United States Patent

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[54] **GROUND-EFFECT TRANSPORTATION SYSTEM**

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[73] Assignee: **Bertin & Cie,** Plaisir, France

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 782,968, Dec. 11, 1968.

[30] **Foreign Application Priority Data**

Apr. 16, 1969 France 6911817

[52] **U.S. Cl.** ..... **104/23 FS,** 104/134, 104/130, 104/244.1

[51] **Int. Cl.** **B61b 13/08**

[58] **Field of Search** ..... 104/23 FS, 134, 244.1, 88, 104/130

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Assistant Examiner—D. W. Keen
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A ground effect transit system in which an air cushion vehicle moves over a track having a guiding upright which is laterally offset with respect to a bearing track surface. The vehicle is provided on each side with a retractable guiding device in the form of an inverted U straddling the upright when the device is in its operative position, so that the vehicle may then be guided selectively from its port side, or from its starboard side, or from both its port and starboard sides. Such a device is useful for marshalling the tracked air cushion vehicle.

6 Claims, 20 Drawing Figures

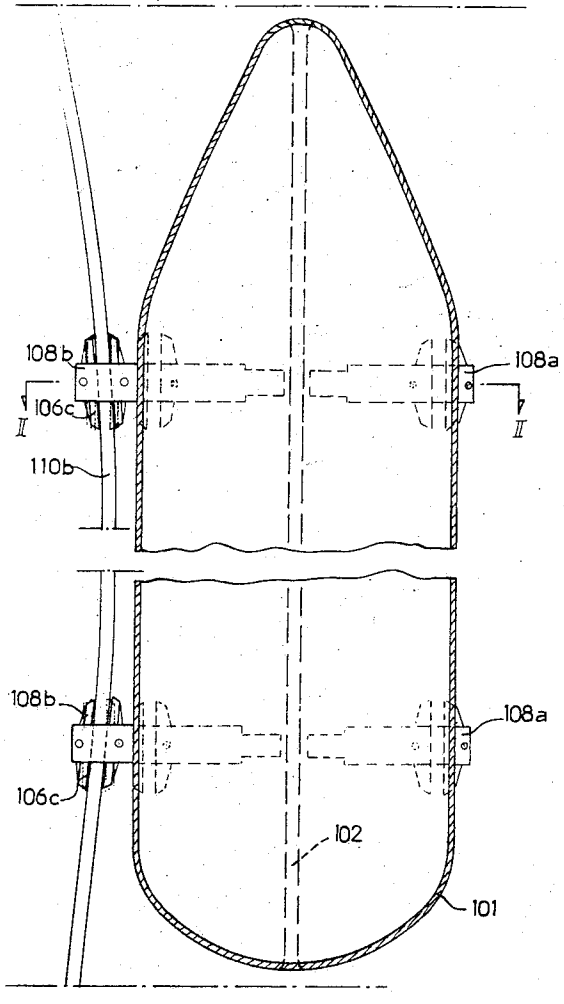


Fig.: 1

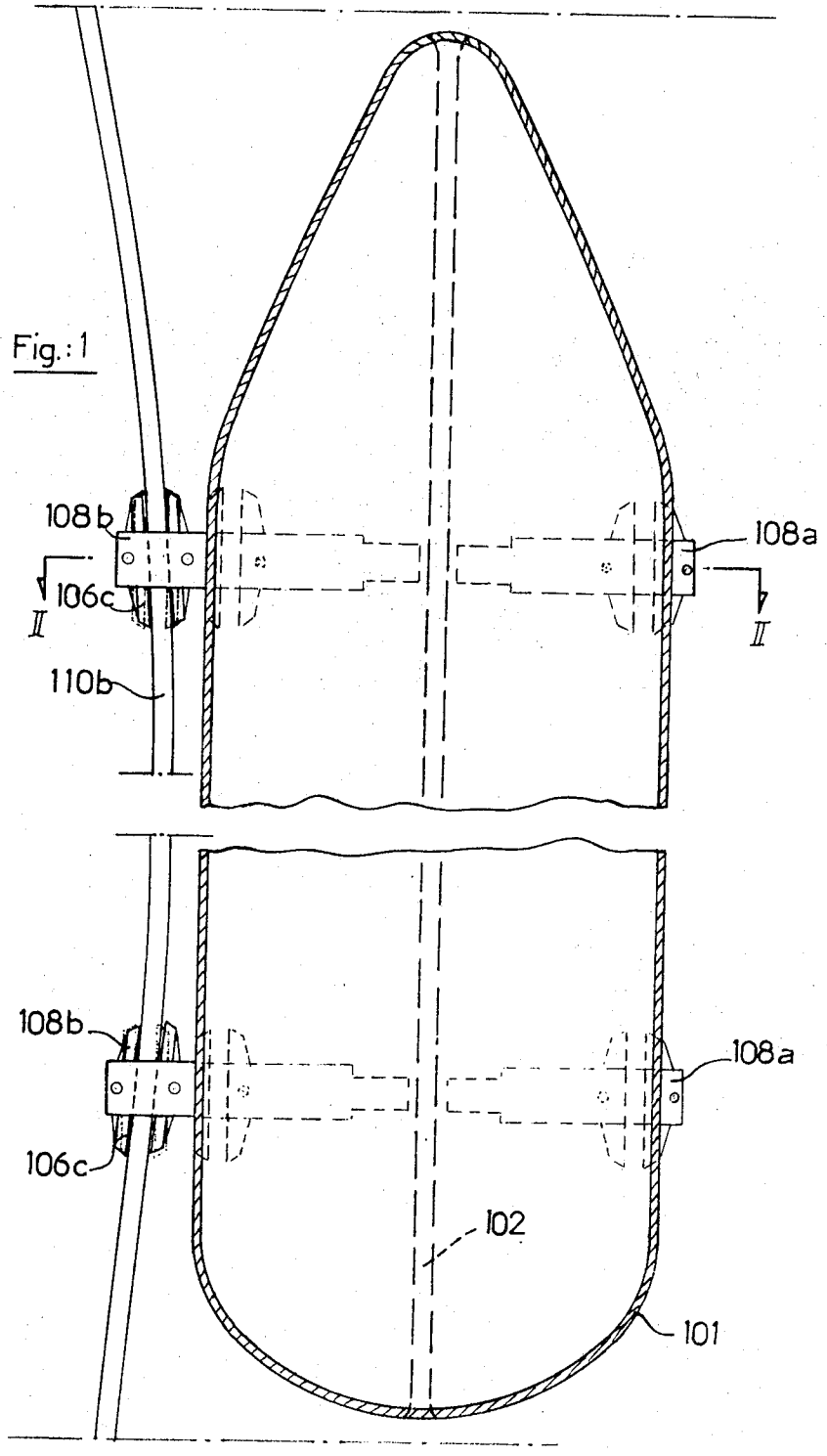


Fig. 2

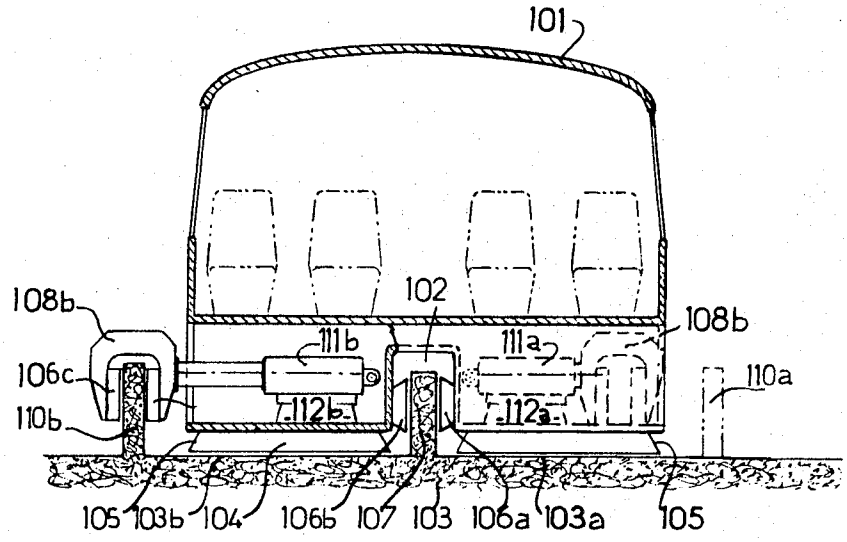

101
102
108b
108b
111b
111a
106c
110a
110b
112b
112a
105
103b
104
106b
107
103
106a
103a
105

Fig. 4

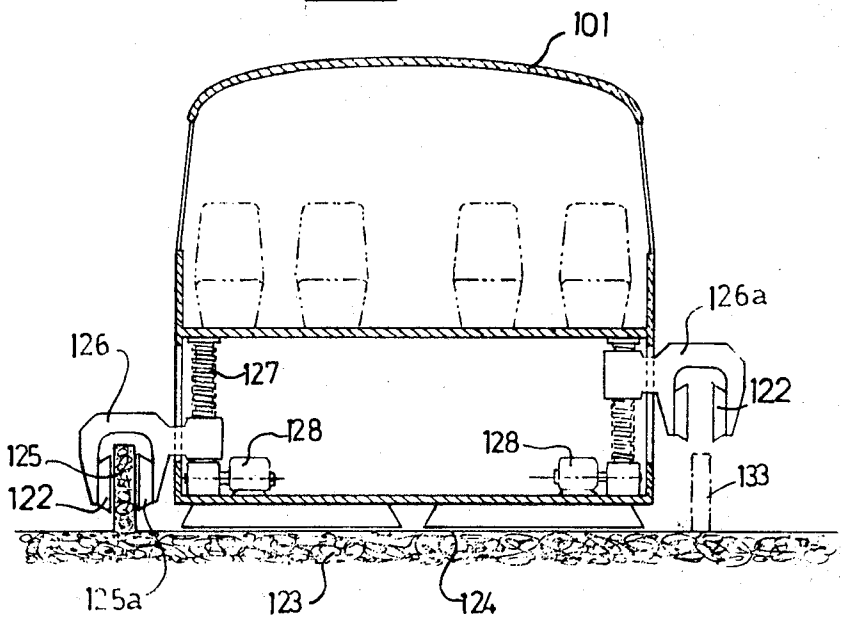

101
126a
126
127
122
128
128
125
133
122
125a
123
124

Fig. 3

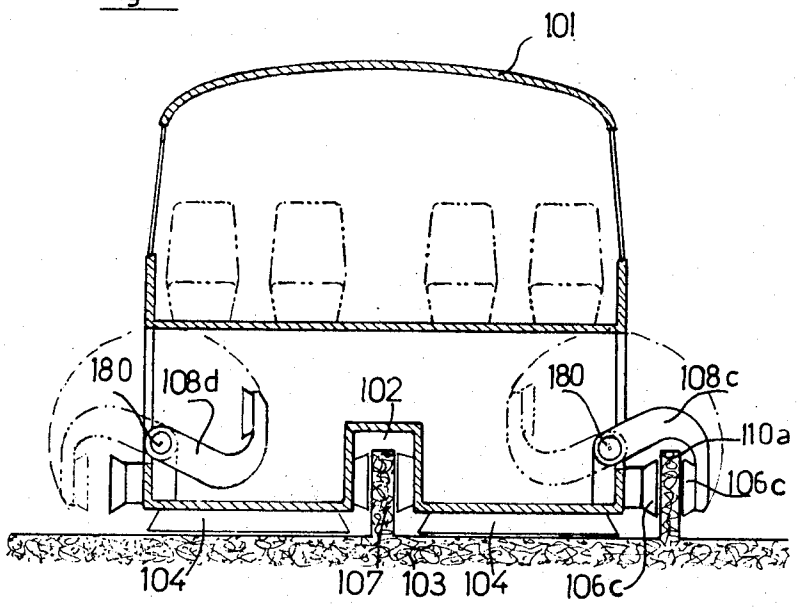
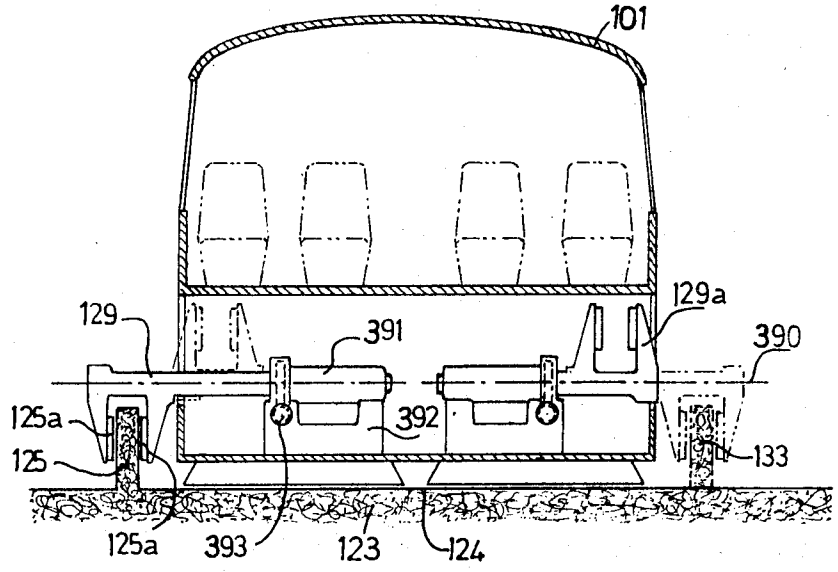
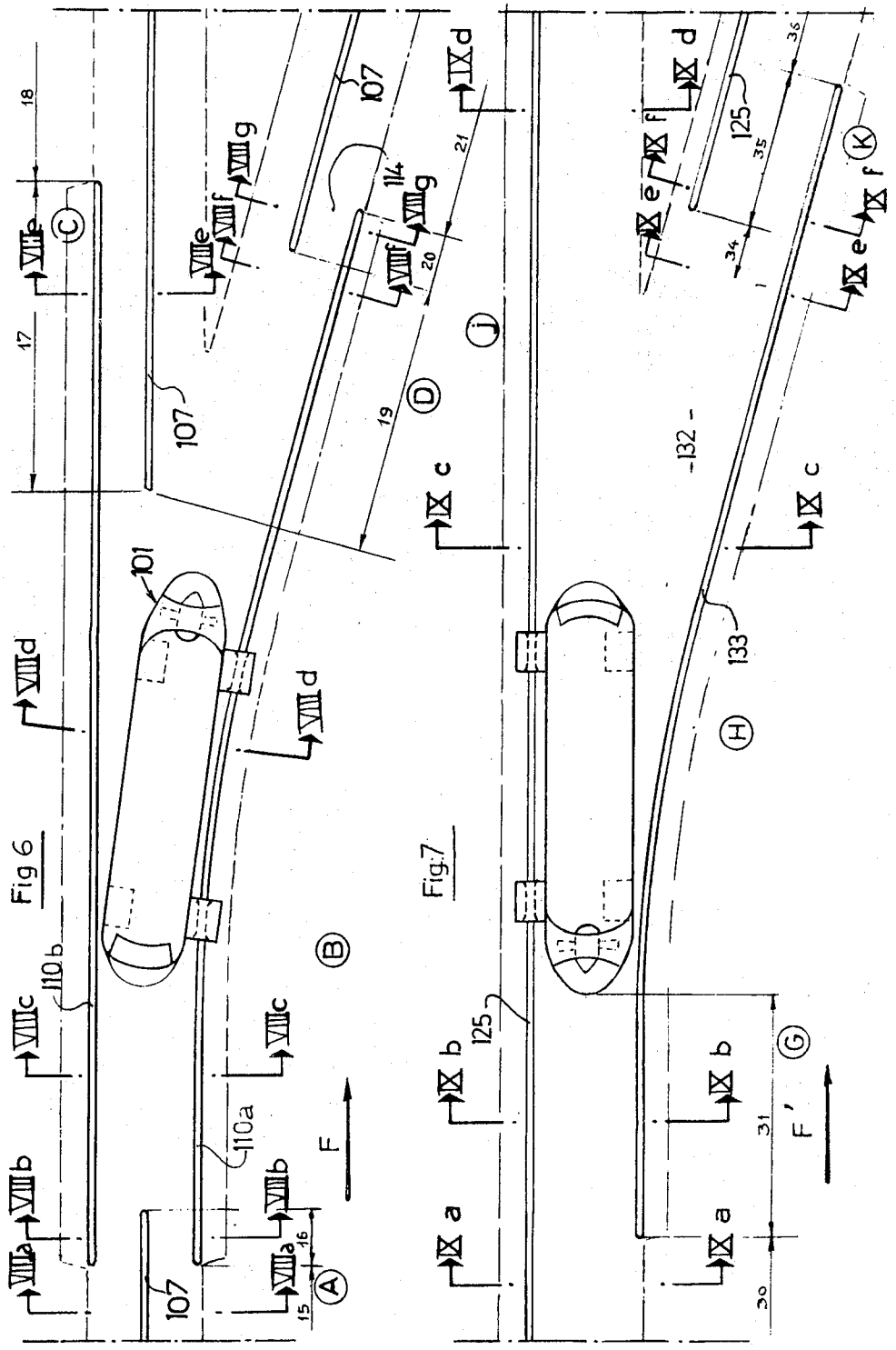
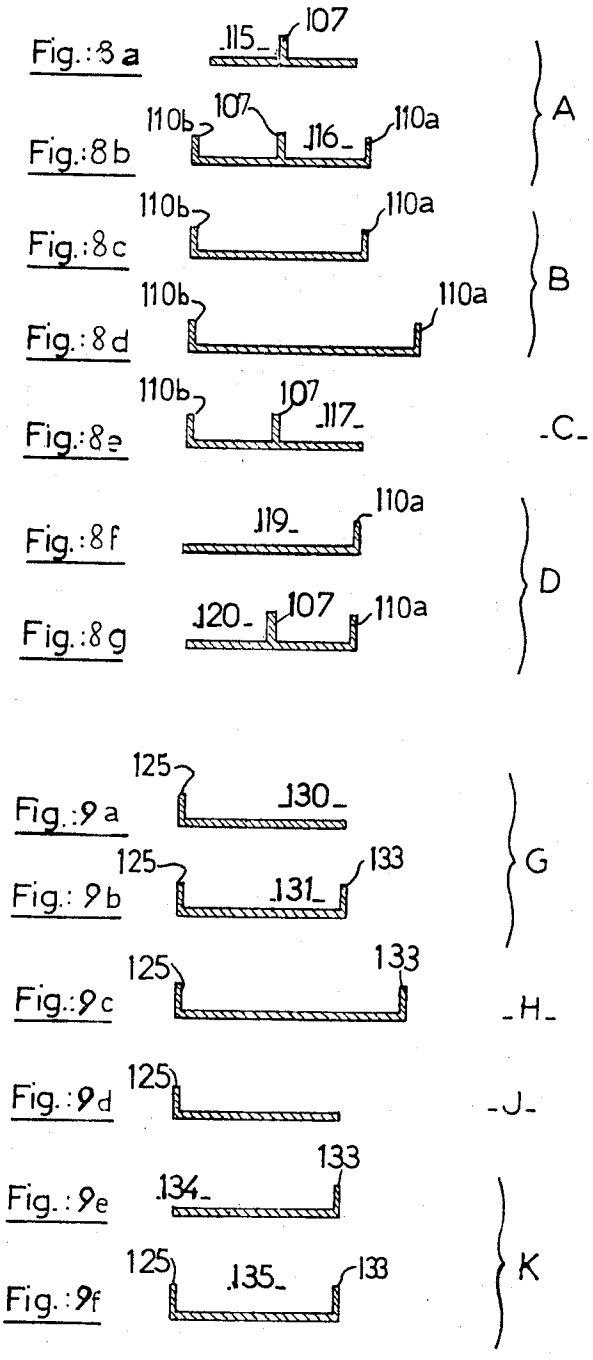

101
180
108d
102
180
108c
110a
106c
104
107
103
104
106c

Fig. 5


101
129
391
129a
390
125a
392
125
133
125a
393
123
124


Fig 6
Fig:7
101
107
110a
110b
114
125
132
133
F
F'
A
B
C
D
G
H
J
K
a
b
c
d
e
f
g
15
16
17
18
19
20
21
30
31
34
35
36


Fig.: 8a
115
107
Fig.: 8b
110b
107
116
110a
A
Fig.: 8c
110b
110a
Fig.: 8d
110b
110a
B
Fig.: 8e
110b
107
117
C
Fig.: 8f
119
110a
Fig.: 8g
120
107
110a
D
Fig.: 9a
125
130
Fig.: 9b
125
131
133
G
Fig.: 9c
125
133
H
Fig.: 9d
125
J
Fig.: 9e
134
133
Fig.: 9f
125
135
133
K

GROUND-EFFECT TRANSPORTATION SYSTEM

This is a continuation-in-part of my copending patent application Ser. No. 782,968 filed on Dec. 11, 1968.

In this copending application is described a ground effect transportation system which comprises:

on the one hand, a dissymmetrical track having a base section with an upwardly facing bearing surface and an extension with two opposite laterally facing guiding surfaces projecting upwardly from said base section, said extension being laterally offset with respect to said base section, and

on the other hand, a ground-effect machine movable along said track with the interposition of a fluid cushion formed against said bearing surface, said machine comprising a body portion borne on said fluid cushion and a guiding device mechanically attached to said body portion and projecting outside to a laterally offset location with respect thereto, said guiding device extending astride said extension and comprising oppositely acting means respectively engaging said opposite guiding surfaces.

An object of the present invention is to improve such guiding device to the effect of rendering it retractable, the machine being then guided by other means which may be conventional.

Another object of this invention is to permit switching of the machine from one track to another, as for marshalling purposes.

Still another object of this invention is to provide a controllable guiding system which may be substituted to or operated in conjunction with conventional guiding means.

In the accompanying drawings:

FIG. **1** is a diagrammatic part sectional plan view of an embodiment of the invention;

FIG. **2** is a section on the line II—II of FIG. **1**;

FIGS. **3** to **5** are sectional views similar to FIG. **2** illustrating three further embodiments of the invention;

FIGS. **6** and **7** are diagrammatic plan views illustrating transportation systems by which a vehicle according to the invention can be transferred from one track to another;

FIGS. **8***a* to **8***g* are sectional views of the track taken on the lines VIII*a*—VIII*a* to VIII*g*—VIII*g* of FIG. **6**; and

FIGS. **9***a* to **9***f* are sectional views of the track taken on the lines IX*a*—IX*a* to IX*f*—IX*f* of FIG. **7**.

In the embodiment according to FIGS. **1** and **2**, the vehicle **101** is supported above the upper surfaces **103***a*, **103***b* of the track **103** by pressure fluid cushions **104** having flexible peripheral walls **105**. The track **103** is provided with upwardly projecting guide extensions or rails **107** and **110***a*, **110***b* arranged centrally and laterally respectively of the track **103**, and the vehicle is provided with central and lateral guide means which cooperate with said guide rails. The central guide means provided on the vehicle comprises a central inverted U-shaped longitudinal channel **102** provided on each of its inner walls with pressure fluid cushions **106***a*, **106***b*.

In accordance with the present invention the vehicle **101** is provided also with guide means **108***a*, **108***b*, provided with pressure fluid cushions **106***c*, each adapted to be extended on one side of the vehicle to cooperate with the laterally disposed guide rails **110***a*, **110***b* respectively.

The guide means **108***a*, **108***b* are arranged with guide elements grouped in pairs, and said guide means on opposite sides of the vehicle may be arranged offset relative to each other or disposed opposite, that is in alignment with each other as shown.

The guide means **108***a*, **108***b* are mounted on the vehicle **101** by means of telescopic members **111***a*, **111***b* carried by support means **112***a*, **112***b* respectively, whereby each of said guide means can be moved into an operative position, as shown in full lines on the left-hand side of FIG. **2**, in which it cooperates with the respective guide rail, or into an inoperative position, as shown in broken lines on the right-hand side of FIG. **2**, in which it is housed within the body of the vehicle below the floor thereof. The telescopic members **111***a*, **111***b* may be in the form of hydraulic or pneumatic rams and preferably means for controlling the operation of said members are provided in the cabin of the vehicle. It will be understood that member **111***a* or **111***b* for moving the guide means **108***a* or **108***b* into operative or inoperative position will be operated when the vehicle is on a section of the track which has no lateral guide rail on that section of the track and whilst the vehicle is being guided by a central guide rail or a guide rail on the other side of the track.

In accordance with a modification the guide elements of the guide means may be arranged so that one is fixed and the other movable by the members **111***a*, **111***b* with the fixed element cooperating with the inner surface of the guide rail and the movable element movable into or out of its operative position. Such a modification is illustrated in FIG. **3**.

In this modification, the vehicle is supported on the track **103** by pressure fluid cushions **104** and is provided with a central guide means **102**, as in the embodiment shown in FIG. **2**, and is provided with guide means **108***c*, **108***d* on the two opposite sides of the vehicle. In each of the guide means **108***c*, **108***d* one of the guide elements **106***c* is fixed to the body of the vehicle so as to be maintained in fixed operative relationship with the inner surface of a lateral guide rail **110***a* and the other guide element **106***c* is movably mounted on the body of the vehicle so as to be movable into and out of operative relationship with the outer surface of said guide rail **110***a*. The movable guide element is mounted on an arm which is pivotally mounted about a horizontal axis **180** so as to be movable into an operative position, shown in full lines, on the right of FIG. **3**, or into an inoperative position shown in full lines on the left of the Figure.

FIGS. **4** and **5** illustrate modified forms of ground effect vehicles according to the invention, which are provided with movable guide means arranged only at the sides of the vehicle, i.e., without central guide means as in the embodiments of FIGS. **1**, **2** and **3**.

In the embodiment according to FIG. **4**, the vehicle is provided on each of its sides with guide means **126**, **126***a* of inverted substantially U-shape having pressure fluid cushions **122** adapted to cooperate with guide rails **125**, **133** on a track **123**. Said guide means **126**, **126***a* are movable vertically between operative and inoperative positions respectively as shown on the left and right-hand sides of the Figure respectively. The vertical movement of said guide means between the operative and inoperative positions is effected by means of screw jacks **127** carried by mounting members **128** fixed to the body of the vehicle. As will be understood, with this construction the guide means can be turned about the vertical axis of the jack so as to be housed within the body of the vehicle when said guide means are in the upper inoperative position as shown at the right-hand side of the Figure.

In the modified arrangement shown in FIG. **5**, the laterally disposed guide means **129**, **129***a* provided with pressure fluid cushions **125***a* are mounted on the outer end of the piston rod of an hydraulic or pneumatic ram **391** carried on a mounting block **392** fixed to the body of the vehicle. The guide means **129**, **129***a* are thus rotatable about a horizontal axis **390** and axially slidable from an operative position to an inoperative position shown in full and broken lines respectively at the left-hand side of FIG. **5**. The operation of the hydraulic or pneumatic ram **391** is controlled by control means preferably situated in the cabin of the vehicle and suitable locking means **393** are preferably provided for locking the guide means in the inoperative position.

The method of operating a ground-effect vehicle having both central and lateral guide means on a track including a main line and a branch line as illustrated in FIGS. **6** and **8***a* to **8***g* will now be described.

The main line, where it joins the branch line is made up at A (FIG. **6**) of the two track sections **115** (FIG. **8***a*) and **116** (FIG. **8***b*).

The track section **115** consists of a single central guide rail **107** and the section **116** includes an extension of the central

guide rail **107** and lateral side rails **110***a* and **110***b* substantially parallel to the central guide rail **107**. The track section indicated at B (FIG. **6**) has no central guide rail but includes continuations of the two lateral guide rails **110***a*, **110***b* (FIGS. **8***c*, **8***d*) with the guide rail **110***a* curving away from the guide rail **110***b* to a branch line D (FIG. **6**). The main track portion indicated at C includes a section **117** (FIG. **8***a*) having a central guide rail **107** and a continuation of the lateral guide rail **110***b* parallel with guide rail **107**. The branch line section D (FIG. **6**) of the track includes portions **119** and **120** (FIGS. **8***f*, **8***g*), the portion **119** of the track shown in FIG. **8***f* includes a continuation of the lateral guide rail **110***a* and the portion **120** of the track includes additionally a central guide rail **107**.

The operation of a ground-effect vehicle according to the invention without central guide means on a track illustrated in FIG. **6** is as follows:

Assuming the vehicle **1** is travelling towards section A of the track in the direction of the arrow F and it is required to continue on the main track to the section C, the guide means on the port side of the vehicle are moved into operative position before it reaches section A. The vehicle is then guided towards section A by the central guide rail **107** and when it reaches section A the port side guide means comes into cooperative relationship with guide rail **110***b* and the central guide means moves out of cooperative relationship with the central guide rail **107**, so that the vehicle is then guided to section C of the track by guide rail **110***b* only. When the vehicle reaches section C of the track it is guided initially by both guide rails **107** and **110***b* and finally by the central guide rail **107** only, whereupon the port guide means are moved back into their inoperative position.

Assuming the vehicle is travelling towards section A of the track in the direction of the arrow F and it is desired to turn the vehicle onto the branch line of the track, that is onto section D, the starboard guide means of the vehicle are moved into their operative position so that as the vehicle approaches section A it is guided only by the central guide rail **107** and as it passes over section A of the track the starboard guide means come into cooperative relationship with the lateral guide rail **110***a*, and the central guide mean move out of cooperative relationship with the central guide rail **107**. The vehicle thus continues to be guided by guide rail **110***a* towards section D of the track. As the vehicle moves into section D of the track it is guided initially by both the central and lateral guide rails **107** and **110***a* respectively and finally the starboard guide means move out of cooperative relationship with the lateral guide rail **110***a*, whereupon they are moved out of their operative position and the vehicle continues along the branch line guided by the central guide rail **107** only.

It will be understood that when the vehicle is travelling in the opposite direction to that indicated by arrow F from section D of the track to section A, the starboard guide means will be moved into operative position, prior to reaching track section D, so that the vehicle will be guided by guide rail **110***a* to track section A after which the vehicle will be guided only by the central guide rail **107** and the starboard guide means moved to their inoperative position.

In the case of a track vehicle having only lateral guide means on a track illustrated in FIGS. **7** and **9***a* to **9***f* having track sections G, H, J and K, the track section G includes a continuous main line track portion **130** (FIG. **9***a*) having a lateral guide rail **125** on one side only and a portion **131** (FIG. **9***b*) having substantially parallel lateral guide rails **125**, **133** on opposite sides of said track. The track section G leads to a main line section J and a branch line section K. The track section leading to the branch line section K passes through a track section H which includes a continuation of the lateral guide rails **125**, **133** (FIG. **9***c*) curving towards section K, and track section K has a portion **134** (FIG. **9***e*) containing only the continuation of guide rail **133** and portion **135** (FIG. **9***f*) containing the lateral guide rail **125** on the opposite side of the track parallel to guide rail **133**, said guide rail **133** ending at section K whilst the guide rail **125** continues along the branch line.

The operation of a ground-effect vehicle according to the invention over the track illustrated in FIG. **10** is as follows:

Assuming the vehicle is travelling towards section G of the track in the direction of the arrow F', the guide means on the port side of the vehicle are in their operative positions and cooperate with guide rail **125**. If the vehicle is to continue along the main line of the track, that is towards section J, the guide means on the port side of the vehicle are kept in their operative position and the guide means on the starboard side retained in the inoperative position. If, however, the vehicle is to be turned onto the branch line, that is towards section K, the guide means on the starboard side of the vehicle are moved into operative position before the vehicle reaches section G of the track. When the vehicle reaches that portion of section G of the track, where the two guide rails run parallel to each other, the guide means on the port side of the vehicle are moved out of their operative position so that the vehicle is guided by said starboard side guide means along guide rail **133**. When the vehicle is approaching section K of the track the guide means on the port side of the vehicle are again moved into their operative position so that when the vehicle reaches section K of the track said guide means will come into operative relationship with guide rail **125** whereupon the guide means on the starboard side of the vehicle will be again moved into their inoperative position, the vehicle continuing to be guided along the branch line of the track by guide rail **125**.

It will be understood that when the vehicle is travelling in the direction opposite to that indicated by arrow F', that is from the section K to section G of the track, the guide means on the part and starboard sides of the vehicle will be moved into and out of their operative positions in the reverse sense, that is the guide means on the port side of the vehicle will be moved into operative position as the vehicle approaches section K of the track, the guide means on the starboard side will be moved in inoperative position at section K of the track and when the vehicle passes the end of guide rail **133** at section G the port guide means will again be moved into inoperative position and the starboard guide means moved back into their operative position to cooperate with guide rail **125**.

I claim:

1. A ground effect transportation system comprising:

a track of generally concave dihedral design having (i) a generally horizontal, upwardly facing bearing surface and (ii) at least one prismatic extension protruding upwardly from said bearing surface to a free top edge parallel thereto and having two opposite though closely adjacent, mutually backed outer guide surfaces facing laterally away from each other, said bearing surface and said extension being laterally offset with respect to each other whereby said track is of generally L-shaped cross section with said bearing surface and said extension forming respectively the horizontal and the vertical arms of the L, and

a ground effect machine comprising (i) a body portion movable over said bearing surface in substantially frictionless wheelless engagement therewith through a support cushion formed against said bearing surface, said body portion being in a laterally offset location with respect to said extension and having a port side and a starboard side, one of which is adjacent to said extension and the other remote therefrom, and (ii) two like guiding devices located respectively at said port side and at said starboard side of said body portion and each selectively controllable to a fully operative position astride said prismatic extension over said free top edge thereof, in substantially frictionless wheelless cooperation with both said guide surfaces through opposite, guide cushions formed against said guide surfaces, each of said guiding devices having at least one guide surface engaging section which is selectively projectable in one direction from the respective one of said body portion sides toward the guide surface to set the corresponding guiding device into said fully operative position thereof, and retractable in the op-

posite direction whereby said corresponding guiding device is no longer in said fully operative position thereof.

2. System as claimed in claim 1, wherein each retractable guiding device section is arranged for being extended into said operative position and retracted therefrom, over said free edge of said prismatic extension.

3. System as claimed in claim 1, wherein each retractable guiding device section is arranged for being extended into said operative position and retracted therefrom, by a rotation movement about an axis substantially level with and parallel to said free edge of said prismatic extension.

4. System as claimed in claim 1, wherein each retractable guiding device section is arranged for being extended into said operative position and retracted therefrom, by a translation movement substantially perpendicular to said prismatic extension.

5. System as claimed in claim 1, wherein each of said guiding devices further comprises another guide surface engaging section which is fixed with respect to the corresponding one of said body portion sides.

6. System as claimed in claim 5, wherein said guiding device section which is projectable and retractable, is arranged to undergo a rotation movement about an axis substantially level with and parallel to said free edge.

* * * * *