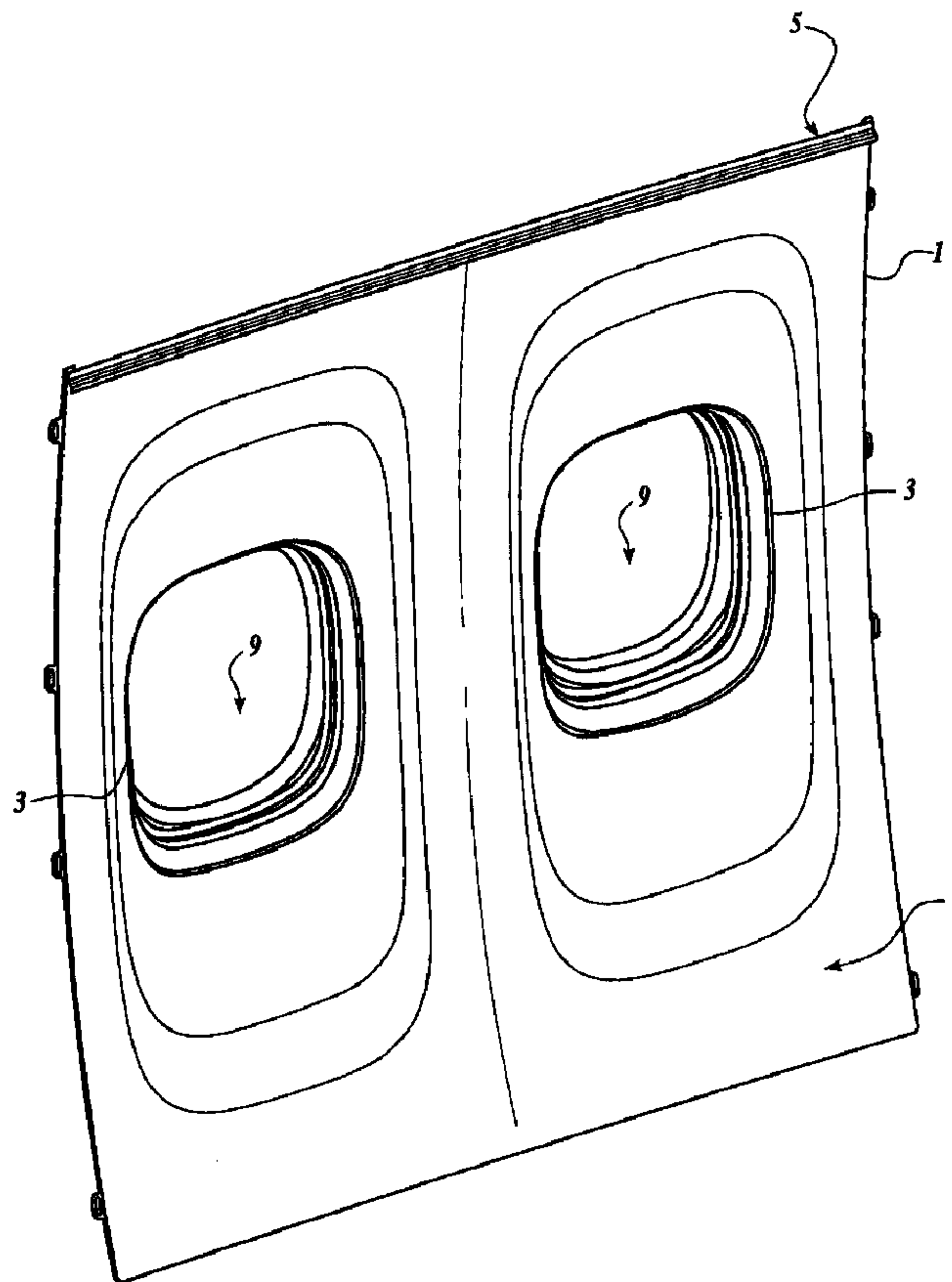




(22) Date de dépôt/Filing Date: 2002/10/01
 (41) Mise à la disp. pub./Open to Public Insp.: 2003/04/25
 (45) Date de délivrance/Issue Date: 2006/07/11
 (30) Priorité/Priority: 2001/10/25 (US10/047,186)

(51) Cl.Int./Int.Cl. *B64C 1/14* (2006.01),
B60J 1/08 (2006.01)
 (72) Inventeur/Inventor:
JONES, GARY E., US
 (73) Propriétaire/Owner:
THE BOEING COMPANY, US
 (74) Agent: SMART & BIGGAR

(54) Titre : HUBLLOT D'AERONEF ENCLIQUETABLE ET METHODE DE MONTAGE
 (54) Title: SNAP-IN WINDOW ASSEMBLY AND METHOD



(57) Abrégé/Abstract:

An aircraft window assembly with a readily attachable window assembly for efficient and easy installation and maintenance of aircraft windows is provided. The aircraft has a sidewall having an inner perimeter that defines an opening. An inner window frame

(57) **Abrégé(suite)/Abstract(continued):**

is readily attachable to the sidewall adjacent to the inner perimeter. The inner window frame defines a first opening. An outer window frame is readily attachable to the inner window frame adjacent the first opening and the outer window frame defines a second opening. The outer window frame and the inner window frame are releasably coupled within the first opening of the inner window frame. The snap-in window assembly is readily detachable from the sidewall adjacent to the inner perimeter.

SNAP-IN WINDOW ASSEMBLY AND METHOD**ABSTRACT OF THE DISCLOSURE**

An aircraft window assembly with a readily attachable window assembly for efficient and easy installation and maintenance of aircraft windows is provided. The aircraft has a sidewall having an inner perimeter that defines an opening. An inner window frame is readily attachable to the sidewall adjacent to the inner perimeter. The inner window frame defines a first opening. An outer window frame is readily attachable to the inner window frame adjacent the first opening and the outer window frame defines a second opening. The outer window frame and the inner window frame are releasably coupled within the first opening of the inner window frame. The snap-in window assembly is readily detachable from the sidewall adjacent to the inner perimeter.

SNAP-IN WINDOW ASSEMBLY AND METHOD

5

FIELD OF THE INVENTION

This invention relates generally to an aircraft window assembly, and more particularly to a snap-in window assembly and a method for installing the assembly to a sidewall panel of an aircraft.

10

BACKGROUND OF THE INVENTION

Current window assembly designs for aircraft include the use of different hardware fastener mechanisms for affixing the window assembly to an aircraft sidewall. The most common of these assemblies require the combination of hardware fastener mechanisms, typically brackets, and adhesives to affix the window assembly to an aircraft's fixed outer sidewall. The brackets are affixed, via the adhesive, to the sidewall. The window assemblies are then affixed to the brackets. In other installations, the window assemblies are affixed to the sidewall using both mechanical affixing and adhesive affixing. The installation of the brackets is very labor intensive and time consuming. This is because the adhesive typically has a long cure period and then must be sanded, along with the aircraft sidewall, before the window assembly can be affixed to the brackets. Further, installation often requires specially designed tools. In addition, fuel economy is negatively affected as the brackets and adhesives add weight to the aircraft, which in turn adds to the operating cost of the aircraft. Often too, the brackets are very pliable and weak and are subject to increased maintenance and replacement costs.

Yet another problem with current designs is an inability to consistently and uniformly attach the brackets on the aircraft sidewall. This is because the brackets cannot be exactly placed when affixed with adhesives. This leads to increased assembly costs because installers must take more time to affix and adjust the brackets.

Additionally, because there is quite a variation in affixing mechanisms between various airplane models, standardization of the window assemblages across airplane models is difficult. Difficult access to whole or part of the window assembly makes standard window maintenance, like cleaning, expensive and time consuming. This is because maintenance must be done by removing the whole window assembly or accessing the whole sidewall.

Thus, there exists a need to provide an aircraft window assembly with a readily detachable window assembly for efficient and easy installation and maintenance of aircraft windows.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention there is provided a releasable snap-in window assembly for an aircraft having a sidewall, the sidewall having an outer surface, at least one first deformable mechanism secured to the outer surface and an inner perimeter that defines an opening. The assembly includes an inner window frame defining a first opening and having a shaped flange operably configured to cooperate with the first deformable mechanism to attach the inner window frame to the sidewall adjacent to the inner perimeter. The assembly also includes an outer window frame defining a second opening. The assembly further includes at least one second deformable mechanism operably configured to attach the outer window frame to the inner window frame adjacent the first opening.

The second deformable mechanism may include at least one fastening clip adapted to secure the outer window frame to the inner window frame.

The assembly may further include a snap fastener adapted to attach an accommodating protrusion on the outer window frame with an accommodating protrusion on the inner window frame.

In accordance with another aspect of the invention, there is provided a releasable snap-in window system for an aircraft. The window system includes a sidewall having an outer surface, at least one first deformable

mechanism secured to the outer surface and an inner perimeter that defines an opening. The window system also includes an inner window frame defining a first opening and having a shaped flange operably configured to cooperate with the first deformable mechanism to attach the inner window frame to the sidewall adjacent to the inner perimeter. The window system further includes an outer window frame defining a second opening, and at least one second deformable mechanism operably configured to attach the outer window frame to the inner window frame adjacent the first opening.

10 The first deformable mechanism may include a deformable flange adapted to tensionably engage the shaped flange of the inner window frame.

The deformable flange may have a hook shape.

15 The first deformable mechanism may include a pawl latch mechanism for securing the inner window frame to the outer surface of the sidewall. The pawl latch mechanism may be adapted to engage the shaped flange along one or more index points to couple and decouple the window assembly from the outer sidewall.

20

The second deformable mechanism may include at least one fastening clip adapted to secure the outer window frame to the inner window frame.

25 The window system may further include a snap fastener adapted to attach an accommodating protrusion on the outer window frame to an accommodating protrusion on the inner window frame.

30 In accordance with another aspect of the invention, there is provided a method of releasably coupling a snap-in window assembly to a sidewall of an aircraft where the sidewall has an inner perimeter that defines an opening. The method involves engaging a shaped flange of an inner window frame defining a first opening with at least one first deformable mechanism secured to an outer surface of the sidewall to attach the inner window frame to the sidewall adjacent to the inner perimeter. The method further involves

engaging an outer window frame defining a second opening with at least one second deformable mechanism cooperating with the inner window frame to attach the outer window frame to the inner window frame adjacent the first opening. Engaging the shaped flange may involve engaging a deformable
5 flange secured to the outer surface of the sidewall to tensionably engage the shaped flange of the inner window frame.

Engaging a deformable flange may involve engaging a hook-shaped flange with the shaped flange.

10

Engaging a deformable flange may involve engaging at least one spring clip mounted on the outer surface of the sidewall.

Engaging a shaped flange may involve engaging a pawl latch mechanism on
15 the outer surface of the sidewall.

Engaging the shaped flange may involve engaging the shaped flange along one or more index points to couple and decouple the window assembly from the outer surface of the sidewall.

20

Engaging an outer window frame may involve engaging at least one clip to tensionably secure the outer window frame to the inner window frame.

Engaging an outer window frame may involve engaging a snap fastener on
25 an accommodating protrusion on the outer window frame with an accommodating protrusion on the inner window frame.

In accordance with another aspect of the invention, there is provided a snap-in window assembly for an aircraft having a sidewall with an inner perimeter
30 that defines an opening. The assembly includes an inner window frame attachable to the sidewall adjacent to an inner perimeter by at least one first deformable mechanism secured to an outer surface of the sidewall and configured to tensionably secure a shaped flange of the inner window frame to the sidewall, the inner window frame defining a first opening. The

assembly also includes an outer window frame readily attachable to the inner window frame by a plurality of fastening devices releasably secured to accommodating protrusions on the outer window frame and that further snap over a perimeter of the inner window frame adjacent the first opening, the
5 outer window frame defining a second opening. The assembly further includes releasable coupling means for releasably coupling the outer window frame and the inner window frame within the first opening of the inner window frame, wherein the releasable coupling means includes a shaped flange of the inner window frame attached to the outer side wall by one or more spring
10 clips and coupled to a hook shaped deformable flange of the outer sidewall and a pawl latch mechanism for engaging the shaped flange along one or more index points to couple and decouple the window assembly from the outer sidewall.

15 In accordance with another aspect of the invention, there is provided releasable snap-in window assembly for an aircraft having a sidewall, the sidewall having an outer surface, at least one first deformable mechanism secured to the outer surface and an inner perimeter that defines an opening. The assembly includes an inner window frame defining a first opening and
20 having a shaped flange, operably configured to cooperate with the first deformable mechanism to attach the inner window frame to the sidewall adjacent to the inner perimeter. The assembly also includes an outer window frame defining a second opening. The assembly further includes connecting means operably configured to connect the outer window frame to the inner
25 window frame adjacent the first opening.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred and alternative embodiments of the present invention are described in detail below with reference to the following drawings.

30

FIGURE 1 depicts an aircraft cabin sidewall as seen from inside a cabin, showing a pair of snap-in window assemblies according to one embodiment of the present invention;

- FIGURE 2 depicts an outer sidewall of the aircraft cabin sidewall shown in Figure 1;
- FIGURE 3 depicts a view in the direction of an aircraft cabin of an upper portion of a window assembly readily attachable to an outer sidewall of the aircraft cabin sidewall shown in Figure 1;
- FIGURE 4 depicts a side view of an upper portion of a window assembly readily attachable to the outer sidewall;
- FIGURE 4A depicts a fragmented view of a deformable flange of an outer window frame receiving and tensionably engaging a shaped flange of an inner window frame;
- FIGURE 5 depicts a view in the direction of an aircraft cabin of a lower portion of a window assembly readily attachable to the outer sidewall; and
- FIGURE 6 depicts a side view of a lower portion of a window frame assembly releasably coupled to the outer sidewall, according to an alternative embodiment.

DETAILED DESCRIPTION

The present invention provides a snap-in window assembly and a method for installing the assembly to a sidewall panel of an aircraft.

FIGURE 1 depicts a snap-in window system comprising a section of an aircraft cabin sidewall 1 and a pair of snap-in window assemblies 3 according to one embodiment of the present invention. In this embodiment, an inner perimeter 7 of an outer sidewall 5 of the aircraft cabin sidewall 1 serves as the structure for defining an opening 9 for the snap-in window assemblies 3.

FIGURE 2 depicts a section of an outer sidewall 5 of the aircraft cabin sidewall 1 showing the pair of snap-in window assemblies 3 in more detail.

The outer sidewall **5** has an inner perimeter **7** defining an opening **9**. The opening **9** serves to index a location for an inner window frame **11** and an outer window frame **13**. In a preferred embodiment, the snap-in window assembly includes a sun-shade guide track **15**.

5

The inner window frame **11** is attached to the outer sidewall **5** in the indexed location of the opening **9** via releasable coupling devices **17** and **19** as is further illustrated in FIGURES **3-6**. The releasable coupling devices **17** and **19** facilitate the coupling and decoupling of the inner window frame **11** from
10 the opening **9** in the outer sidewall **5** without having to remove the outer sidewall **5** to access the outer window frame **13** or the inner window frame **11**.

In one embodiment, the outer window frame **13** is attached to the inner window frame **11** via a plurality of window snap fasteners **21** contiguously spaced and aligned around a perimeter of the inner and outer window frames
15 **11** and **13**, respectively. In this embodiment, the window snap fasteners **21** include one or more tension clip devices releasably secured to an accommodating protrusion **23** on the outer window frame **13** and that further snap over an accommodating protrusion **24** along the perimeter of the inner
20 window frame **11**.

The window snap fasteners **21** further serve to align the inner window frame **11** and the outer window frame **13** in the indexed opening **9** of the inner perimeter **7** of the outer sidewall **5**.

25

Alternatively, the inner window frame **11** and outer window frame **13** are coupled via the plurality of window snap fasteners **21** contiguously spaced and aligned along a perimeter of the inner and outer window frames **11** and **13**, respectively as described above, prior to their attachment to the outer
30 sidewall **5** via the coupling devices **17** and **19**.

FIGURE **3** depicts a view, in the direction of an aircraft cabin of an upper portion of a window assembly **3** that is attached to the outer sidewall **5**. The outer window frame **13** is readily attached to the inner window frame **11** by a

plurality of window snap fasteners **21** illustrated in FIGURE 2. In one embodiment, the window snap fasteners **21** include one or more tension clip devices releasably secured to an accommodating protrusion **23** on the outer window frame **13** and that further snap over an accommodating protrusion **24** along the perimeter of the inner window frame **11**.

The window snap fasteners **21** permit detaching the inner window frame **11** and the outer window frame **13** from the outer sidewall **5** as a single window assembly **3** without having to remove the outer sidewall **5**.

10

In another embodiment, the snap fasteners **21** can be secured to the inner window frame **11** and snap-over a protruding surface along the perimeter of the outer window frame **13**. It will be appreciated that the snap fasteners **21** are suitably any device that uses tension force to facilitate the securing and attaching of both the outer window frame **13** and the inner window frame **11** in a single window assembly **3**.

15

The inner window frame **11** is releasably attached to the outer sidewall **5** via one or more spring clips **25** attached to the edge of the outer sidewall, which are evenly spaced thereon, and correspond to a shaped flange **27** extending along the outer top perimeter of the inner window frame **11**. In a preferred embodiment the spring clips **25** are secured to the outer sidewall **5** so that the spring clips **25** securely affix the shaped flange **27** to the outer sidewall **5**. The spring clips **25** provide compressive spring force to secure the inner window frame **11** to the outer sidewall **5** in a snap-together assembly. The shaped flange **27** further provides one or more sun-shade guide track lugs **22**. The sun-shade guide track lugs **22** facilitate the attaching of a sun-shade track **15** to the shaped flange **27**.

20

25

As shown in Figures **4** and **4A**, in an alternative embodiment, the outer window frame **13** is releasably attached to the inner window frame **11** via the coupling of a deformable flange **29** of the outer window frame **13** and a shaped flange **28** secured to the inner window frame. In this embodiment, the deformable flange **29** extends along a portion of the outer top perimeter of the

30

outer window frame **13** and is designed such that it is formed to define a pliable hook. The deformable flange **29** allows the coupling of the inner window frame **11** and the outer window frame **13** without the use of additional coupling hardware, for example affixable brackets.

5

In another alternative embodiment, the deformable flange **29** is replaced with a similarly positioned rigid flange. The rigid flange is formed so as to define a shape that is accommodating for the outer window frame **13** to engage the shaped flange **28** in a coupling snap-together assembly.

10

As described in connection with Figure 3 and seen from a different perspective in FIGURE 4, spring clips **25** are attached to the outer sidewall **5** and secure a shaped flange **27**, of the inner window frame **11**, to the outer sidewall **5**. The deformable flange **29** of the outer window frame **13** is positioned over the top center of the inner window frame **11** and is snapped over the shaped flange **28** as shown in FIGURE 4A so that both the inner window frame **11** and the outer window frame **13** are engaged in a snap-together assembly.

15

FIGURE 5 depicts a view in the direction of an aircraft cabin of a lower portion of a window assembly **3** readily attached to an outer sidewall **5**. The outer window frame **13** is attached to the inner window frame **11** by a plurality of window snap fasteners **21** of the type illustrated in FIGURES 2 and 3.

20

The snap fasteners **21** further permit the decoupling of the inner window frame **11** and the outer window frame **13** from the outer sidewall **5** as a single window assembly without having to remove the outer sidewall **5**.

25

In another embodiment, the snap fasteners **21** can be secured to the inner window frame **11** and snap over a protruding surface along the perimeter of the outer window frame **13**. It will be appreciated that the snap fasteners **21** are suitably any device that uses tension force to facilitate the securing and attaching both the outer window frame **13** and the inner window frame **11** in a single window assembly.

30

The inner window frame **11** is releasably attached to the outer sidewall **5** via at least one retention spring clip **31** centered within the interior surface of a gusset **33** supporting a shaped flange **35** extending along the lower bottom
5 perimeter of the inner window frame **11**.

In one embodiment, the retention spring clip **31** is secured to the outer sidewall **5** so that the spring clip securely affixes the shaped flange **35** to the outer sidewall **5**.

10

The spring clip **31** provides compressive spring force to secure assembly of the inner window frame **11** to the outer sidewall **5** in a snap-together assembly. The gusset **33** provides maximum strength at the corner of the shaped flange **35** and is designed so that the load of the outer window frame
15 is borne by the gussets **33** and not solely by the shaped flange **35**.

In an alternative embodiment, illustrated in FIGURE **6**, the inner window frame **11** may be releasably coupled to the outer sidewall **5** via a pawl latch mechanism **37**.

20

FIGURE **6** depicts a side view of a lower portion of the window assembly attached to an outer sidewall **5**. In this embodiment, the inner window frame **11** is releasably attached to the outer sidewall **5** via the pawl latch mechanism **37**.

25

The pawl latch mechanism **37** operates by rotating a latch **39**, having a pawl finger **41** radially attached to its shank **143**. The rotation of the latch **39** is indexed to one or more index points **43** to visually or tactily provide a relative position for opening or closing the latch to couple or decouple the inner
30 window frame **11** from the outer sidewall **5**.

In a closed position, a press of the pawl finger **41** through an access hole **47** brings the latch **39** under a shaped flange **35** of an inner window frame **11** thereby releasably coupling the outer sidewall **5** to the inner window frame **11**

and held in position by coiled springs **45**. In an opened position, a pull of the pawl finger **41** in the opposition rotation provides release of the pawl latch, thus providing a quick decoupling of the inner window frame **11** from the outer side wall **5** and disengaging the coiled springs **45**. The access hole **47** provides access to the pawl finger **41** from the interior side of the cabin sidewall **1**.

It is further contemplated that when the inner window frame **11** remains coupled to the outer sidewall **5** via one of the coupling means **17** illustrated FIGURE **2**, the pawl latch mechanism **37** allows a window assembly **3** to remain in an open position not totally decoupled from the outer sidewall **5**. This would allow, for example, maintenance access to both sides of the inner window frame **11** and outer window frame **13** without having to decouple the whole window assembly **3** from the outer sidewall **5**.

15

In alternative embodiments, it is contemplated that the pawl latch mechanism has a widely-adjustable grip range or has self-adjusting spring pawl latches.

In another alternative embodiment, the pawl latch mechanism **37** may be replaced with other latching devices that provide quick coupling and decoupling of an outer sidewall **5** from an inner window frame **11**.

While preferred embodiments of the invention have been illustrated and described, as noted above, many changes can be made without departing from the spirit and scope of the invention. Accordingly, the scope of the invention is not limited by the disclosure of the embodiments described. Instead, the invention should be determined entirely by reference to the claims that follow.

30

THE EMBODIMENTS OF THE INVENTIONS IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A releasable snap-in window assembly for an aircraft having a sidewall,
5 the sidewall having an outer surface and at least one first deformable mechanism secured to the outer surface and an inner perimeter that defines an opening, the assembly comprising:
- an inner window frame defining a first opening and having a
10 shaped flange operably configured to cooperate with the first deformable mechanism to attach the inner window frame to the sidewall adjacent to the inner perimeter;
- an outer window frame defining a second opening; and
- 15 at least one second deformable mechanism operably configured to attach the outer window frame to the inner window frame adjacent the first opening.
- 20 2. The window assembly of claim 1, wherein the second deformable mechanism comprises at least one fastening clip adapted to secure the outer window frame to the inner window frame.
- 25 3. The window assembly of claim 1, wherein the outer window frame has an accommodating protrusion and wherein the inner window frame has an accommodating protrusion and further comprising a snap fastener attached to the accommodating protrusion on the outer window and adapted to snap over the accommodating protrusion on the inner window frame.
- 30 4. A releasable snap-in window system for an aircraft comprising:

a sidewall having an outer surface and an inner perimeter that defines an opening;

5 at least one first deformable mechanism secured to the outer surface;

10 an inner window frame defining a first opening and having a shaped flange, operably configured to cooperate with the first deformable mechanism to attach the inner window frame to the sidewall adjacent to the inner perimeter;

an outer window frame defining a second opening; and

15 at least one second deformable mechanism operably configured to attach the outer window frame to the inner window frame adjacent the first opening.

- 20 5. The window system of claim 4, wherein the first deformable mechanism includes a deformable flange adapted to tensionably engage the shaped flange of the inner window frame.
6. The window system of claim 5, wherein the deformable flange has a hook shape.
- 25 7. The window system of claim 4, wherein the first deformable mechanism includes a pawl latch mechanism for securing the inner window frame to the outer surface of the sidewall.
- 30 8. The window system of claim 7, wherein the shaped flange has one or more index points and wherein the pawl latch mechanism is adapted to

engage the shaped flange along said one or more index points to couple and decouple the window assembly from the outer sidewall.

- 5 **9.** The window assembly of claim 4, wherein the second deformable mechanism comprises at least one fastening clip adapted to secure the outer window frame to the inner window frame.
- 10 **10.** The window assembly of claim 4, wherein the outer window frame has an accommodating protrusion and wherein the inner window frame has an accommodating protrusion and further comprising a snap fastener attached to the accommodating protrusion on the outer window and adapted to snap over the accommodating protrusion on a perimeter of the inner window frame.
- 15 **11.** A method of releasably coupling a snap-in window assembly to a sidewall of an aircraft, the sidewall having an inner perimeter that defines an opening, the method comprising:
- 20 engaging a shaped flange of an inner window frame defining a first opening, with at least one first deformable mechanism secured to an outer surface of the sidewall to attach the inner window frame to the sidewall adjacent to the inner perimeter; and
- 25 engaging an outer window frame defining a second opening with at least one second deformable mechanism cooperating with the inner window frame to attach the outer window frame to the inner window frame adjacent the first opening.
- 30 **12.** The method of claim 11, wherein engaging the shaped flange comprises tensionably engaging a deformable flange secured to the

outer surface of the sidewall to the shaped flange of the inner window frame.

- 5
- 13.** The method of claim **12**, wherein engaging the deformable flange comprises engaging a hook-shaped flange with the shaped flange.
- 14.** The method of claim **12**, wherein engaging the deformable flange comprises engaging at least one spring clip mounted on the outer surface of the sidewall.
- 10
- 15.** The method of claim **11**, wherein engaging the shaped flange comprises engaging a pawl latch mechanism on the outer surface of the sidewall.
- 15
- 16.** The method of claim **12**, wherein engaging the shaped flange comprises engaging the shaped flange along one or more index points to couple and decouple the window assembly from the outer surface of the sidewall.
- 20
- 17.** The method of claim **11**, wherein engaging the outer window frame comprises engaging at least one clip to tensionably secure the outer window frame to the inner window frame.
- 25
- 18.** The method of claim **11**, wherein engaging the outer window frame comprises engaging a snap fastener on an accommodating protrusion on the outer window frame with an accommodating protrusion on the inner window frame.
- 19.** A snap-in window assembly for an aircraft having a sidewall with an inner perimeter that defines an opening, the assembly comprising:
- 30

an inner window frame attachable to the sidewall adjacent to an inner perimeter by at least one first deformable mechanism secured to an outer surface of the sidewall and configured to

tensionably secure a shaped flange of the inner window frame to the sidewall, the inner window frame defining a first opening;

an outer window frame readily attachable to the inner window frame by a plurality of fastening devices releasably secured to accommodating protrusions on the outer window frame and that further snap over a perimeter of the inner window frame adjacent the first opening, the outer window frame defining a second opening; and

releasable coupling means for releasably coupling the outer window frame and the inner window frame within the first opening of the inner window frame, wherein the releasably coupling means includes a shaped flange of the inner window frame attached to the outer side wall by one or more spring clips and coupled to a hook shaped deformable flange of the outer sidewall and a pawl latch mechanism for engaging the shaped flange along one or more index points to couple and decouple the window assembly from the outer sidewall.

- 20.** A releasable snap-in window assembly for an aircraft having a sidewall, the sidewall having an outer surface and at least one first deformable mechanism secured to the outer surface and an inner perimeter that defines an opening, the assembly comprising:

an inner window frame defining a first opening and having a shaped flange, operably configured to cooperate with the first deformable mechanism to attach the inner window frame to the sidewall adjacent to the inner perimeter;

an outer window frame defining a second opening; and
connecting means operably configured to connect the outer window frame to the inner window frame adjacent the first opening.

1/6

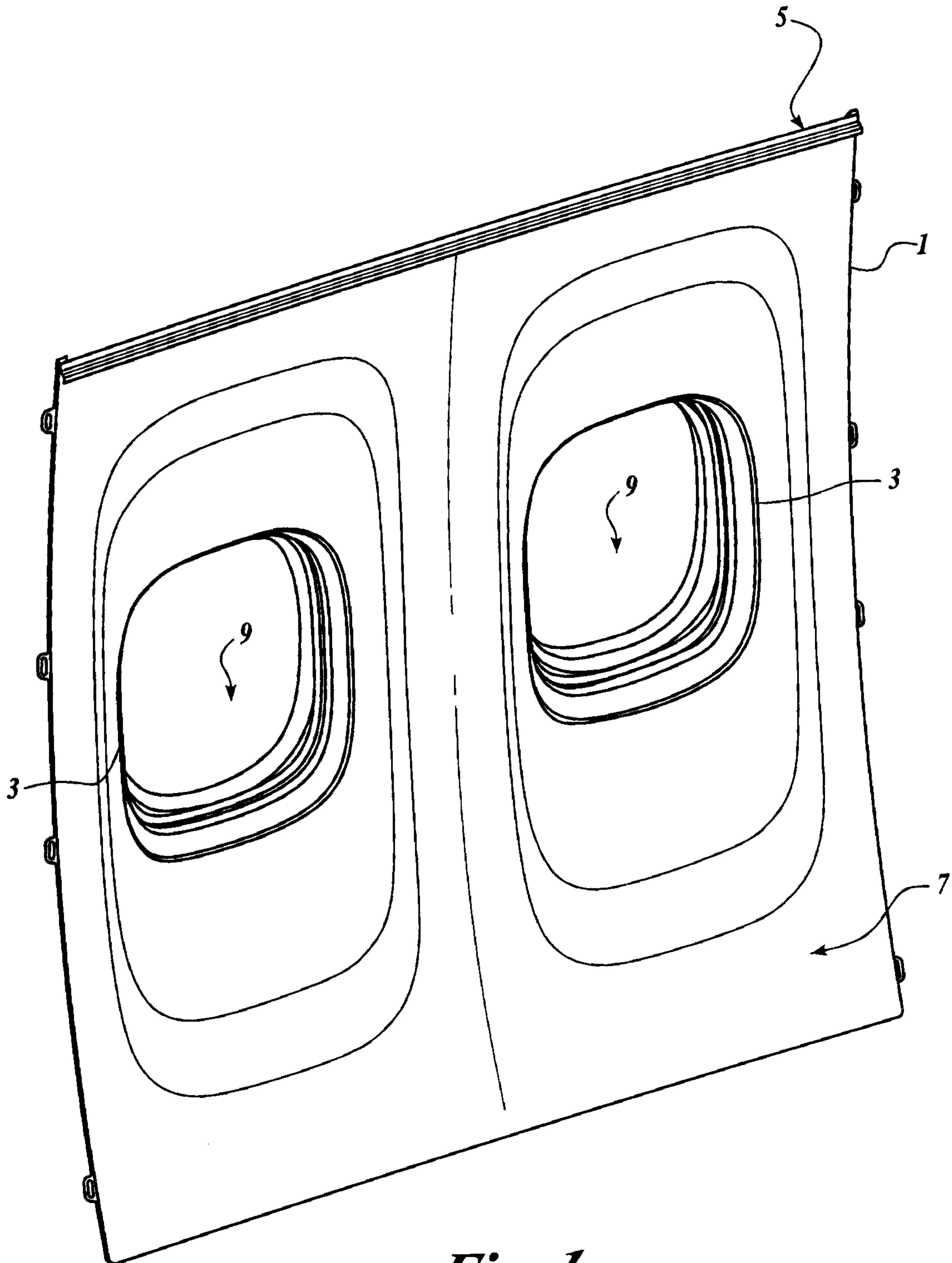


Fig. 1.

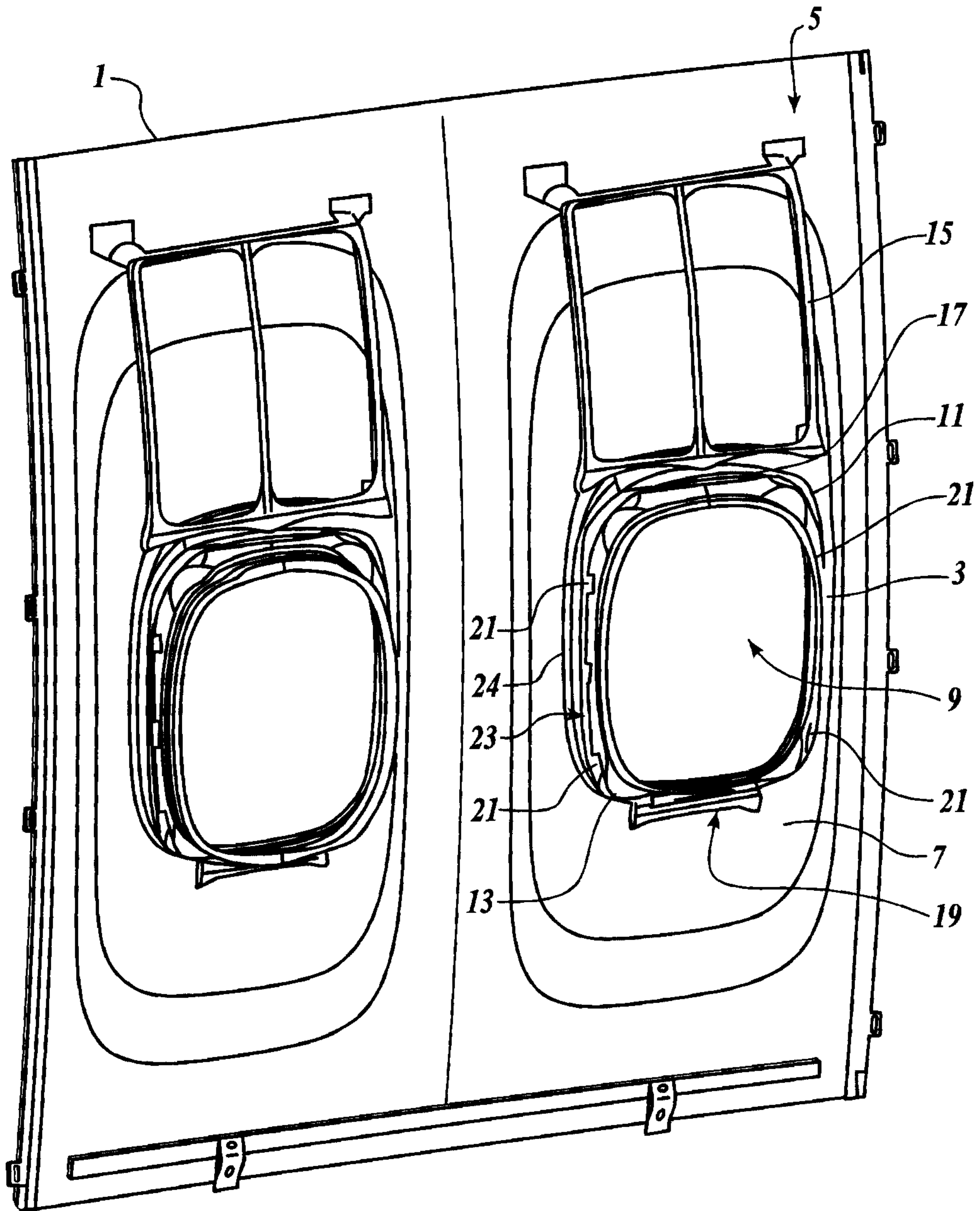


Fig. 2.

4/6

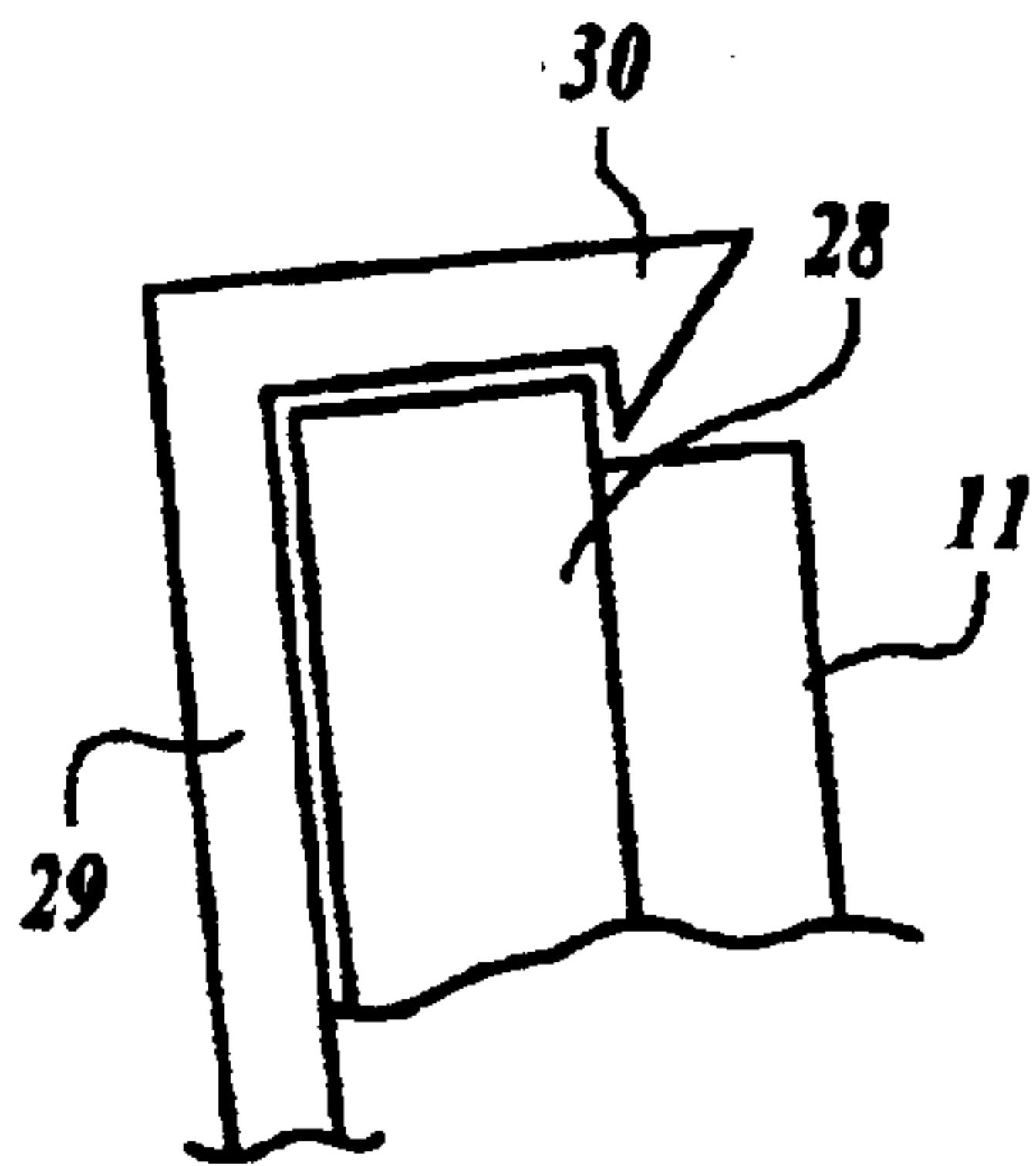


Fig. 4A.

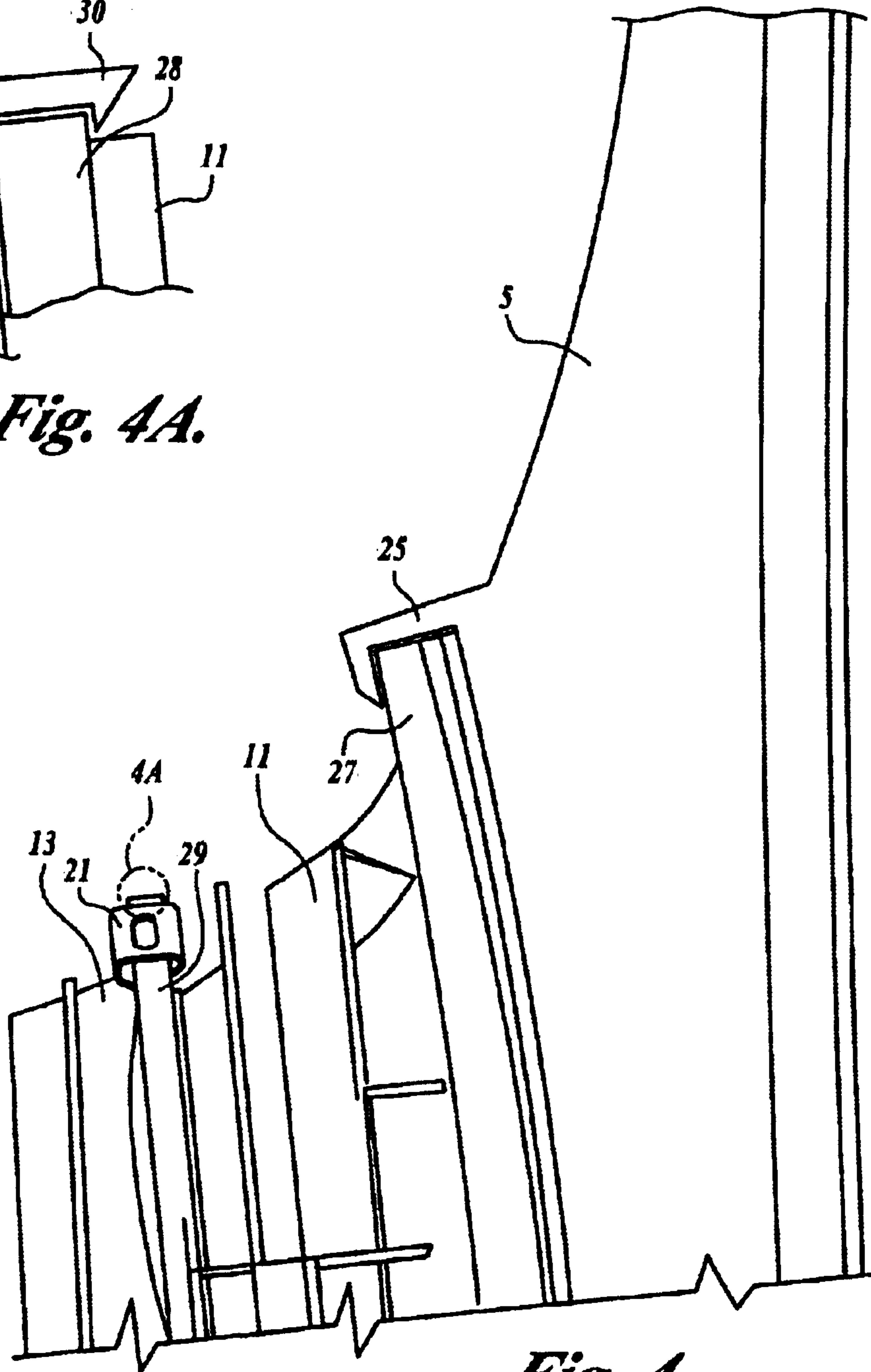


Fig. 4.

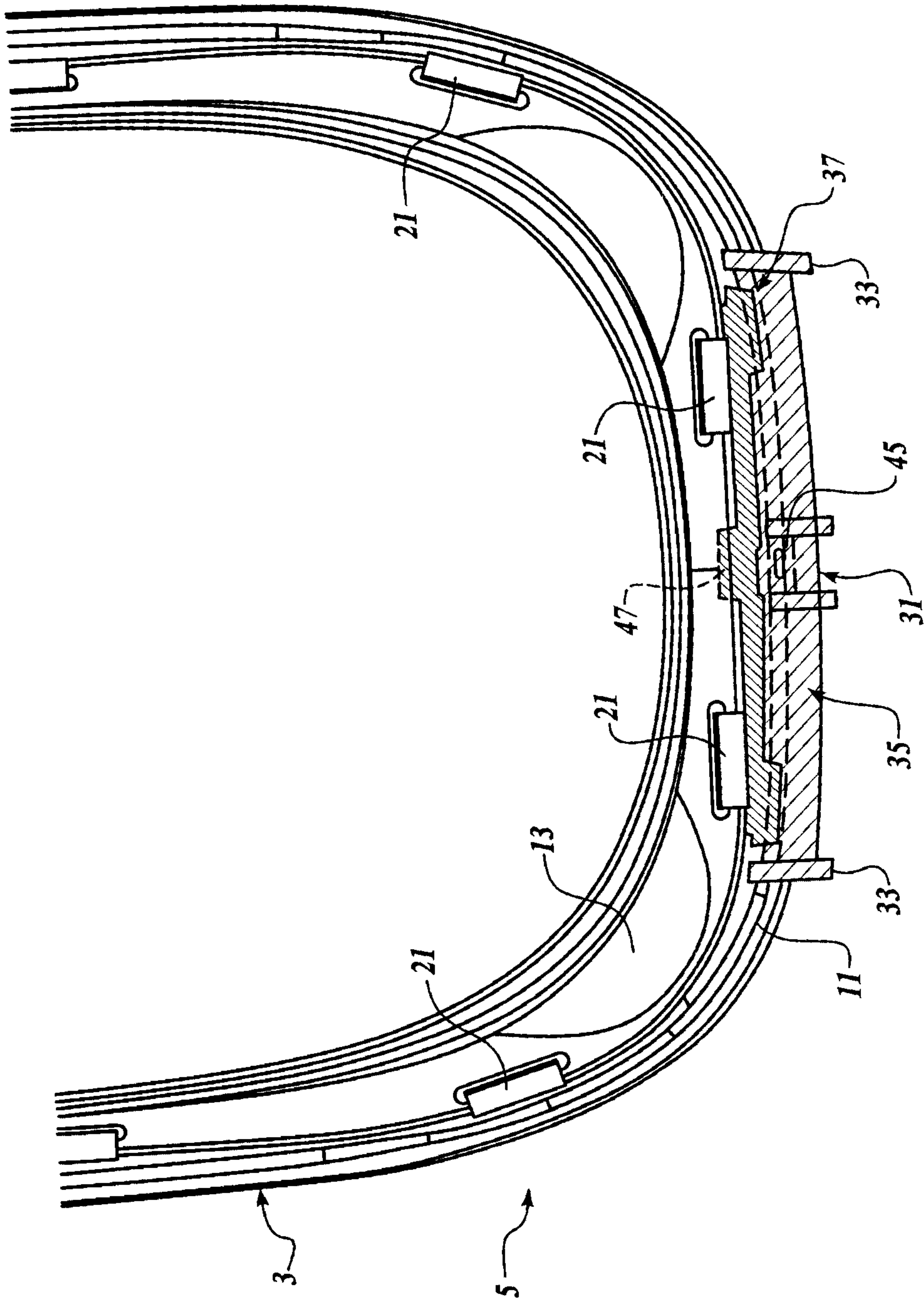


Fig. 5.

6/6

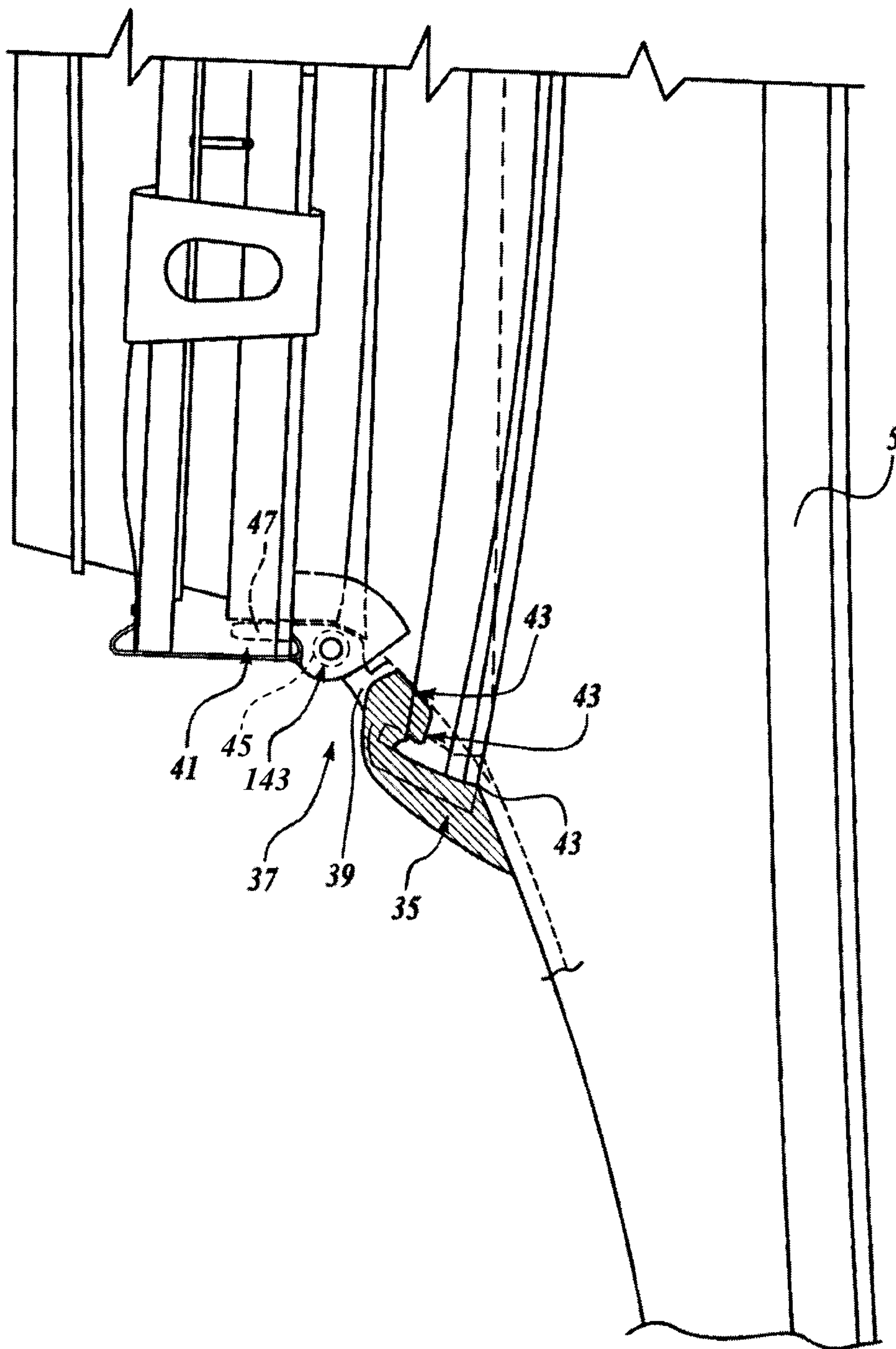


FIG. 6

