to its inoperative position.

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