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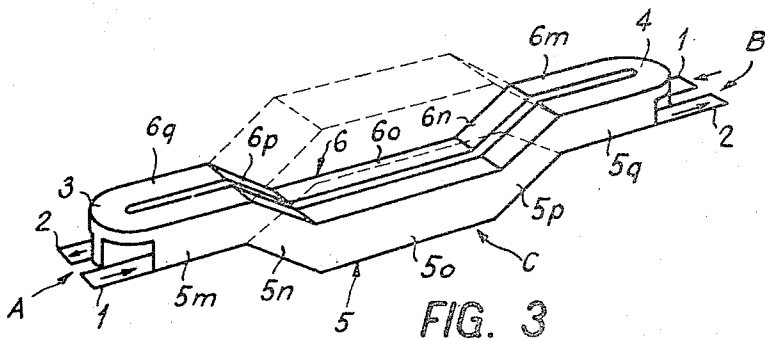
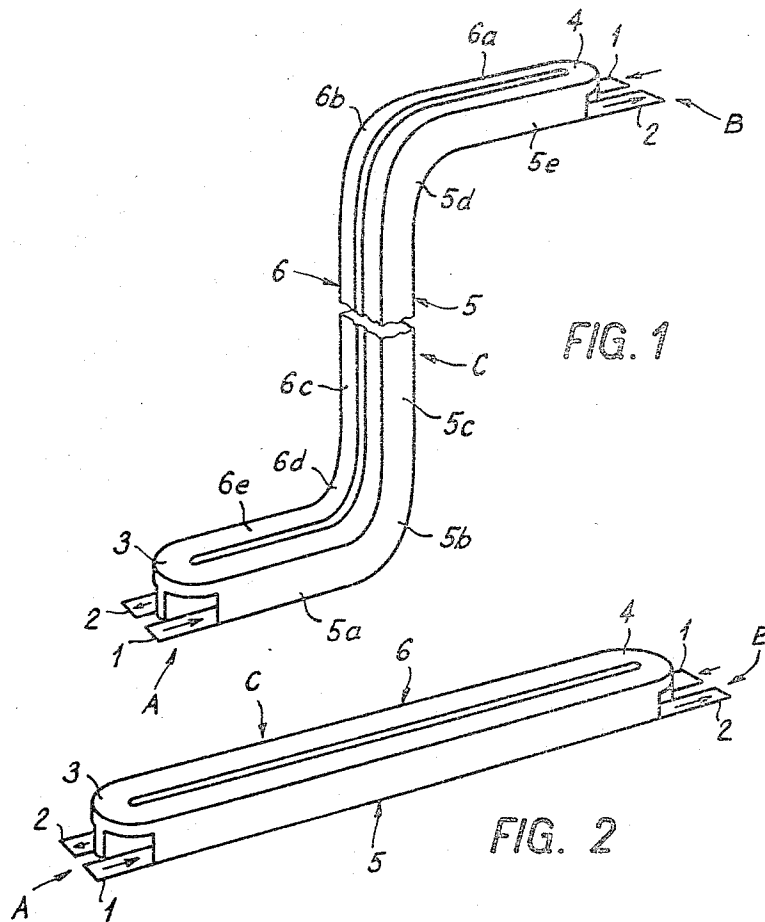
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3,364,872

CONTINUOUS TRANSPORT INSTALLATION

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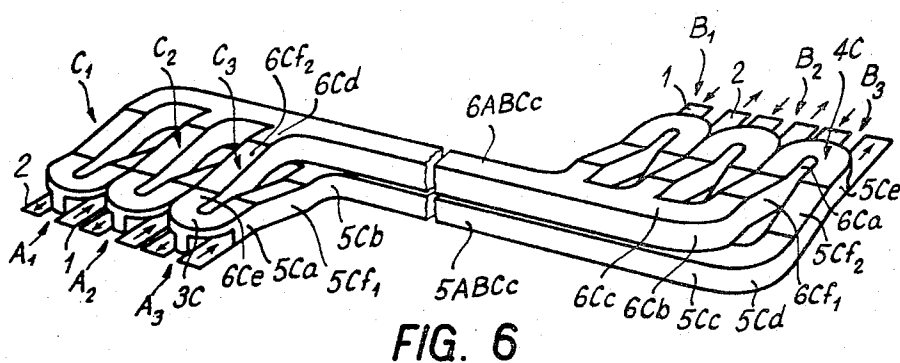
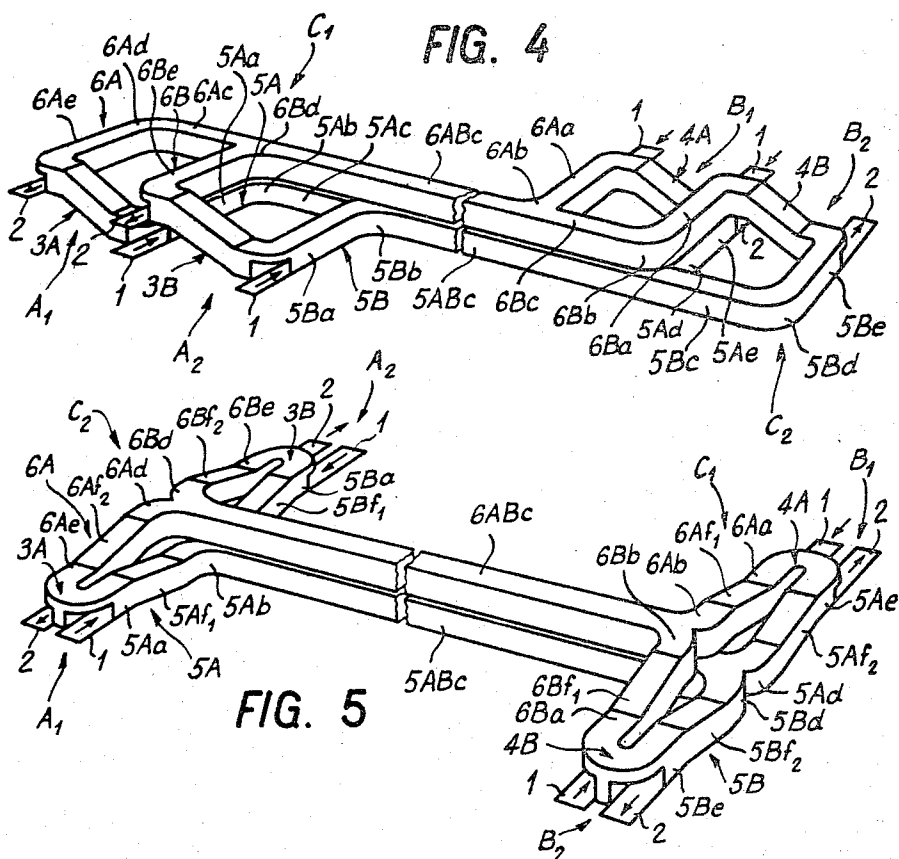
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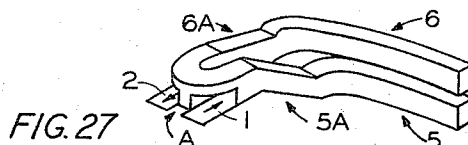
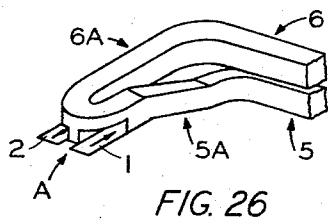
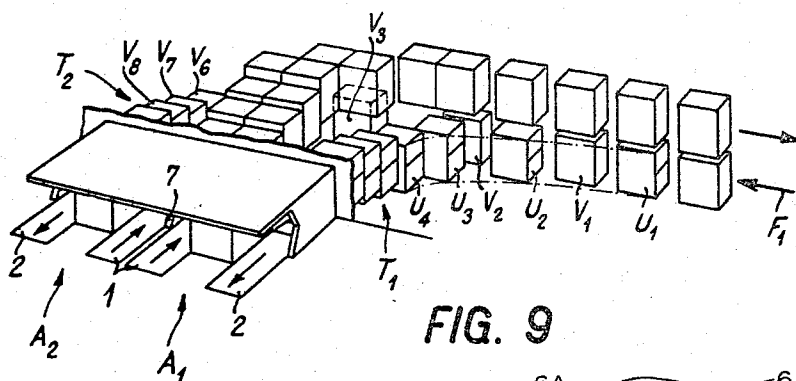
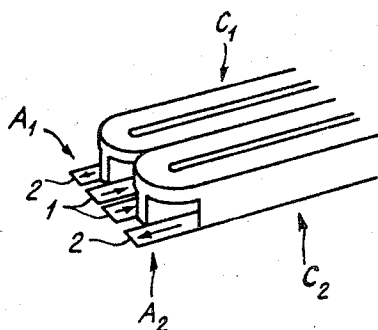
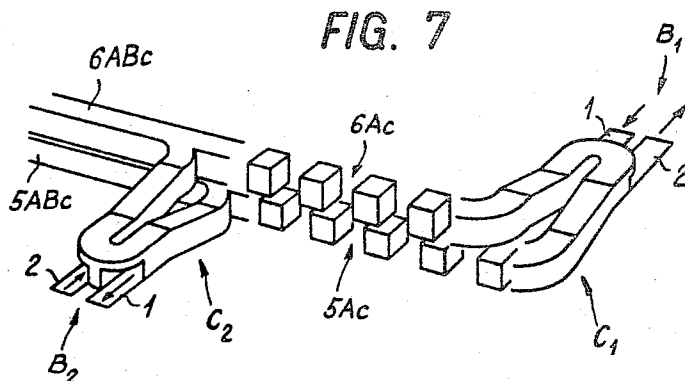
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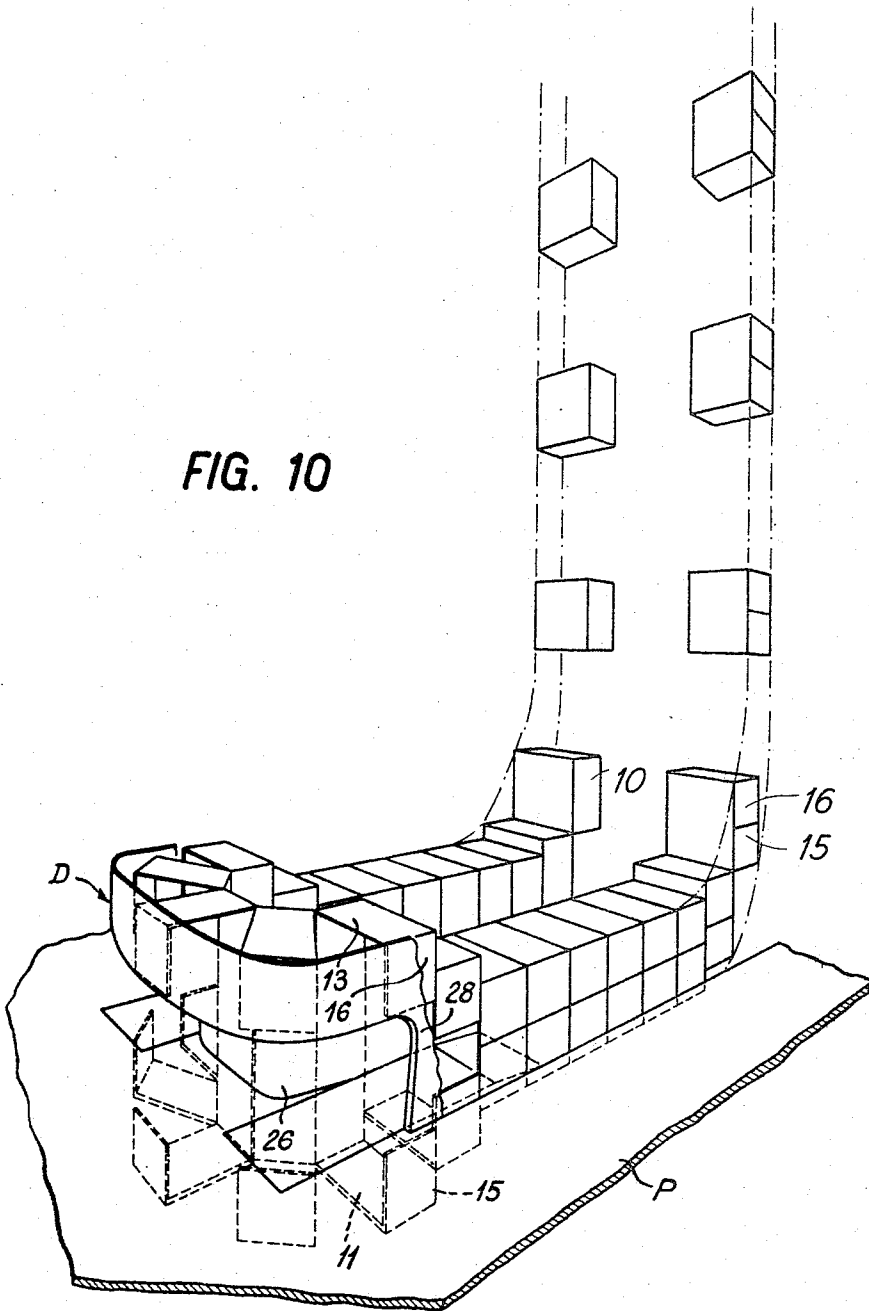
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FIG. 10



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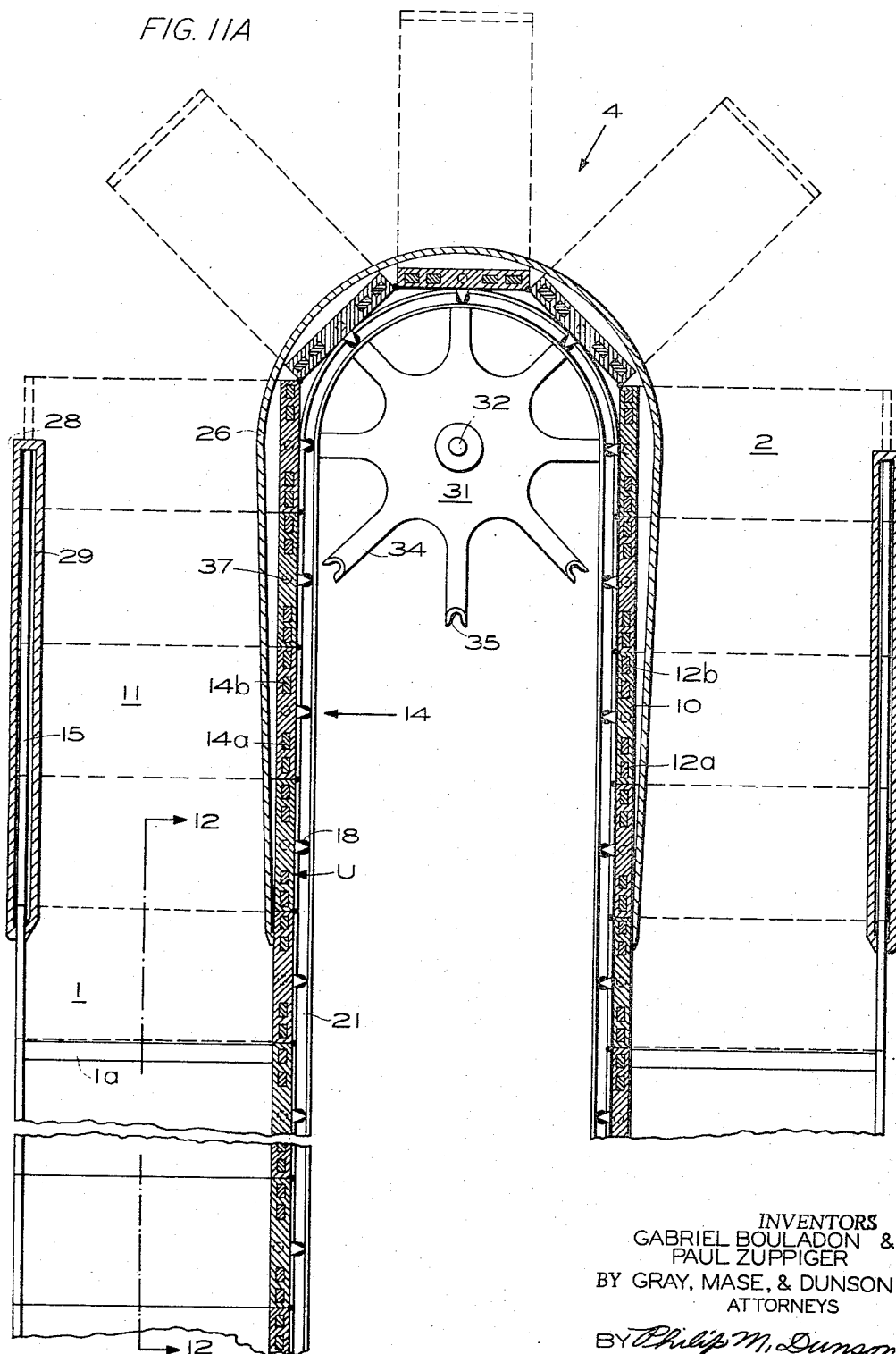
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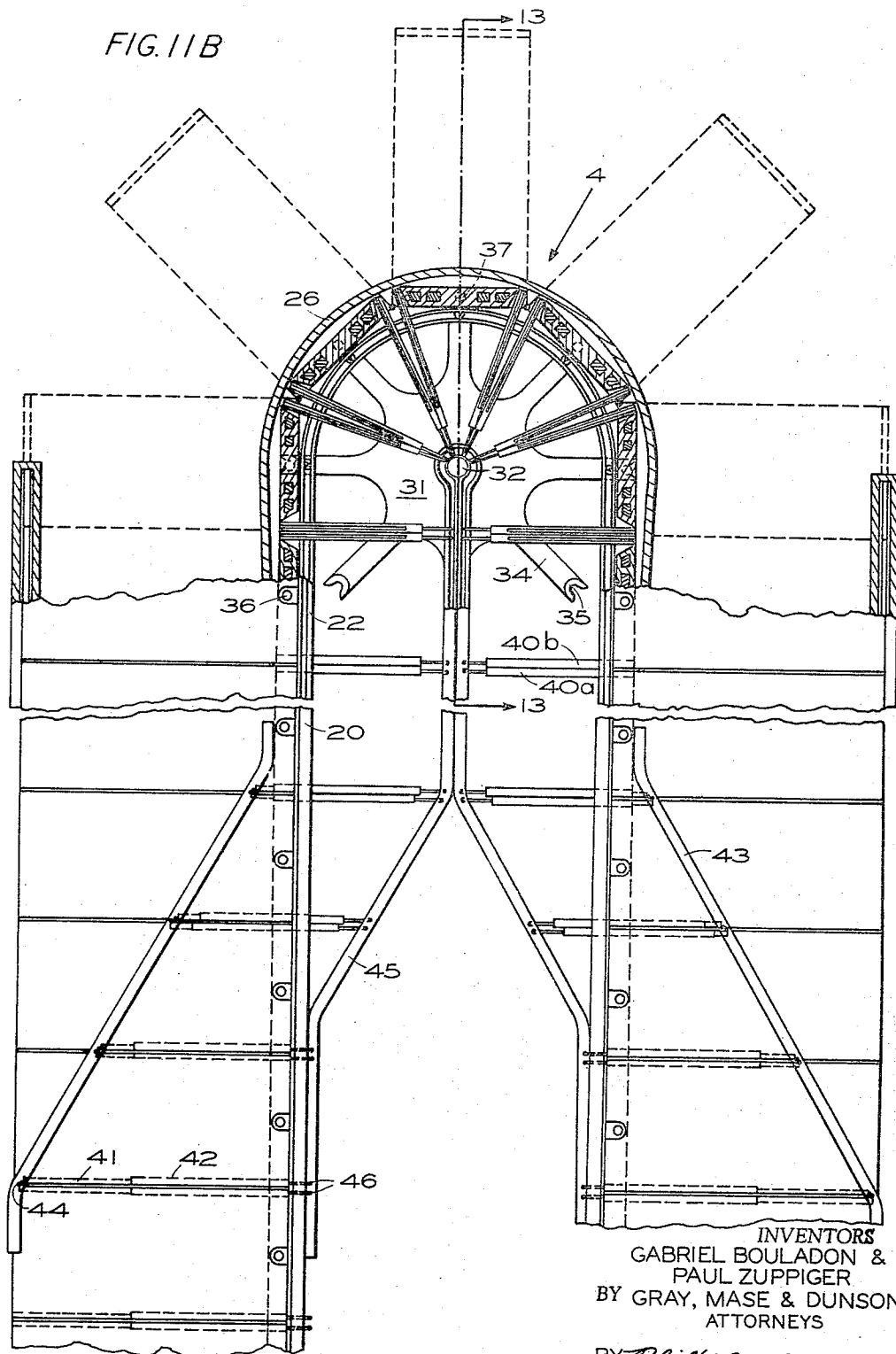
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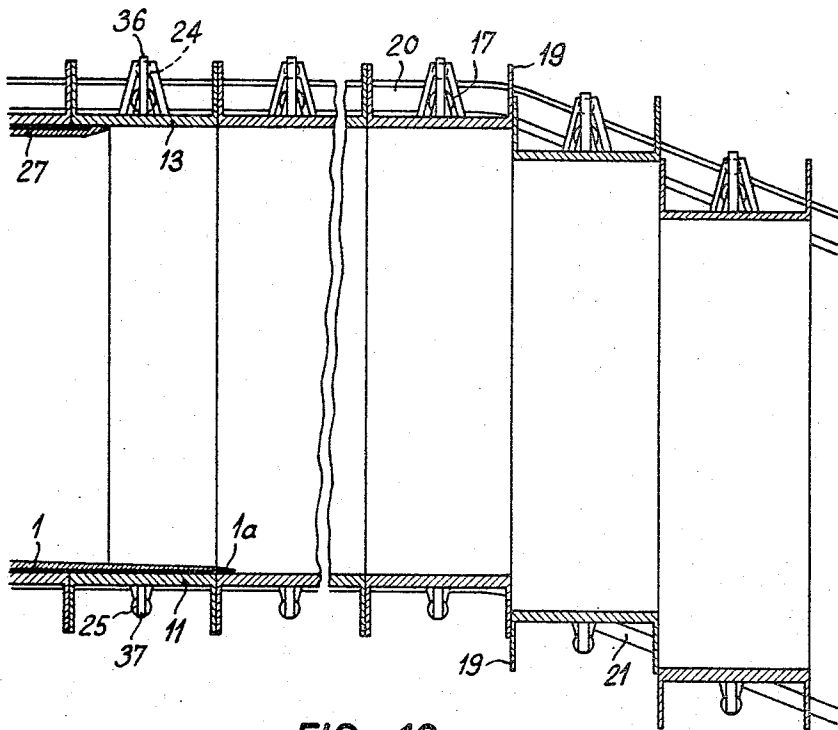


FIG. 12

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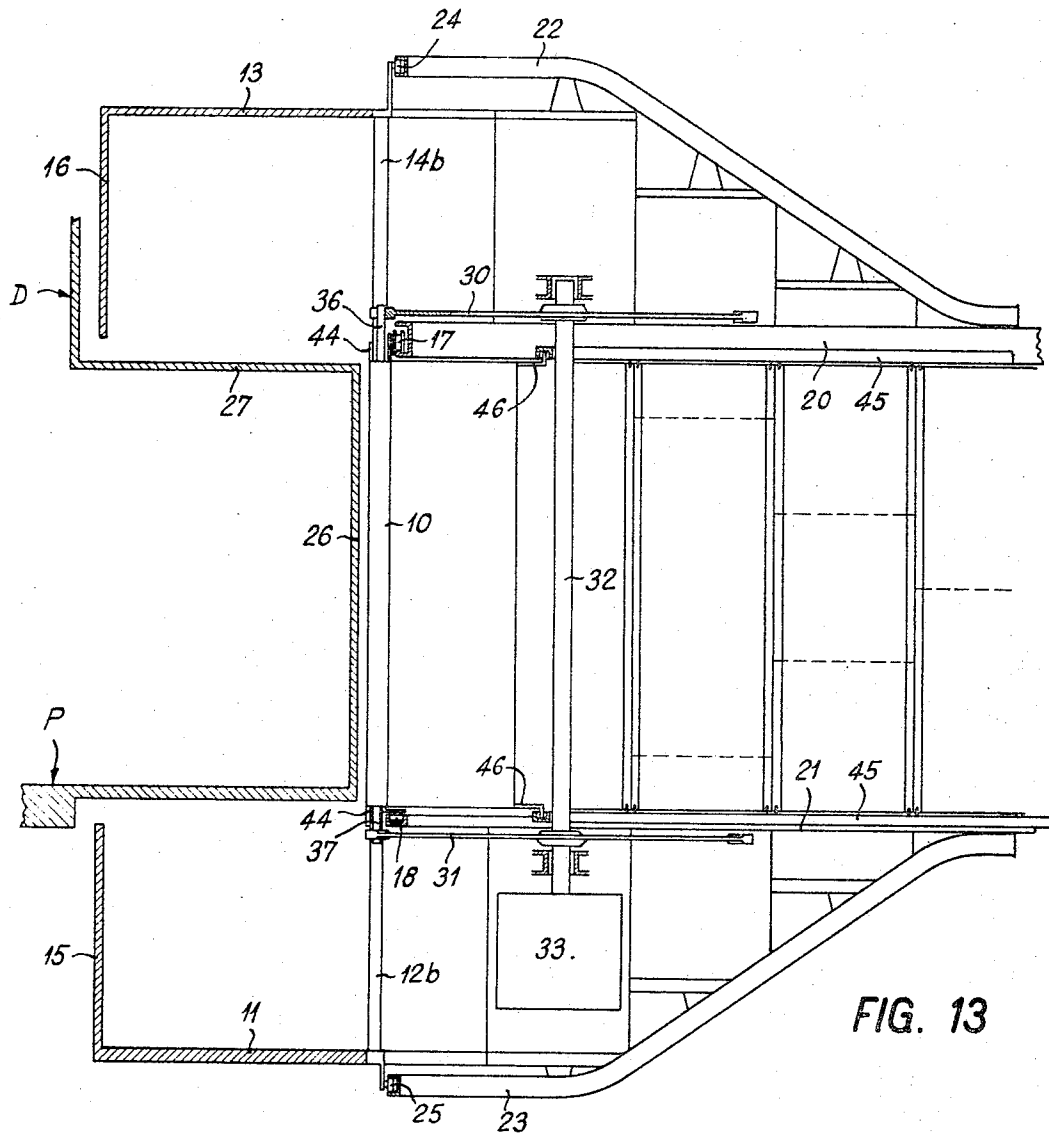


FIG. 13

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FIG. 17

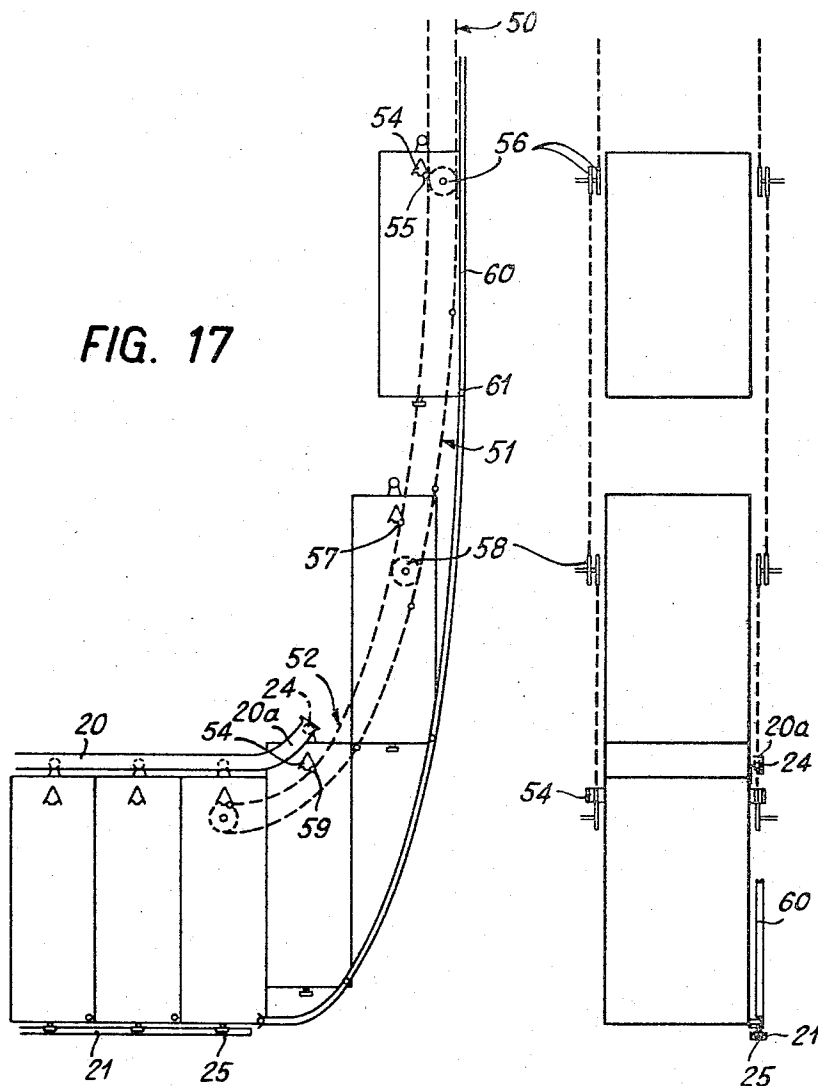


FIG. 18

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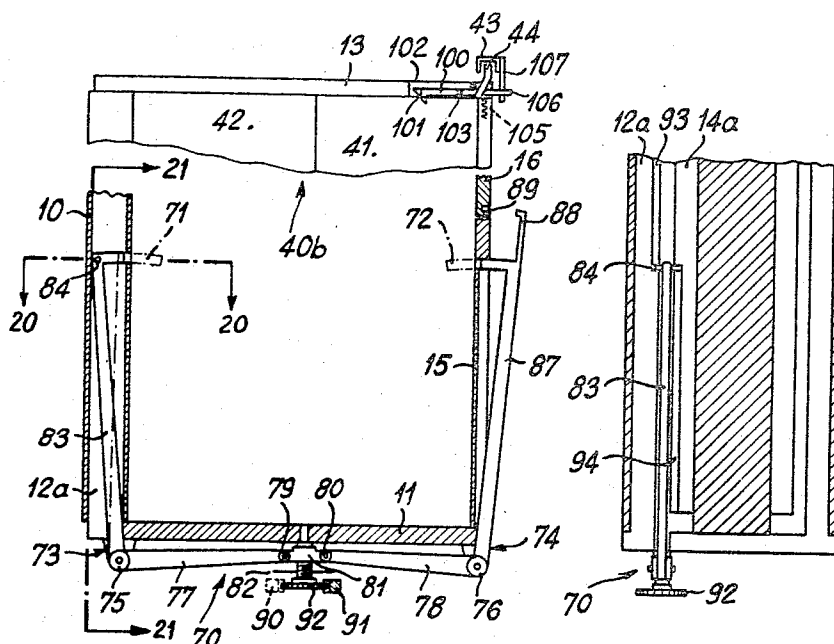


FIG. 19

FIG. 21

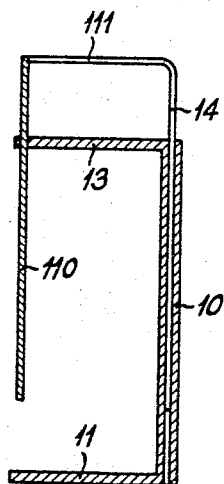


FIG. 23

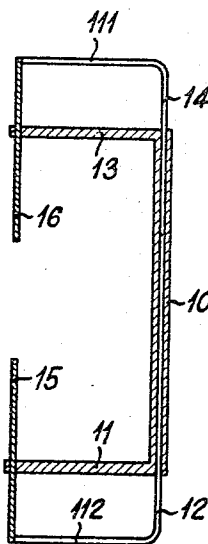


FIG. 24

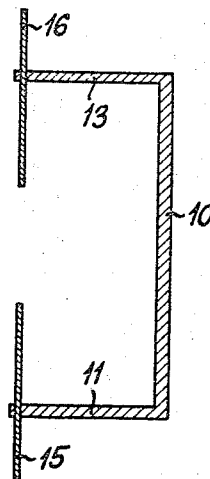


FIG. 25

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CONTINUOUS TRANSPORT INSTALLATION
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Claims priority, application Switzerland, Apr. 9, 1964,
4,540/64

43 Claims. (Cl. 104—25)

ABSTRACT OF THE DISCLOSURE

Continuously moving enclosed units carry passengers in endless circuits vertically (FIG. 1), horizontally (FIGS. 2-9), or both. The transport units are opened and turned around (FIG. 10) at terminal stations where passengers enter and leave. The units move close together at low speed into and away from the stations, spaced apart at high speed in the main travel sections, and at progressively varying speed in curved or inclined acceleration and deceleration sections therebetween. Units of different circuits can be intercalated to travel simultaneously in the same main travel section. Means are provided for driving, guiding, unlocking, opening, closing, and locking the transport units.

The present invention relates to a transport installation comprising at least one terminal loading and unloading station and transport apparatus serving said station, said transport apparatus including a succession of transport units, having a platform, and guide and drive means imposing to said transport units a continuous movement along a closed loop circuit and obliging said transport units successively to pass through said station.

The transport installation according to the invention is characterized in that said station includes a boarding stage and landing stage laterally spaced from the boarding stage, and in that said guide and drive means are adapted to bring the transport units in close and aligned formation towards one end of the landing stage, to cause the platforms of said transport units to disappear successively under said landing stage, to return the transport units in a substantially opposite direction, and to cause their platforms to reappear successively from under the boarding stage end corresponding to said one end of the landing stage and in the alignment of the boarding stage from which they move away in close and aligned formation, said close and aligned platform formations being maintained at least in the immediate vicinity of said ends.

The installation according to the present invention thus constitutes a modification or improvement of the installations described in United States patent application Ser. No. 326,523, filed Nov. 27, 1963, now United States Patent 3,236,191, United States patent application Ser. No. 326,525, filed Nov. 27, 1963, now United States Patent 3,238,893, and United States patent application Ser. No. 353,515, filed Mar. 20, 1964, now United States Patent 3,352,250.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made to the accompanying diagrammatic drawings in which:

FIGS. 1 to 6 are general schematic views of six different embodiments of the transport installation according to the invention;

FIG. 7 illustrates diagrammatically a modification of the right hand end of the embodiment illustrated in FIG. 5;

FIG. 8 illustrates diagrammatically one end of a modified

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constructional form of the embodiments depicted in FIGS. 1 to 3;

FIG. 9 illustrates diagrammatically one end of a modified constructional form of the embodiments depicted in FIGS. 5 and 6;

FIG. 10 is a perspective view, on an enlarged scale and partly broken away, of the lower portion of the embodiment depicted in FIG. 1;

FIG. 11A is a view in horizontal section of one end of a transport installation such as that depicted in FIG. 3;

FIG. 11B is a view partly in plan and partly in horizontal section of one end of a transport installation such as that depicted in FIG. 1;

FIG. 12 is a section taken on plane 12—12 of FIG. 11A;

FIG. 13 is a section taken on plane 13—13 of FIG. 11B;

FIG. 14 is a side view along arrow 14 of FIG. 11A, of a transport unit;

FIG. 15 shows in section a detail, on an enlarged scale, of FIG. 11A;

FIG. 16 is a perspective view of a detail of FIG. 11B;

FIGS. 17 and 18 are, respectively, side and front views of part of the guide and drive means used in the embodiment depicted in FIG. 1;

FIG. 19 shows certain structural details of a transport unit of the installation of which one end is depicted in FIG. 11B, the lower half of FIG. 19 being a section taken on plane 19—19 of FIG. 20;

FIG. 20 is a section taken on plane 20—20 of FIG. 19;

FIG. 21 is a section taken on plane 21—21 of FIG. 19;

FIG. 22 is a plan view of a detail of FIG. 19;

FIGS. 23 to 25 are sectional views illustrating modified constructional forms of the transport unit depicted in FIG. 14; and

FIGS. 26 and 27 are schematic views showing modifications of portions of the embodiments depicted in FIGS. 5, 6, 7, and 9.

To facilitate the understanding of the drawings, the same reference characters have been used in the different embodiments to designate corresponding parts.

The transport installations represented in FIGS. 1 to 3 each comprise two similar loading and unloading terminal stations A and B served by a transport apparatus including a succession of transport units or vehicles having a platform and guide and drive means, described below, imposing to said platform transport units a continuous movement along a closed loop circuit C, each station being provided with a boarding stage 1 and a landing stage 2 parallel to stage 1, these two stages being laterally spaced from one another and being located at the same level.

In all three cases, circuits C include at their ends U-shaped return sections 3 and 4 along which the transport units must effect a substantially semi-circular movement around a vertical axis.

The three embodiments essentially differ from one another by their intermediate circuit sections 5 and 6 which respectively connect stage 1 of station A to stage 2 of station B and stage 1 of station B to stage 2 of station A.

In the embodiment illustrated in FIG. 1, the intermediate sections 5 and 6 of circuit C consists, in the direction of movement of the platform transport units of the transport apparatus, of horizontal boarding portions 5a and 6a along which the platform transport units travel at a minimum speed in close and aligned formation; of curved acceleration portions 5b and 6b along which the speed of the platform transport units is progressively increased from this minimum speed to a maximum speed, of vertical so-called transport portions 5c and 6c along which the transport units travel at maximum

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speed in open and aligned formation, of curved deceleration portions 5d and 6d along which the speed of the transport units is progressively reduced from the maximum speed to the minimum speed, and of horizontal landing portions 5e and 6e along which the transport units travel at minimum speed in close and aligned formation. Stations A and B are thus located at different elevations and the transport apparatus constitutes an elevator of which the transport units move at variable speed.

In the embodiment illustrated in FIG. 2, the intermediate sections 5 and 6 of circuit C are horizontal and rectilinear over their entire length and the platform transport units travel along these sections at constant speed in close and aligned formation thereby enabling the platforms of the transport units to form moving walks along these sections 5 and 6.

In the embodiment illustrated in FIG. 3, stations A and B have, as in the second embodiment, the same elevation. In addition the platform transport units of the transport apparatus also travel along the intermediate sections 5 and 6 at constant speed in close and aligned formation. In contradistinction, these intermediate sections consist, in the direction of travel of the transport units, of horizontal fractions 5m and 6m, of downwardly inclined fractions 5n and 6n, or horizontal fractions 5o and 6o, of upwardly inclined fractions 5p and 6p, and of horizontal fractions 5q and 6q, the later being on the same level as fractions 5m and 6m. Thus, along fractions 5m and 6m, 5o and 6o, and 5q and 6q, the platforms of the transport units form moving walks, while along the inclined fractions 5n and 6n, and 5p and 6p, the platforms form escalators. This embodiment can thus be used, for example, in an underpass.

This third embodiment also shows in broken lines a modified constructional form for passing over an obstacle. It suffices to reverse the position of the inclined fractions 5n, 6n and 5p, 6p.

It will however be noted that in all three cases the intermediate sections 5 and 6 are in parallel relationship over their entire length.

The three transport installations illustrated in FIGS. 4 to 6 differ essentially from the previous embodiments in that they comprise several pairs of terminal stations A, B served by separate transport apparatus using different closed loop circuits, although the latter are co-extensive over part of their length.

Thus, the installation illustrated in FIG. 4 includes two pairs of loading and unloading stations A₁, B₁ and A₂, B₂ placed at the same elevation but the stages 1 and 2 of which are located at different levels. The two pairs of loading and unloading stations A₁, B₁ and A₂, B₂ are served by two transport apparatus the platform transport units of which travel at variable speed along two closed loop circuits C₁ and C₂. The intermediate circuit sections 5A, 6A and 5B, 6B consist, in the direction of travel of the transport units, of rectilinear and horizontal boarding portions 5Aa, 6Aa, 5Ba and 6Ba along which the transport units travel at a minimum speed in close and aligned formation, of horizontal and curved acceleration portions 5Ab, 6Ab, 5Bb, and 6Bb along which the speed of the transport units progressively increases from the minimum speed to a maximum speed, of horizontal so-called transport portions 5Ac, 6Ac, 5Bc and 6Bc along which the transport units travel at maximum speed in close and aligned formation, of horizontal and curved deceleration portions 5Ad, 6Ad, 5Bd and 6Bd along which the speed of the transport units progressively decreases from the maximum speed to the minimum speed, and of rectilinear and horizontal landing portions 5Ae, 6Ae, 5Be and 6Be along which the transport units travel at minimum speed. It should be noted that portions 5Ac and 5Bc co-extend at 5ABc over a major part of their length, as also do portions 6Ac and 6Bc at 6ABc.

The acceleration of the transport units along portions

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5Ab and 5Bb, on the one hand, and along portions 6Ab and 6Bb, on the other hand, is such as to cause the transport units to become spaced apart enabling those of both transport apparatus to be intercalated so as to form along the common parts 5ABc and 6ABc of the four transport portions only two rows which divide out at the end of these common parts.

As opposed to the installation shown in FIG. 2, in which the intermediate sections 5 and 6 are arranged side by side at the same level, the intermediate sections 5A and 5B, on the one hand, and sections 6A and 6B, on the other hand, of the embodiment illustrated in FIG. 4, are arranged at different levels, the transport portions 5Ac and 5Bc being located directly beneath the transport portions 6Ac and 6Bc, the connection between the two levels occurring along the terminal sections 3A, 3B, and 4A, 4B.

The installation illustrated in FIG. 5 is similar in its basic structure to the one described previously. It differs therefrom, however, by its ends. Stations A₁ and A₂, on the one hand, and stations B₁ and B₂, on the other hand, instead of being juxtaposed as in the previous embodiment, are arranged in opposite relation. Moreover, stages 1 and 2 of each station are placed at the same level, as in the embodiments illustrated in FIGS. 1 to 3, but in mezzanine in relation to the levels of the common transport portions 5ABc and 6ABc of circuits C₁ and C₂. Accordingly, the connection between the two levels does not take place along the terminal sections 3A, 3B, 4A and 4B, as in the preceding embodiment, but along inclined portions 5Af₁, 5Bf₁, 6Af₁ and 6Bf₁ intercalated between the boarding portions and the acceleration portions of the intermediate circuit sections 5A, 5B, 6A and 6B, and along inclined portions 5Af₂, 5Bf₂, 6Af₂ and 6Bf₂ intercalated between the deceleration portions and the landing portions of these intermediate circuit sections.

In the modified constructional form illustrated in FIG. 7, stations B₁ and B₂, instead of being in opposite relation as in FIG. 5, are laterally offset in relation to one another. In FIG. 7, the platform transport units of the transport apparatus using circuit C₁ are shown in open formation along transport portions 5Ac and 6Ac, the spaces between these units being occupied, along the common parts 5ABc and 6ABc of the transport portions, by the platform transport units of the transport apparatus serving stations A₂ and B₂.

In the installation illustrated in FIG. 6, which is similar to that shown in FIG. 5, is to be found again the juxtaposed arrangement of the stations of the embodiment shown in FIG. 4. In the present embodiment, the stations, three in number at each end, are analogous to those of the installation illustrated in FIG. 5 in that their stages 1 and 2 are also in mezzanine. The parts of circuits C₁ and C₂ have accordingly not been identified so as not to overload the drawing. Only the parts of the third circuit, C₃, have been identified.

In the three installations illustrated in FIGS. 4 to 6, the transport portions, which constitute the major part of the circuits, are parallel to one another. Moreover, since these three installations are multiple circuit installations in which the circuits co-extend over part of their length, the transport portions are arranged at different levels so as to enable the transport units to travel without level crossings. If these installations were single circuit installations, the transport portions of their circuit could be positioned side by side as in the embodiment illustrated in FIG. 1.

It will moreover be observed that in all of the embodiments so far described, the two terminal stations A and B of each circuit C are oriented in opposite directions so as to enable a passenger getting on at one station to arrive at the other station in facing relationship to the landing stage at this other station.

Although the capacity of the transport units is variable,

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the capacity of a transport installation can be increased by increasing the number of circuits.

In the case of installations, such as that shown in FIG. 1, in which the transport units are accelerated at the beginning of a journey and are decelerated at the end of a journey, the number of circuits can be increased without however correspondingly increasing the volume occupied by such a multiple circuit installation, as will be observed in the case of the installations illustrated in FIGS. 4 to 6 in which the transport portions of the intermediate circuit sections are common over a major part of their length since the platform transport units of the several transport apparatus may be intercalated.

In the case of installations, such as those shown in FIGS. 2 and 3, in which the transport units travel at constant speed in close formation, an increase in the number of circuits requires a substantially corresponding increase of the space used.

In the stations depicted so far, one enters generally on the right hand side, whether the installations are single circuit or multiple circuit installations. This arrangement is not essential: FIG. 8 shows two juxtaposed stations A_1 and A_2 served by two transport apparatus the platform transport units of which travel along circuits C_1 and C_2 in opposite directions. Consequently, the boarding stages 1 will be located at one end side by side in the center, as shown, and on the outside at the opposite end.

The same arrangement of the boarding and landings stages is again to be found in FIG. 9. This figure illustrates one end of a transport installation having two circuits along which the transport units of the two transport apparatus T_1 and T_2 travel at varying speed and in opposite directions. As in the embodiments illustrated in FIGS. 5 and 6, the installation comprises two adjoining stations A_1 and A_2 in mezzanine relation to the levels of the transport portions of the intermediate sections of the two circuits, and the boarding and landing stages 1 and 2 which are arranged laterally in relation to these transport portions.

Along the two circuits travel two successions of platform transport units U and V respectively belonging to the transport apparatus T_1 and T_2 . Starting from arrow F_1 , it will be observed that the units U and V are first perfectly aligned in alternate relation behind one another along the common part of the transport portions of the lower intermediate circuit sections, that these units then separate, as shown, under the action of suitable guide means, which may be similar to those described in United States patent application Ser. No. 326,523, filed Nov. 27, 1963, now United States Patent 3,236,191, leading the units into the horizontal and curved deceleration portions, the units V being subjected to a certain lag in relation to the units U since their transport portion extends beyond the separation zone. Along the deceleration portions, the transport units U and V are progressively brought from an open end to end formation to a close side to side formation while keeping a constant orientation, the units being made to shift in relation to one another, first horizontally along the deceleration portions and then vertically at the beginning and end of the inclined portions connecting the deceleration portions to the landing portions at the mezzanine level, then to proceed towards the forward edge of stages 2 of stations A_1 and A_2 in perfect side to side alignment and in close formation. During this progression, the cabins are automatically opened by means which will be described with reference to FIGS. 11A and following, thereby enabling the passengers to land on stages 2 with the same ease as the user of a conventional escalator.

Once the passengers have landed, cabins U and V, the platforms of which slide under stages 2, are sent back in the opposite direction by causing them to describe a substantially semi-circular movement in order to reappear in close formation at the ends of the boarding stages 1, cabins U bordering cabins V with which they

move in pairs. To avoid jostling during boarding, a dividing wall 7 separates the two stages 1. Upon moving away from stages 1, the cabins U and V automatically close along the boarding portions. Once closed, the cabins rise, still in close formation, along the upwardly inclined portions connecting the boarding portions to the acceleration portions of the upper intermediate sections, with consequent relative vertical shifting at the beginning and at the end of the inclined portions. Along the acceleration portions, cabins U and V advance in pairs and pass from a side to side close formation to an end to end open formation while maintaining a constant orientation, the speed of the cabins progressively rising from the minimum loading and unloading speed to the maximum transport speed.

Instead of being in mezzanine relation to the levels of the transport portions, as in FIGS. 5, 6, 7, and 9; any station may be on the same level as one of the transport portions, as in FIG. 26 where the station A is shown at the same level as the upper transport portion 6; or it may be below or above the levels of both transport portions, as in FIG. 27 where the station A is shown at a level above the levels of the transport portions 5 and 6.

FIG. 11A shows in horizontal section one end of a transport installation in which the platform transport units U of the transport apparatus are driven at constant speed in close formation along the intermediate sections of the closed loop circuit, and notably of a transport installation of which the intermediate sections include inclined fractions, such as the installation illustrated in FIG. 3.

FIG. 11B shows partly in plan and partly in horizontal section one end of a transport installation in which the platform transport units U of the transport apparatus are driven at varying speed along the intermediate sections of the closed loop circuit, at times in close formation along the boarding and landing portions and at other times in open formation along the transport portions, and notably of a transport installation including intermediate sections having vertical transport portions, such as the installation illustrated in FIG. 1 of which the lower part is shown on an enlarged scale in FIG. 10.

The transport units U of the transport installation of which one end is shown in FIG. 11A, each include a main wall 10 (see also FIG. 14), a platform 11 laterally rigid with the lower ends of a pair of vertical bars 12a and 12b slidably engaged from below into two internal vertically extending grooves formed in wall 10, and a ceiling 13 laterally rigid with the upper ends of a second pair of vertical bars 14a and 14b which are slidably engaged from above between bars 12a and 12b into the internal grooves of wall 10. Along the outer sides of platform 11 and of ceiling 13 are secured vertical panels 15 and 16 having a height equal to half that of wall 10. Thus, when the transport units U are closed, the adjacent edges of panels 15 and 16 contact one another and the latter form together with the wall 10, the platform 11 and the ceiling 13 a closed rectangular rigid frame.

The transport units U are driven along a carrier rail 20 (FIGS. 12, 13, 16) from which the transport units are laterally suspended by grooved vertical rollers 17 mounted at the top of main walls 10, and along an auxiliary rail 21 against which the transport units bear through the intermediary of horizontal rollers 18 mounted at the bottom of the main walls 10. These rails have a constant vertical spacing therebetween and form along the terminal sections of the circuit semi-circular curves.

These rails moreover each form a closed loop and thus guide the transport units along the entire circuit.

FIG. 12 shows the horizontal boarding fraction of an intermediate circuit section followed by the beginning of a downwardly inclined fraction. When passing from the boarding fraction to the inclined fraction, the transport units slide vertically against one another. In order to fill the spaces that this vertical off-setting would produce, ceilings 13 and platforms 11 carry along their transverse

edges vertical plates 19 having a height greater than the maximum extent of the off-setting.

When arriving at the landing stage 2 of a station, the transport units are closed. To enable alighting passengers to leave this stage, the transport units U must be opened, as is apparent from FIG. 10.

The transport units are only closed again upon completion of the return movement to enable passengers wishing to step into the transport units to have access to the boarding stage 1. The means for opening and closing the transport units U are shown in FIG. 13. These means comprise a cam rail 22 for lifting the ceilings 13 of the transport units to a level such that the lower edge of panels 16 be located above the upper end of main walls 10. They comprise moreover a cam rail 23 for lowering the platforms 11 of the transport units to a level that the upper edge of panels 15 be located below the bottom end of main walls 10. These cam rails, which are located in the terminal sections of the circuit along which travel the transport units have a shape which, when viewed in plan, corresponds to that of rails 20 and 21, but move away therefrom in a vertical plane along the landing stage 2 then move closer thereto along the boarding stage 1, the ends of these cam rails resting on rails 20 and 21 in set back relation to the end 1a of stage 1 and to the corresponding end of stage 2 (see FIG. 11), and their intermediate curved parts maintaining a constant spacing in relation to rails 20 and 21.

Thus, when the platforms 11 of the transport units U, which, along the horizontal landing portions or fractions of the circuit, are brought in close and aligned formation towards the landing stages 2, will have entirely disappeared beneath the latter, vertical rollers 24 and 25 mounted laterally at the edge of ceilings 13 and platforms 11, respectively, engage in cam rails 22 and 23 to open the transport units, the opening movement being completed when the return movement is initiated. The closure of the transport units is only begun upon termination of the return movement, the closing movement being completed before reaching the end 1a of the boarding stages 1 so that the platforms 11 will successively reappear in alignment with these stages from which they move away in close and aligned formation along the horizontal boarding portions or fractions of the circuit.

As shown by FIG. 10, the users can pass without any hindrance from a floor P to the boarding stage 1 and from the landing stage 2 to the floor P, the lower shells, formed by the platforms 11 and the panels 15, passing under the stages 1 and 2 and the floor P, the upper shells, formed by the ceilings 13 and the panels 16, passing into a casing D, and the main walls 10 passing behind a U-shaped wall 26 the bottom edge of which is secured to the inner edges of stages 1 and 2 and to the floor P and the upper edge of which is secured to the inner edge of the bottom 27 of casing D (see FIG. 13). Moreover, along the outer edges of stages 1 and 2 are provided protection walls, such as 28, formed with slots, such as 29 (see FIG. 11A), in which are inserted or from which issue, as the case may be, the panels 15 and 16 of the transport units, the movement of these panels away or towards one another taking place within these protection walls.

The return movement of the transport units U is ensured at each station by means comprising two identical drive wheels 30 and 31 rigid with a shaft 32 rotatably driven by a motor 33. Each drive wheel is provided with several radial arms 34 of which the free ends are each formed with a fork 35. The forks 35 of the two drive wheels 30 and 31 are intended to cooperate with stems 36 and 37 vertically secured to the ends of main walls 10. These stems which, as appears from FIG. 16, extend through notches formed in the inner edges of ceilings 13 and of platforms 11, and are normally masked by the brackets carrying rollers 24 and 25. When the transport units are opened under the action of cam rails 22 and

23, stems 36 and 37 are cleared and can thus be engaged by forks 35 of drive wheels 30 and 31 which, as may be seen in FIG. 13, are located one above carrier rail 20 and the other below the auxiliary rail 21.

During the return movement, the transport units become angularly spaced. To prevent rattling that this angular spacing might cause, the transport units can be hingedly connected to one another along the inner vertical edges of their main walls 10 by coupling means such as those shown in FIG. 15. The illustrated coupling means comprise a female member 38 in the form of an axially slit tube in which can slide vertically a male member 39 in the form of a cylinder, these two members being so designed that they enable the required angular movement during the return movement of the transport units along the terminal sections of a circuit. These coupling means enable moreover the transport units to slide vertically in relation to one another along the inclined portions or fractions of a circuit.

As stated above, FIG. 11B relates in particular to a transport installation comprising intermediate sections having a vertical transport portion. In the installation illustrated in FIGS. 1, 10, 11B, 17 and 18, the carrier rails 20 and the auxiliary rails 21 do not form closed loops. As is apparent in FIG. 17, these rails start at the beginning of the horizontal landing portions of the intermediate circuit sections and terminate at the end of the horizontal boarding portions, the carrier rails 20 having moreover at the ends thereof curved parts, such as 20a, extending along part of the acceleration and deceleration portions of the intermediate circuit sections in order to facilitate the transfer of the transport units from an arrangement of load moving means to the carrier rails 20 or vice versa. Each such arrangement consists, along the maximum speed transport portions, of one or several constant speed load moving means, such as 50, and, along the curved acceleration and deceleration portions, of varying speed load moving means, such as 51 and 52. These load moving means each comprise two endless chains which include a succession of links equidistantly connected to one another by hinge members, and which cooperate with two pairs of driving wheels. The varying speed load moving means, such as 51 and 52, which are described in United States Patent 3,292,769 (application Ser. No. 368,551, filed May 19, 1964), comprise moreover for the hinge members of each chain, closed loop guide means (not shown) adapted to separate the hinge members of each chain into two series of which the first includes the members intended to engage the transport units for displacement thereof, the members of one series alternating with those of the other, and adapted so that at least that part of the guide means which corresponds to one of the passes of the chain imposes, by varying the spacing of the two series of hinge members, a variation of the distance between the hinge members of said first series along said part of the guide means whereby said transport units, upon engagement, may be moved by said chain pass at varying speed.

Thus, when traveling along the downward transport portion of the intermediate circuit section connecting the boarding stage of the upper terminal station and the landing stage of the lower terminal station, the transport units move downward at constant maximum speed between the two chains of the load moving means 50, the transport units being each provided with a pair of hooks 54, secured one at the top of the main wall 10 and the other at the top of the panel 16 of each unit, these hooks 54 cooperating with the hinge members, such as 55, of the two chains. At the lower end of the chains of the load moving means 50, the transport units are transferred opposite wheels 56 to the load moving means 51 to be carried by the hinge members, such as 57, of its two chains to be then transferred again opposite wheels 53 to the hinge members, such as 59, of the chains of the load moving means 52.

As shown by FIG. 17, the chains of the varying speed load moving means 51 and 52, in cooperation with their guide means (not shown), compel the transport units to travel along a curvilinear path of which the curvature progressively increases towards the bottom. Thus, the transport units are not only decelerated and brought closer to one another by the two load moving means 51 and 52, but are also translated laterally to enable them to shift vertically in relation to one another to bring them into close and side to side formation towards the landing stage at minimum speed.

Before hooks 54 reach the lower end of the chains of the load moving means 52, the rollers 24, carried by the main walls 10 of the transport units, engage in the curved extension 20a of carrier rail 20, and rollers 25 also carried by the main walls 10 of the transport units, then engage, at the end of the downward motion of the latter, in the auxiliary rail 21.

During the downward movement of the transport units, the latter are maintained in their vertical position by a guide rail 60 of appropriate shape in which vertical rollers 61 engage at the beginning of the acceleration portion of the downward intermediate section of the circuit. Only after engagement of rollers 25 in the auxiliary rail 21 do the rollers 61 leave rail 60, which rollers 61 are preferably mounted on the lower part of the main walls 10 and to the side thereof that will face the upper terminal stations.

The transport units shown in FIG. 11B differ essentially from those in FIG. 11A in that they are each provided with doors 40a and 40b, which doors are preferably provided in any installation in which occur speed variations of the transport units causing a separation and/or realignment of the latter.

The doors 40a and 40b each consist of two panels 41 and 42 slidable in grooves formed along the transverse edges of the ceilings 13 and of the platforms 11, panels 41 being moreover slidable inside panels 42. These doors are automatically opened and closed by analogous devices respectively provided at the entrance and the exit of each station. The automatic opening device illustrated in FIG. 11B comprises a pair of fixed cam rails 43 located one above and the other below the transport units and intended to actuate the panels 41 through the intermediary of fingers 44 secured to the front ends of the upper and lower edges of each panel 41, and a pair of fixed cam rails 45 also located one above and the other below the transport units and intended to actuate the panels 42 through the intermediary of fingers 46 secured to the rear ends of the upper and lower edges of each panel 42. Thus, when the transport units are moved towards the landing stage of the terminal station along the horizontal portion preceding this stage, fingers 44 and 45 successively engage in the two pairs of rails 43 and 45. In order to insert panels 41 into panels 42 before causing the latter to slide, the rails 45 remain, over a certain distance, parallel to the carrier rail 20 before moving away therefrom in a horizontal plane. Once doors 40a and 40b are opened inwardly of the closed loop of the circuit, fingers 44 leave rails 43, the latter ending ahead of cam rails 21 and 22, while fingers 46 remain engaged in rails 45, the latter extending in their space position parallel to carrier rail 20 to pass around the shaft 32 of driving wheels 30 and 31 where they meet up with the corresponding rails of the analogous means for automatically closing the doors at the exit of the station. These extensions of rails 45 enable doors 40 to be supported in their open position through the intermediary of fingers 46. By adopting a telescopic construction for the doors 40, their width when open can be reduced by half thereby enabling the intermediate sections of the closed loop circuit to be moved closer to a corresponding extent, and hence substantially reducing the space occupied by installation.

In order not to interfere with the return movement of the transport units by drive wheels 30 and 31, the ver-

tical edges of the main walls 10 are bevelled to enable doors 40a and 40b of each transport unit to fold towards one another. To enable this angular movement of the doors, the vertical edges of the curved parts of the extensions of rails 45 have a spacing slightly greater than that of the vertical edges of the rectilinear parts of these extensions.

While in the case of the doorless transport units the coupling means between main walls may extend over the entire height of these walls, in the case of transport units fitted with doors the coupling means are only provided at the lower and upper ends of the main walls so as not to hinder the opening of the doors. These coupling means will only be coupled when the transport units will have completed their vertical movement to travel along the horizontal landing portions of the intermediate circuit sections, and will be uncoupled when the transport units will have reached the end of the horizontal boarding portions to be accelerated along the curved sections, the vertical shifting movement between the transport units ensuring, in cooperation with the guide rails with which cooperate rollers 61, the coupling and uncoupling of the coupling means.

FIGS. 19 and 21 show a transport unit provided with a device 70 both for locking the lower and upper shells of each transport unit upon closure thereof and for projecting into each transport unit retractable handles 71 and 72. This device comprises two bell-crank levers 73 and 74 pivotally mounted at 75 and 76 on lugs secured to the lower face of the platform 11 of the transport unit. Arms 77 and 78 of these levers are pivotally connected at 79 and 80 to an internally threaded annulus carried by a threaded member 82 rotatably mounted beneath platform 11 near its forward transverse edge (see FIG. 21). Arm 83 of bell-crank lever 73 extends upwardly between bar 12a of the lower shell and bar 14a of the upper shell, these bars being intended to slide in opposite directions within the main wall 10. The upper end of this arm 83 carries a retractable handle 71 and has a key 84 extending therethrough adapted to be inserted into two slots 85 and 86 formed in bars 12a and 14a, respectively (see FIG. 20). The upper end of arm 87 of lever 74 carries the retractable handle 72 and a hook 88 adapted to cooperate with a hole 89 formed in the outer face of upper panel 16.

This device is actuated at each station by two fixed racks 90 and 91 respectively located beneath the landing and boarding stages and opposite the ends of cam rails 21 and 22 thereby to lock and unlock the transport units. These racks 90 and 91, with which cooperate a pinion 92 secured to the lower end of the threaded member 82, are so positioned that pinion 92, when it will come into meshing engagement with the racks, will rotate in the one case in one direction and in the other case in the other direction, thereby successively causing unlocking and locking of the transport unit at each station.

Thus, when platform 11 of this transport unit has slidably passed under the landing stage 2 of a station and rollers 24 and 25 have engaged in cam rail 22 and 23, pinion 92 meshes with rack 90 to cause the rise of annulus 81, the outward rocking of levers 73 and 74, the withdrawal of key 84 from slots 85 and 86 and of hook 88 from hole 89, and the retraction of handles 71 and 72, thereby enabling bars 12 and 14 to slide in opposite directions within the main wall 10 under the action of cam rails 21 and 22. In order that key 84 will not interfere with the sliding motion of bars 12a and 14a, the latter are formed with grooves 93 and 94 extending from slots 85 and 86 to the free ends of the bars. When the return movement of the transport unit is completed and upon closure thereof, pinion 92 meshes with rack 91 just before rollers 24 and 25 reach the end of cam rails 22 and 23. Rack 91 being placed on the opposite side of pinion 92 in relation to rack 90, the consequent rotation of pinion 92 causes the downward movement of annulus 81, the inward rocking of lever arms 83 and 87, the insertion of

key 84 into the slots 85 and 86 of bars 12a and 14a to prevent any relative movement of the latter, the insertion of hook 88 into hole 89, and the projection of handles 71 and 72 which passengers, stepping into the transport unit when the latter reaches the end 1a of the boarding stage 1 of this station, may hold on to.

The transport unit is moreover provided with two devices for locking the doors upon closure of the latter. FIGS. 19 and 22 show such a locking device for door 40b. This device comprises a lever 100 having a hook 101. This lever is mounted in a housing 102 at the outer end of the rear transverse edge of ceiling 13, and pivots about an axis 103. In the closed position of door 40b, hook 101 is retained in a hole 104 under the action of a spring 105 housed in a cavity formed in the panel 16. When the transport unit reaches cam rails 43 and 45 (FIG. 11B), arm 106 of lever 100 abuts against the beveled end of a cam 107 consisting of a plate secured to the initial portion of the upper cam rail 44, which plate follows this rail until beyond the bend formed in the latter to cause the door panel 41 to slide. This cam causes the disengagement of hook 101 from hole 104 and maintains the hook in its raised position until rail 43 has initiated the opening movement of door panel 41 through the intermediary of finger 44. Upon closing the door at the exit of the station, the forward edge of panel 41 abuts against the chamfered face of hook 101 to lift the latter against the action of spring 105 before finally dropping back into hole 104, thereby locking the door until entering the next station. In order to maintain hook 101 at the proper height, once panel 41 has been withdrawn, a stop 108 secured to the ceiling 13 restricts the lifting movement of lever arm 106 by spring 105.

FIGS. 23 to 25 show in vertical section three modified constructional forms of the transport unit illustrated in FIG. 14. In these three modified constructional forms, platforms 11 and ceilings 13 are rigidly attached to the main walls 10.

In the case of FIG. 23, the transport unit comprises an outer wall 110 in a single piece of which the upper edge is secured to arms 111 rigid with bars 14 sliding in the main wall 10. In this constructional form, the wall 110 replaces the two panels 15 and 16, and bars 12 are not required. Moreover, this form of construction does not require a locking device such as 70 (FIGS. 19 to 21). This modified constructional form, however, requires a greater lifting action to open the transport unit. This modified constructional form can in turn itself be modified by dispensing with arms 14 and arms 111. The lifting cam rail would thus act directly on the wall 110 through the intermediary of rollers mounted on the upper edge of this wall.

In the case of FIG. 24, the panels 15 and 16 of the transport units are connected to bars 12 and 14 by arms 111 and 112, whereas in the case of FIG. 25, the transport unit has neither bars 12 and 14 nor arms 111 and 112. In the latter instance, the cam rails actuating panels 15 and 16 act directly on these panels through the intermediary of rollers respectively mounted on their lower and upper edges.

It would also be possible to resort to transport units such as those illustrated in FIGS. 28 and 29 of United States Patent 3,352,250 (patent application Ser. No. 353,515, filed Mar. 20, 1964), referred to above, i.e., transport units in which the ceilings and platforms are rigid with the main walls and comprise doors made of two parts, one rigid, constituting the rear end of the door, and the other flexible, constituting the front end of the door, this flexible part being extended to form when closed, one half of the longitudinal wall facing the main wall, these parts being both slidably mounted in grooves formed along the edges of the ceiling and of the platform.

While the forms of the invention disclosed herein constitute presently preferred embodiments, it is not intended

to describe or mention all of the possible equivalent forms or ramifications of the invention. It is to be understood that the disclosure herein is illustrative rather than limiting, and that various changes may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. A transport installation comprising at least one terminal loading and unloading station and transport apparatus serving said station, said transport apparatus including a succession of transport units, each having a platform with a pair of normally opposite vertical walls extending upward therefrom, and guide and drive means imposing to said transport units a continuous movement along a closed loop circuit and obliging said transport units successively to pass through said station, said station including a boarding stage and a landing stage laterally spaced from the boarding stage, and the guide and drive means being adapted to bring the transport units in close and aligned formation towards one end of the landing stage, to move one said vertical wall of each successive transport unit vertically away from said landing stage, to cause the platforms of said transport units to disappear successively under said landing stage, to return the transport units in a substantially opposite direction, to move said one vertical wall of each transport unit from a region vertically displaced from said boarding stage to its normal position opposite the other said vertical wall and extending upward from its associated platform, and to cause the platforms of said transport units to reappear successively from under the boarding stage end corresponding to said one end of the landing stage and in the alignment of the boarding stage from which they move away in close and aligned formation, said close and aligned platform formations being maintained at least in the immediate vicinity of said ends.

2. A transport installation according to claim 1, comprising a first said terminal station, a second terminal station similar to the first and served by said transport apparatus, said circuit comprising a first intermediate section connecting the boarding stage of the first station to the landing stage of the second station, a second intermediate section connecting the boarding stage of the second station to the landing stage of the first station, a first return section connecting the landing stage and the boarding stage of the first station, and a second return section connecting the landing stage and the boarding stage of the second station.

3. A transport installation according to claim 2, wherein each said return section is U-shaped in plan view, and each transport unit effects a substantially semi-circular movement around a vertical axis therein.

4. A transport installation according to claim 2, wherein the two intermediate sections of the circuit are, at least to a major extent, parallel.

5. A transport installation according to claim 2, wherein the two stations have the same elevation and the guide and drive means convey the platform transport units in close formation from one station to the other at constant speed along the two intermediate sections.

6. A transport installation according to claim 5, wherein the intermediate sections of the circuit are horizontal and rectilinear thereby enabling the platforms to form moving walks over the entire length of these intermediate sections.

7. A transport installation according to claim 2, wherein the intermediate sections of the circuit each comprise successively a first horizontal fraction, a first inclined fraction, a second horizontal fraction, a second inclined fraction, and a third horizontal fraction.

8. A transport installation according to claim 2, wherein the intermediate sections of the circuit each comprise successively a first horizontal fraction, a first inclined fraction, a second horizontal fraction, a second inclined fraction, and a third horizontal fraction at the same level as the first, the guide and drive means imposing to the

platforms of said transport units a vertical offset therebetween along the inclined fractions to form escalators along these fractions, said platforms forming moving walks along the horizontal fractions.

9. A transport installation according to claim 1, wherein the stages of at least one station are at the same level.

10. A transport installation according to claim 1, wherein the stages of at least one station are at different levels.

11. A transport installation according to claim 2, wherein the intermediate sections of the circuit each comprise, in the direction of movement of the transport units, a horizontal boarding portion along which the transport units travel in close and side to side formation at minimum speed, an acceleration portion along which the speed of the transport units is progressively increased from said minimum speed to a maximum speed, a transport portion along which the transport units travel at said maximum speed, a deceleration portion along which the speed of the transport units is progressively reduced from the maximum speed to the minimum speed, and a horizontal landing portion along which the transport units travel in close and side to side formation at said minimum speed.

12. A transport installation according to claim 11, wherein the transport portions are at least at one of their ends at right angles to the horizontal boarding portions and are at least at the other of their ends at right angles to the horizontal landing portions, and the acceleration portions and the deceleration portions are curved, the guide and drive means imposing to the transport units a constant orientation along said acceleration and deceleration portions thereby to achieve a realignment of the transport units.

13. A transport installation according to claim 12, wherein the two stations have different elevations, and the transport portions are vertical.

14. A transport installation according to claim 12, wherein the two stations have the same elevation, and the transport portions are horizontal.

15. A transport installation according to claim 11, wherein the two stations are oriented in opposite directions on opposite sides of the transport portions.

16. A transport installation according to claim 12, comprising several pairs of terminal stations served by distinct transport apparatus using different closed loop circuits, said first intermediate circuit sections connecting the stations at one end of the installation to the stations at the other end of the installation being co-extensive over at least part of their transport portions, and said second intermediate circuit sections connecting said stations in the opposite direction also being co-extensive over at least part of their transport portions.

17. A transport installation according to claim 12, comprising several pairs of terminal stations served by distinct transport apparatus using different closed loop circuits, said first intermediate circuit sections connecting the stations at one end of the installation to the stations at the other end of the installation being co-extensive over at least part of their transport portions, said second intermediate circuit sections connecting said stations in the opposite direction also being co-extensive over at least part of their transport portions, and the acceleration provided along the acceleration portions being such that the transport units of each transport apparatus establish between themselves sufficient spacing to enable the transport units of the other transport apparatus to be intercalated therebetween.

18. A transport installation according to claim 17, wherein a station is laterally offset from another station beyond an end of the co-extensive parts of said intermediate circuit sections, the transport units serving the station farther from the co-extensive parts moving in open formation along separate transport portions between said stations, and the spaces between said units being occupied along the co-extensive parts by the transport units serving the station nearer to the co-extensive parts.

19. A transport installation according to claim 17, wherein the co-extensive parts of said first intermediate circuit sections are located above the co-extensive parts of said second intermediate circuit sections.

20. A transport installation according to claim 19, wherein the boarding and landing stages of each station are positioned in mezzanine in relation to the co-extensive parts of said first and second intermediate circuit sections, and the intermediate circuit sections include inclined portions between the boarding portions and the acceleration portions and between the deceleration sections and the landing sections.

21. A transport installation according to claim 19, wherein the boarding and landing stages of each station are at different levels and at the levels of the co-extensive parts of said first and second intermediate circuit portions, and the return circuit sections each include an intermediate inclined portion.

22. A transport installation according to claim 1, wherein said stages are parallel.

23. A transport installation according to claim 1, wherein each transport unit, while moving along said intermediate sections, forms a closed rectangular frame of which the bottom is formed by said platform.

24. A transport installation according to claim 23, wherein each transport unit comprises a main vertical wall at the ends of which are slidably mounted a ceiling and said platform, said ceiling and said platform having vertical panels secured thereto for completing said frame.

25. A transport installation according to claim 23, wherein each transport unit comprises a main vertical wall to the ends of which are secured a ceiling and said platform, and vertical panels slidably mounted on said ceiling and platform for completing said frame.

26. A transport installation according to claim 23, wherein each transport unit comprises a main vertical wall to the ends of which are secured said platform and a ceiling, and a vertical panel slidably mounted on said ceiling for completing said frame.

27. A transport installation according to claim 23, wherein the stations include means for opening the frames formed by the transport units when the platforms have disappeared under the landing stages and for closing said frames again upon completion of the return movement and before the platforms reappear from beneath the boarding stages.

28. A transport installation according to claim 23, wherein the transport units are provided with a second pair of normally opposite vertical walls perpendicular to said pair of walls already mentioned, and the stations include means for sliding said second pair of vertical walls horizontally away from the landing stage upon entering each station and for sliding them horizontally back to their normal positions in the transport unit upon leaving the station.

29. A transport installation according to claim 1, wherein each transport unit is driven along a carrier rail from which the transport unit is laterally suspended by grooved vertical rollers mounted at the top of the transport unit, and along an auxiliary rail against which the transport unit bears through the intermediary of a horizontal roller mounted at the bottom thereof, said rails having a constant vertical spacing therebetween and forming semi-circular curves along the terminal sections of the circuit.

30. A transport installation according to claim 8, wherein the transport units slide vertically against one another when passing between a horizontal fraction and an inclined fraction, and the ceilings and platforms carry along their adjacent edges vertical plates each having a height greater than the maximum extent of the vertical offsetting of adjacent ceilings and platforms, to fill the spaces that the vertical offsetting would produce.

31. A transport installation according to claim 24,

wherein the stations include means for opening the frames formed by the transport units when the platforms have disappeared under the landing stages and for closing said frames again upon completion of the return movement and before the platforms reappear from beneath the boarding stages.

32. A transport installation according to claim 31, wherein the means for opening and closing the frames comprise a first cam rail for lifting the ceilings of the transport units to a level such that the lower edges of the vertical panels secured to the ceilings are located above the upper ends of the main walls, and a second cam rail for lowering the platforms of the transport units to a level such that the upper edges of the vertical panels secured to the platforms are located below the bottom ends of the main walls,

33. A transport installation according to claim 23, wherein each transport unit is driven along a carrier rail from which the transport unit is laterally suspended by grooved vertical rollers mounted at the top of the transport unit, and along an auxiliary rail against which the transport unit bears through the intermediary of a horizontal roller mounted at the bottom thereof, said rails having a constant vertical spacing therebetween and forming semi-circular curves along the terminal sections of the circuit; wherein the stations include means for opening the frames formed by the transport units when the platforms have disappeared under the landing stages and for closing said frames again upon completion of the return movement and before the platforms reappear from beneath the boarding stages; wherein the means for opening and closing the frames comprise a first cam rail for lifting the ceilings of the transport units to a level such that the lower edges of the vertical panels secured to the ceilings are located above the upper ends of the main walls, and a second cam rail for lowering the platforms of the transport units to a level such that the upper edges of the vertical panels secured to the platforms are located below the bottom ends of the main walls; and wherein said cam rails, said carrier rail, and said auxiliary rail have the same shape, viewed in plan; said cam rails moving vertically away from said carrier and auxiliary rails along the landing stages, maintaining a substantially constant spacing from said carrier and auxiliary rails in the portions of the stations between the boarding and landing stages, and then moving vertically toward said carrier and auxiliary rails along the boarding stages.

34. A transport installation according to claim 24, wherein users can pass without any hindrance from a floor provided in a station to the boarding stage of the station and from the landing stage of the station to the floor, the lower shells formed by the platforms and the vertical panels secured thereto passing under the boarding and landing stages and the floor, the upper shells formed by the ceilings and the vertical panels secured thereto passing into a casing provided at a substantial height above the floor, and the main walls of the transport units passing behind a vertical wall the bottom edge of which is secured to the inner edges of the boarding and landing stages and to the floor and the upper edge of which is secured to the inner edge of the bottom of said casing.

35. A transport installation according to claim 34, wherein a vertical protection wall is provided along the outer edge of each boarding and landing stage, each said protection wall having a slot into which said vertical panels may project, the vertical movements of said panels away from and toward one another in opening and closing said frames taking place within said slots.

36. A transport installation according to claim 32, wherein the return movement of each transport unit is provided at a station by means comprising at least one drive wheel on a rotatably driven vertical shaft, each said drive wheel having a plurality of radial arms each

bifurcated at its outer end to engage a vertical stem secured to the main wall of the adjacent transport unit.

37. A transport installation according to claim 36, wherein the transport units are hingedly connected to one another along the inner vertical edges of their main walls, at least at each end of said edges, by coupling means comprising a female member in the form of an axially slit tube along one said vertical edge, at least at each end thereof, in which can slide vertically a male member in the form of a cylinder similarly located along the adjacent vertical edge of the next transport unit, said male and female members being so constructed and arranged as to allow the required angular movement to take place during the return movement of the transport units along the terminal sections of a circuit, and to allow the transport units to slide vertically in relation to one another along any inclined portions of a circuit.

38. A transport installation according to claim 29, including a first intermediate circuit section having a horizontal boarding portion connecting at one end with said boarding stage and at the other end with an inclined portion of said first intermediate section, and a second intermediate circuit section having a horizontal landing portion connecting at one end with said landing stage and at the other end with an inclined portion of said second intermediate section, said carrier and auxiliary rails starting at the beginning of the horizontal landing portion of said second intermediate circuit section and terminating at the end of the horizontal boarding portion of said first intermediate circuit section, and said carrier rails having curved parts at the ends thereof extending along part of the adjacent inclined portions of the intermediate circuit sections to facilitate the transfer of transport units between said inclined portions and said horizontal portions.

39. A transport installation according to claim 38, wherein said inclined portions include drive and guide means engaging the transport units in said inclined portions, and said carrier rail and said auxiliary rail engage said vertical and horizontal rollers respectively on each said transport unit while said drive and guide means also engage said transport unit at the end of the inclined portion adjacent said rails during the transfer of the transport unit between said inclined portion and said horizontal portion.

40. A transport installation according to claim 28, wherein each said second pair of vertical walls consists of a pair of panels slidable in grooves formed along transverse edges of the ceiling in the transport unit and of the platform opposite said ceiling, one said panel being slidable inside the other said panel, and wherein said walls are automatically opened and closed by similar devices respectively provided at the entrance and the exit of each station, the automatic opening device comprising a first pair of fixed cam rails located one above and the other below the transport unit and adapted to actuate said one panel through fingers secured to the front ends of the upper and lower edges of said one panel, and a second pair of fixed cam rails also located one above and the other below the transport unit and adapted to actuate said other panel through fingers secured to the rear ends of the upper and lower edges of said other panel, arranged so that when the transport unit is moved toward the landing stage of the terminal station along a horizontal portion preceding said landing stage, said fingers respectively engage in said pairs of rails, and said rails guide said fingers so as first to slide said one panel into said other panel and then to slide both said panels together into an open position, and third and fourth pairs of fixed cam rails similar to said first and second pairs and arranged so that when the transport unit is moved away from the boarding stage of the terminal station along a horizontal portion succeeding said boarding stage the foregoing sequence and direction of sliding actions are reversed to move said panels into a closed position.

41. A transport installation according to claim 28, including automatic means for locking said second pair of vertical walls in place immediately after they have been slid back to their normal positions and unlocking them immediately before they are to be slid away from the landing stage. 5

42. A transport installation according to claim 27, including automatic means for locking said frames immediately after they have been closed and unlocking them immediately before they are to be opened. 10

43. A transport installation according to claim 42, wherein said locking and unlocking means include retractable handles that project into each transport unit so that passengers may hold onto said handles when said 15

frames are closed and locked, said handles being retracted as said frames are unlocked.

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Dedication

3,364,872.—*Gabriel Bouladon* and *Paul Zuppiger*, Geneva, Switzerland.
CONTINUOUS TRANSPORT INSTALLATION. Patent dated
Jan. 23, 1968. Dedication filed Sept. 11, 1975, by the assignee, *The
Battelle Development Corporation*.

Hereby dedicates to the People of the United States the entire remaining
term of said patent.

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