

SPECIFICATION

Portals for vehicles

5 *Field of Invention*

The invention relates to portals for providing a passageway between end faces of two coupled vehicle boxes, especially railway cars.

Background of invention

- In a known passageway system having separable portals, for example that described in U.S. Patent 2,826,998, pivoted linkage supports are disposed above and below a passageway and the lower of the two pivoted linkage supports includes a lightly domed bridge member, in the form of a plate, which is pivotable around a transverse axis disposed at a face end of a vehicle box. Other bridge members, on which the former bridge member lies in scale-like manner, are supported on a threshold of a portal end frame either directly or by means of a support system which is itself supported by a vehicle box coupler lying below. A disadvantage of this construction is that the coupler must cooperate in the functioning of the passageway system and is thus loaded by the portal end frames. The construction cannot accommodate substantial differences in height between the two vehicle boxes such as may take place if the springs on one of the vehicle boxes break.
- Further known is a passageway system as described in U.S. Patent 1,012,451, in which each of the separable portals is supported from below by a coupler and from above by a pivoted linkage connected to the vehicle box in the region of the roof. This pivoted linkage includes a telescoping device which may be pivoted around a vertical axis mounted on the vehicle box but at some distance from the end face of the box and located inside the vehicle box. In the region lying outside the plane defining the end face of the box, a spring-tensioned telescoping device has mounted on it a lever arm which pivots around a vertical axis, the other end of the lever arm being fastened to an end frame of the associated portal. In this disposition, the portal is carried by one of the couplers and thus moves laterally with the coupler. The walkway which passengers use in their passing from one box to the other includes a rigid plate extending from the end face of the box. On this rigid plate lies a bridge plate which can glide on the rigid plate in the manner of a fish scale and which is mounted for movement around a transverse axis at the threshold of the vestibule frame.

- It is an object of the invention to provide a portal construction which permits the two connected portals to be held in defined position and in which a walkway for supporting passengers in a passageway is guided so as to reduce danger unpleasant effects and disturbances to passengers using the passageway.

Description of the invention

- The invention provides a portal on a vehicle box for forming, with another portal, a passageway between coupled vehicles which portal includes a walkway formed by a first bridge member hinged to the vehicle box, a second bridge member hinged to a portal end member, said respective bridge members being in overlapping slidable relationship and resting on a pivot linkage support enclosed within a membrane for surrounding the passageway.

- The membrane is known more conventionally as the "skirt". The arrangement of the invention permits the passageway to be supported from above and not by the coupler. To permit this option to be used conveniently there is provided also an upper pivot linkage support between the vehicle box and the portal end member above the membrane capable of supporting the downward load created by the portal projecting outwardly of the vehicle box. The upper pivot linkage support can, if necessary, also help to support the weight of any passengers on the walkway. The walkway pivot linkage support permits both bridge members to be constructed pivotably about transverse axes, without one fixed bridge member having to perform a support function for the other, because both bridge members are supported by means of the pivot linkage system. Preferably then one of the bridge members is movable integrally on hinging and rests directly on the pivot linkage support (this is conveniently the first bridge member) and the other one of the bridge members is subdivided to hinge individually and rests on top of the other bridge member.

- The invention facilitates safe and comfortable use of the passageway by the passengers who are reliably protected against any effects of the weather or the environment by the surrounding rubber membrane which also surrounds the lower walkway. The bellows or membrane seals the passageway against draughts, water, snow, dust, sand, smoke and noise. This type of sealing is significant especially in air-conditioned vehicles due to the good thermal and acoustical insulation it affords. Finally, the effective seal makes it possible to dispense with additional doors at the end of the vehicle box and/or compartment doors which is advantageous with respect to weight as well as to cost.
- An advantage of the passageway system using portals according to the invention is also the



large usable interior cross section and the substantially continuous flat walkway floor without appreciable ramps or steps. Thus, the passageway can be used for the comfortable movement of passengers during normal operation, for utilization as a standing room in heavy traffic and as an escape route from one carriage to another. Finally, the passageway system using portals

5 according to the invention permits sufficient mobility to accommodate any relative motions of the coupled vehicle boxes which occur in use. The system can accommodate very small track curvatures, as well as deliberately transversely inclined carriage boxes, large irregularities in the track and any motions due to vehicle suspension and vehicle coupling. A further advantage is the possibility of simple and reliable joining and separating of the portals forming the

10 passageway when the railway vehicles are coupled or uncoupled. The couplings used may include automatic as well as manually actuated couplers and possibly permanent or semi-permanent couplers.

The passageway system using portals according to the invention can accommodate any rotation or displacement which the two vehicle ends may perform relative to each other during a

15 trip.

Preferably the pivot linkage support is pivotably connected for movement about upright and transverse axes to the vehicle box at one end and to the portal end member at the other end and is extensible in a longitudinal vehicle box direction. In an exemplary embodiment, the pivot linkage support includes a bridge support mounted on the vehicle box by a two-axis pivot. The

20 bridge support guides telescopically and displaceably in the longitudinal vehicle direction a further bridge support extending to the end of the portal, and attached to the end member or frame by a ball joint. This embodiment of the pivot linkage system is especially advantageous. Conveniently the linkage support has side arms for supporting one of the bridge members at transversely spaced positions and the pivot linkage support has a roller for rolling under one of

25 the bridge members as the linkage support is pivoted about an upright axis.

Preferably there are further provided shields pivotable about an upright axes between the passageway and the inside of the membrane and ceiling members between the passageway and the top of the membrane which ceiling members are supported by a pivot linkage support between the membrane and the ceiling members.

30 In a preferred embodiment of the invention, the ceiling members include a cover plate at each end of the portal, one of the cover plates being pivoted at the vehicle box around a transverse and a longitudinal axis and the other pivoted at the portal frame end about a transverse and vertical axis. This covering of the ceiling results not only in an attractive appearance of the interior space of the passageway but also provides an additional feeling of security for the

35 occupants. Finally, the covering hides the rubber membrane and thus protects it against deliberate damage. The ceiling members are preferably provided as partially overlapping plates and the pivot linkage support provides telescopic guidance. One end of the pivot linkage support is mounted at the vehicle box and the other at the portal end frame. The two plates are preferably so embodied that they provide a covering without gaps. Finally upper cover plates

40 can also be so formed as to cover a region above their pivot linkage support so that those latter upper coverplates and hence the associated pivot linkage support may serve for supporting the membrane.

Suitably the portal end member is pivotably connected to a coupler movable resiliently in a longitudinal vehicle direction and located below the portal and connected to the vehicle box for

45 joining a pair of vehicles. In a preferred embodiment of the invention, in which a lower releasable coupler rod (known *per se*) is provided, the coupler rod is attached to the vehicle box with a ball joint and has longitudinal elasticity and the coupler rods are used to guide the associated portals in the longitudinal and transverse directions through a pivotal connection. The coupler on one vehicle box may be rigidly or fully releasably connected to an appropriate

50 coupler of another box. The guidance provided by the couplers in a longitudinal and transverse direction may be separate from any support function and the pivotal connection then serves solely to maintain a single defined position of the passageway even during transverse accelerations when the passageway is substantially supported by an upper support system for the portals. Suitably the portal end member has a pin for engaging in a recess of the coupler to

55 pivotably connect the portal end member and the coupler.

In order to relieve the coupler from the load of the portal and to permit suspension of the portal on upper carrier arms of the upper pivot linkage support system, a preferred embodiment provides that the two upper pivotable guiding arms have a path-limiting stop located at their common joint whose effect is to cause both guiding arms to constitute a rigid suspension beam

60 which is itself supported by two slides. In this way, the load is distributed in approximately equal parts on two upper pivotal arms mounted on both vehicle boxes.

In order to permit a transfer of the entire weight of coupled portal to one of the two coupled vehicle boxes in case the other of the two boxes experiences a failure of, say, its pneumatic suspension, it is possible to mount path-limiting stops between the guiding arms and the slide.

65 The effect of these stops is to cause the weight of the passageway to be borne in such a case by

the vehicle box whose suspension is intact.

Suitably rigid tension rods are disposed between the vehicle box and the portal end member to aid coupling.

Preferably resilient tension rods are disposed between the vehicle box and the portal end member for helping to support the portal weight.

Preferably, each of the portal end frames cooperate with a compression spring mounted between the vehicle box and the upper carrier arm and acting in the longitudinal direction of the vehicle away from the vehicle box. The result is that, when uncoupled, the corresponding portal end frame is pushed outwardly whereas, in the coupled condition, the two joined portal halves are held approximately midway between the two ends of the carriages.

In similar manner as in the ceiling region, a preferred exemplary embodiment of the invention provides internal shields at the sides of the passageway which cover the rubber membrane or bellows. These shields are mounted movably at the lateral box portal columns and pivot about the vertical axis.

15 DRAWINGS:

Figure 1 is a side view of two vehicles including a passageway of portals according to the invention;

Figure 2 is a schematic cross section through a portal according to Fig. 1 with passengers in the passageway between two vehicle boxes;

20 Figure 3 is a schematic longitudinal section through a pair of coupled ports of the invention with the constructional assemblies indicated;

Figure 4 is a schematic diagram in symbolic representation of a closed passageway of portals according to the invention to illustrate different freedoms of motion;

25 Figure 5 is a top view of a walkway with sectionally represented side membranes formed by a pair of interconnected portals according to the invention;

Figure 6 is a longitudinal section through the walkway of Fig. 5;

Figure 7 is a top view of a covering of the portals of Fig. 5 with lateral membranes shown in section;

30 Figure 8 is a longitudinal section through an upper pivotal linkage support and the covering of Fig. 7 for the portals of Fig. 5 and

Figure 9 illustrates different modes of use of portals according to the invention in schematic representations.

Preliminary explanation of drawings

35 There are six possible components of motion which two coupled vehicle boxes may execute with respect to one another.

Table 1

Motion	Symbol	
Displacement parallel to longitudinal axis	along x	$\dot{x}$
Displacement parallel to transverse axis	along y	$\dot{y}$
45 Displacement parallel to vertical axis	along z	$\dot{z}$
Rotation about longitudinal axis	about x	$\ddot{x}$ (Roll)
Rotation about transverse axis	about y	$\ddot{y}$ (Pitch)
Rotation about vertical axis	about z	$\ddot{z}$ (Yaw)

50 When comparing different supports for portals forming walkways a characteristic role is played by the central transverse plane indicated as MQE of the drawings. This is the separation plane of a passageway formed by two separable portals. It is the plane of symmetry. The MQE can move with respect to the vehicle box motions in and about the Y and A axes referred to in Table 1.

55 Fig. 1 of the drawing is a purely schematical representation of two vehicle boxes 1 and 2 belonging respectively to two railway vehicles or cars 3 and 4 shown in side view. The ends of the vehicles 3 and 4 are provided respectively with vehicle couplers 6 and 7. The end faces 12 and 16 of the vehicle boxes 1 and 2 are provided with portals or vestibules 9 and 10 which permit the walking passage of persons from one railway car to the other, as illustrated in the cross section of a portal 9 shown in Fig. 2. The separation plane is indicated at 14. Illustrated in Fig. 2 are two persons in the process of walking across a bridge member in the form of plate 18 in the portal 9. It will be seen that the persons are completely protected against external influences.

65 Illustrated in Figs. 1 and 2 are the three orthogonal axes X, Y, Z of a cartesian coordinate

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system to which further references will be made.

The portals serve as passages and as shelter for railway passengers, although they may execute continuous motion corresponding to the relative motion of the railway cars during the trip. The portals also protect the passengers against external influences and furthermore protect the passageway itself externally and internally. The portal has to accomodate a number of functions for providing mobility and further protective functions. The attached flow diagram illustrates the inter-relationship between the various functions.

Table II

FROM PROBLEM TO SOLUTION

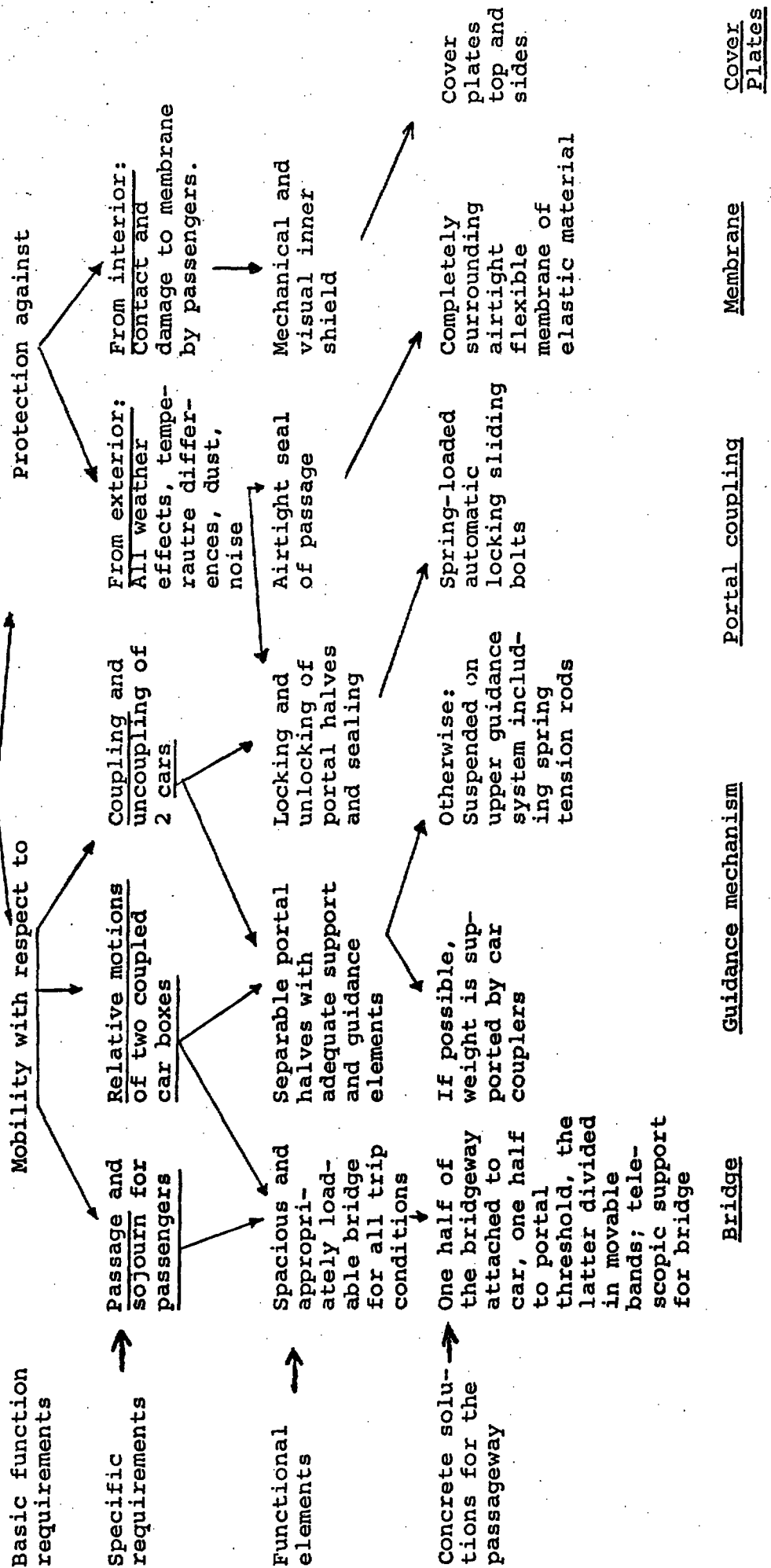


Fig. 3 is a schematic representation of a longitudinal cross section through a passageway formed by two portals between two vehicle bodies and shows the following constructional groups for portals of the invention at the following levels:

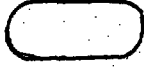
- | | | |
|----|--|----|
| 5 | A. The vehicle coupler | 5 |
| | B. An elastic membrane or bellows | |
| | C. A walkway | |
| | D. A passageway, lateral covering and linkages | |
| | E. An upper covering | |
| 10 | F. An upper pivotal linkage system | 10 |

The conditions and possibilities relative to the vertical support of the portals are summarized in Table IV.

- | | | |
|----|--|----|
| 15 | Fig. 4 represents a pivotal linkage network or a mobility plan. This plan includes rectangular bands which represent rigid elements, bands with rounded ends which represent elastic members and circles which represent elastic members and circles which represent pivots. Furthermore, the pivotal symbols are provided with the symbol representing the possibilities of motion as set out in Table III with respect to the six components of motion. This symbolic representation helps to ascertain the functioning of the parts shown in other drawings. The exact construction of the individual pivots and links in | 15 |
| 20 | | 20 |

Table III

5 The pivot linkage network is shown in a side view. The 5
four main symbols are

- 10  = rigid links  = elastic links 10
15  = pivots (joints)  = two links can be 15
coupled rigidly or
completely separated

The mobility symbols in a joint symbol have the meaning:

- 20  rotatable about } { z axis; vertical axis in 20
y axis; transverse to { plane of
25 • displaceable in } { x axis; longitudinal axis in 25
drawing

The number of mobility symbols yields the types of joints:

- 30  pivotal, transmits rotation about the two 30
other axes }
35  two-axis pivot (universal joint) transmits 35
rotation about third axis } pivots
 three axis pivot, transmits no torques }
40 • linear freedom of motion, straight line 40
guidance, transmits forces in two other
directions }
45 • • area freedom of motion, transmits forces 45
in third direction, } sliding
joints
• • • spatial freedom of motion, transmits no
translation forces }

Table IV

Type of construction and load		Support of the passageway on the vehicle coupler 6, 7 is			
Operative during		<u>permissible</u>		<u>not permissible</u>	
		net weight only	w/ payload	net weight only	with payload
Normal operation	uncoupled	Rigid rod (pendulum) mounted only for installation aid removed for normal operation	---	Spring tension rod 28 (elastic pendulum) as construction element; supports approximately net weight of passageway	x
	coupled	All vertical forces are applied to coupler 6, 7 via elastic intermediate element and distributed over both car boxes		Vertical forces are distributed over both car boxes by central stop 18 and upper guidance	
Extreme height difference, e.g. suspension breakage		Entire passageway suspended from upper guidance by box-side stop 62 of the car with damaged suspension		As at left, except net weight of passageway supported by spring tension rods 18 from undamaged car	

the drawings may be varied but the functioning will not be affected as long as the components of movement of Fig. 4 are adhered to.

Exemplary embodiments of construction of passageways between vehicle boxes will be described with reference to Figs. 5 to 8 showing a corresponding embodiment in side views and longitudinal sections. In Fig. 4, all the pivots are provided with the mobility symbols according to Table III but only the most important reference numerals used in Figs. 8 to 11 are included for the purpose of clarity. Figs. 4-8 are described together and detail the general arrangement of Figs. 1-3.

Shown are part of two coupled vehicle boxes 1 and 2 belonging to the two cars 3, 4 and two separable portals 9, 10. The function of the parts of both portals are the same and they are arranged symmetrically on either side of the separation plane 14. Only the left half of Figs. 4-8 will be described below. The portal 9 has a bridge plate 18 which is pivotably attached in the manner of a hinge at one threshold 20 of an end face opening of the vehicle box where it pivots about a transverse axis 23. Rotatably disposed about a transverse axis 26 are bridge members 25 attached to a threshold 21 of a portal end frame 24 and the bridge members 25 glidingly lie on the bridge plate 18 attached to the vehicle box to form a walkway. The bridge members 25 consist of individual adjacent elements 50-54 which are capable of close adhesion even when the bridge plate 18 on the box side undergoes rotation about the longitudinal axis. Disposed below the passage walkway 18, 25 is a pivotal linkage support or guidance system. This system consists of a bridge support 29 attached to the box 1 by means of a two-axis pivot. Its purpose is to support and guide the bridge plate 18 attached to the car box as well as to be connected to a bridge support attached to the portal end frame by means of a longitudinally displaceable telescope mechanism. The bridge support 30 attached to the portal end frame is connected to the portal half 24 by means of a two-axis (cardan) pivot 31.

The portal halves 24 are held in the central position between the two end faces 12, 16 of the vehicle boxes with respect to distance and angular position. The passageway formed by the coupled portals can be sealed by a completely closed surrounding rubber membrane 42. Lateral cover plates 44 may be attached so as to provide lateral shielding between the rubber membrane 42 and the passenger space 43 (Fig. 2). The lateral cover plates 44 may, for example, be pivotably attached to the box 1 by hinge 46 extending in the vertical direction and may be glidingly supported on the central portion of the portal half 24. Spring tension rods 28 are also illustrated (See Fig. 7).

The passenger space 42 is covered at the top by means of a movable covering. This consists of horizontal plates or sheets 66, 67, 68 which are mutually displaceable in the longitudinal direction by being connected to telescoping parts 75 and 76 and which are supported pivotably at the box 1 or the portal end frame 24. The type of pivots at connection chosen for the exemplary embodiment can be derived from Fig. 4.

The vehicles 3, 4 may be coupled by the manual or automatic vehicle couplers 6, 7. The weight of the portals when the cars are coupled is normally supported by an upper pivot linkage support and guidance including elements 57-64. However, if the vehicle coupler 6, 7 is suitably constructed, it may support the portal partially or completely.

The upper portal pivotal linkage support, shown enlarged in Fig. 8, consists of a mechanical pivotal linkage between the vehicle box and the associated portal end frame. A pivotal arm 58 which pivots about a vertical axis 57 is attached to the vehicle box 1. The pivotal arm 58 carries a slide 59 which is slidable in the longitudinal direction. Rotatably attached to the slide 59 about a transverse axis 61 is a single or double support arm 60 which is pivotably and separably attached to the upper end of the portal end frame 24 at a joint 63. The slide 59 is urged outwardly by a system of springs 64 so that when the vehicles are uncoupled, the portal halves 24 assume their outermost position whereas, when coupled, the two joined portal end frames 24 are held approximately in the middle between the two vehicles 3, 4. Further provided between the support arm 60 and the slide 59 are path-limiting stops 62 which limit the extent of the downward motion of the portal end frames 24.

Depending on whether the vehicle couplers 6, 7 (Fig. 6) can be loaded with the weight of the portals or not two variants of construction result. In a first case, the upper pivotal linkage support will be loaded with the weight of the portal only under special conditions, namely when extreme differences occur in the vertical position of the two boxes 1 and 2. Normally however, the portal is supported by the vehicle coupler 6, 7. In a second case if the vehicle coupler 6, 7 cannot be loaded with the weight of the portal, the upper pivotal linkage support supports the weight of the passageway. In that case, there is provided a further stop 78 which limits the relative motion of the two support arms 60. As a result, the two support arms 60 form a rigid support yoke whose two ends are suspended from the two slides 58 and the centre of which is loaded by the portals.

The associated pivotal linkage chain may be deducted from Fig. 4. The walkway, which is seen in detail in Figs. 8 and 9, is disposed between the vehicle boxes 1 or 2 and the associated respective portal end frames 24 at the height of the floor of the vehicles 3 or 4. On the side of

the vehicle box, the approximately half-rounded plate 18 is pivotably attached to the transverse axis 23. The counter plate 25 is pivotably attached to the transverse axis 26 at the portal half 24 and is glidingly supported on the plate 18 attached to the box. One of the two plates, in this case the plate 25, is subdivided into individually movable strips 50-54 so as to permit

5 improved adaptation to motions in use. Disposed underneath the bridge plates 18, 25 is the telescopic carrier assembly of parts 29, 30 connected between the vehicle box 1 and the portal frame 24. This assembly acts to support the walkway. In the exemplary embodiment shown, the bridge support 29 is a telescopic tube attached by the two-axis pivot 23, 31 beneath the bridge plate 18 on the vehicle box side. The cooperating telescopic rod 30 which is guided by the
10 telescopic tube 29 is attached below the pivot of the bridge plate 25 at the portal frame side to rotate about a transverse axis 31. The bridge plate 18 is glidingly support on the telescopic tube 29.

The upper covering of the interior of a passageway between two railway vehicles which may be separated in a central transverse plane 14 and which is completely surrounded by, for
15 example, a rubber membrane 42 is illustrated in Figs. 10 and 11. The covering is composed of the cover plates or sheets 66, 67 and 68. One of the end plates 66 is attached to the portal end frame 24 and pivots about the vertical axis of a joint 73 and about the transverse axis of a pivot 72. The other end plate 68 is attached by means of a two-axis joint 71 to the vehicle box 1. The partially overlapping plates 66 and 68 can be augmented as is clearly shown in Figs. 10
20 and 11 by segment plates 67 for the purpose of completing the covering. The segment plates are pivotable about a vertical axis 79 at one or other of the end plates 66 or 68. The entire assembly of plates is guided by the telescoping parts 75 and 76 where, in the case shown, the piston part 75 of the telescope is attached to the box and the cylinder part 76 is attached to the end frame.

25 Advantageously, the segment plates 67 are so guided by means of compression springs 69 and stops 70 that, when the end plates 66 and 68 are widely separated, the segment plates cover the lateral gaps between them, whereas, when the plates 66 and 68 are close together, the segment plates 67 are pushed between them. This construction prevents an uncontrolled to and fro motion when accelerating.

30 As shown in Fig. 8, the end plate 66 is pocket-shaped and its lower surface, as explained, serves as the end plate 66 whereas the upper surface 74 supports the rubber membrane 42.

The following remarks may be made with respect to the function of the motion-limiting stops 62 and 78 of the support arm 60. Fig. 9 is a set of schematic illustrations distributed over four rows a, b, c, d and three columns A, B, C in which various conditions of use of the portals are
35 shown. The rows a and b illustrate a portal which is normally supported by the vehicle couplers 6, 7 but is always guided thereby. The rows c and d illustrate a portal which is guided by the couplers 6 and 7 only in the horizontal direction but is not supported thereby. In rows a, c, the portal is shown unoccupied whereas in rows b, c, it is shown loaded by the presence of passengers.

40 Column A illustrates the vehicles in the coupled state and in normal operation, column B illustrates the vehicles in the coupled state but with an extreme vertical distance between the two vehicle boxes 1 and 2 and column C shows one of the vehicles uncoupled and thus unloaded.

The illustrations of Fig. 9 show the function of the upper motion limiting stops at both the box
45 side and the portal frame side. In the drawing, those elements such as support arms, spring tension rods or vehicle couplers which carry the load are shown shaded. The stop at the portal frame side which causes the upper support arms to be joined into a single continuous beam, becomes operative in the illustrated cases Ac and Ad in Fig. 9, whereas the stops at the carriage box come into play in the case Ba, Bb, Bc, Bd and Cc.

CLAIMS

1. A portal on a vehicle box for forming, with another portal, a passageway between coupled vehicles which portal includes a walkway formed by a first bridge member hinged to the vehicle box, a second bridge member hinged to a portal end member, said respective bridge members
55 being in overlapping slidable relationship and resting on a pivot linkage support enclosed within a membrane for surrounding the passageway.

2. A portal according to claim 1 in which the pivot linkage support is pivotably connected for movement about upright and transverse axes by a two pivot joint to the vehicle box at one end and by a ball joint to the portal end member at the other end and is extensible in a
60 longitudinal vehicle box direction.

A portal according to claim 1 or claim 2 in which the linkage support has side arms for supporting one of the bridge members at transversely spaced positions.

4. A portal according to any of the preceding claims in which the pivot linkage support has a roller for rolling under one of the bridge members as the linkage support is pivoted about an
65 upright axis.



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A portal according to claim 1 or claim 2 in which the linkage support has side arms for supporting one of the bridge members at transversely spaced positions.

4. A portal according to any of the preceding claims in which the pivot linkage support has a roller for rolling under one of the bridge members as the linkage support is pivoted about an
65 upright axis.



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5. A portal according to any of the preceding claims in which one of the bridge members is movable integrally on hinging and rests directly on the pivot linkage support.
6. A portal according to any of the preceding claims in which one of the bridge members is subdivided into parts which hinge individually and rests on top of the other bridge member.
- 5 7. A portal according to any of the preceding claims in which the portal end member is pivotably connected to a coupler movable resiliently in a longitudinal vehicle direction and located below the portal and connected to the vehicle box for joining a pair of vehicles. 5
8. A portal according to claim 7 in which the portal end member has a pin for engaging in a recess of the coupler to pivotably connect the portal end member and the coupler.
- 10 9. A portal according to claim 7 or 8 in which rigid tension tools are disposed between the vehicle box and the portal end member to aid coupling. 10
10. A portal according to any of the preceding claims in which resilient tension rods are disposed between the vehicle box and the portal end member for helping to support the portal weight.
- 15 11. A portal according to any of the preceding claims further including shields pivotable about an upright axes between the passageway and the inside of the membrane. 15
12. A portal according to any of the preceding claims further including ceiling members between the passageway and the top of the membrane which ceiling members are supported by a pivot linkage support between the membrane and the ceiling members.
- 20 13. A portal according to any of the preceding claims having an upper pivot linkage support between the vehicle box and the portal end member above the membrane capable of supporting the downward load created by the portal projecting outwardly of the vehicle box. 20
14. A portal on a vehicle substantially as shown in and described with reference to Figs. 5 and 6.