



(43) International Publication Date
8 October 2015 (08.10.2015)

- (51) International Patent Classification:
B64D 11/06 (2006.01) *B60N 2/44* (2006.01)
- (21) International Application Number:
PCT/US2015/024123
- (22) International Filing Date:
2 April 2015 (02.04.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/974,492 3 April 2014 (03.04.2014) US
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: INTEGRATED DEPLOYABLE LEG REST FOR RECLINING PASSENGER SEATS

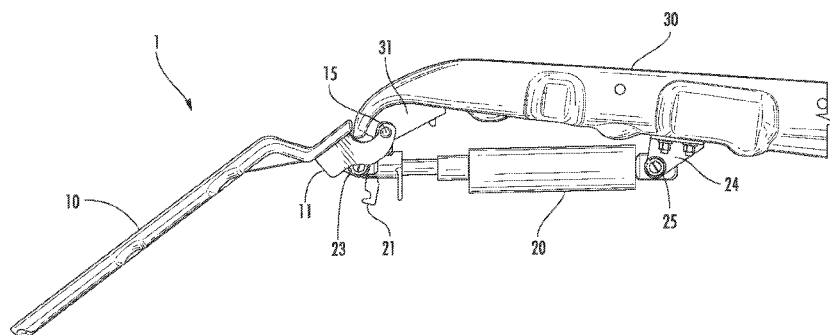


FIG. 2

(57) Abstract: Described are reclining passenger seats having deployable leg rests coupled to the seat bottom. An actuator, which may be a gas cylinder, spring, or electric motor, moves the deployable leg rest between stowed and deployed positions. A locking mechanism may be used to stabilize the deployable leg rest in the stowed position, the deployed position, or any intermediate position. The coupling of the deployable leg rest to the seat bottom allows for a greater range of movement with a lighter, more compact mechanism.

INTEGRATED DEPLOYABLE LEG REST FOR RECLINING PASSENGER SEATS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is related to and claims priority benefits from U.S. Provisional Application Serial No. 61/974,492 (“the ‘492 application”), filed on April 3, 2014, entitled “Deployable Legrest that Moves with the Seat Pan”. The ‘492 application is hereby incorporated in its entirety by this reference.

FIELD OF THE INVENTION

[0002] The field of the invention relates to passenger seats or the like, and more particularly to deployable leg rests for use with passenger seats.

BACKGROUND

[0003] Many passenger seats such as those on passenger aircraft, busses, trains, and the like are designed with a recline function to allow for greater comfort to passengers, particularly on longer journeys. To increase passenger comfort, seats may be designed with complex articulations, including different motions for the seat back and seat bottom or pan.

[0004] In some instances, a passenger seat may include a leg rest to support the passenger’s calves, feet, or thighs when they are in a reclined position. These leg rests are typically mounted to a solid part of the passenger seat structure. For example, a leg rest may be mounted directly to a stationary part of the seat frame or to a seat tube. It is desirable to include a leg rest on a reclining seat to increase passenger comfort. The conventional method of mounting a leg rest to a reclining passenger seat has a number of disadvantages. The addition of a leg rest mounted to the seat tube or other stationary part of the passenger seat adds additional mounting hardware and linkages that may encroach on the mounting hardware and linkages for the seat back and seat bottom. Additional hardware may also be necessary to coordinate the motion of the seat back, seat bottom, and leg rest during seat recline.

[0005] Because of the additional hardware, the addition of more moving parts to a reclining seat, like a leg rest, often times leads to compromises in the range and type of motion available to each individual seat component. Not only do the additional mechanical parts restrict motion, but allowances for complementary ranges of motion for different

portions of the passenger seat further diminishes available motion to avoid impingement of the portions of the passenger seat on one another.

[0006] In certain cases, it may be desirable to provide a passenger seat with a deployable leg rest that is coupled directly to the seat bottom. This arrangement may allow the leg rest to move and articulate with the seat and pivot and/or extend away from the seat bottom during deployment. The resulting mechanism, including an actuator to initiate and deploy the leg rest, is often simpler, lighter, and more compact than existing leg rest mechanisms. Such an integrated leg rest may allow for a greater range of movement for the seat back and seat bottom by reducing the amount of hardware contained under and within the seat and moving with the seat bottom to avoid interference with other reclining mechanisms and hardware.

SUMMARY

[0007] The terms “invention,” “the invention,” “this invention” and “the present invention” used in this patent are intended to refer broadly to all of the subject matter of this patent and the patent claims below. Statements containing these terms should be understood not to limit the subject matter described herein or to limit the meaning or scope of the patent claims below. Embodiments of the invention covered by this patent are defined by the claims below, not this summary. This summary is a high-level overview of various aspects of the invention and introduces some of the concepts that are further described in the Detailed Description section below. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in isolation to determine the scope of the claimed subject matter. The subject matter should be understood by reference to appropriate portions of the entire specification of this patent, any or all drawings and each claim.

[0008] According to certain embodiments of the present invention, a passenger seat may comprise a deployable leg rest coupled to a seat bottom and an actuator coupled to the deployable leg rest and the seat bottom. The actuator may induce deployment of the deployable leg rest.

[0009] In some embodiments, the seat bottom is moveable during the reclining of the passenger seat.

[0010] In some embodiments, the actuator may comprise a gas-charged cylinder.

[0011] In certain embodiments, the actuator may comprise a spring.

[0012] In some embodiments, the spring may comprise a coil spring.

[0013] In certain embodiments, the spring may comprise a torsion spring.

5 [0014] In some embodiments, the actuator may comprise a spring in combination with a gas-charged cylinder.

[0015] In some embodiments, the passenger seat further comprises a control button to initiate deployment of the deployable leg rest.

10 [0016] In certain embodiments, the passenger seat further comprises a locking mechanism to maintain the position of the deployable leg rest in a deployed position, a stowed position, or any intermediate position.

[0017] In some embodiments, the locking mechanism may comprise a ratchet.

[0018] In certain embodiments, the locking mechanism may comprise a clutch.

[0019] In some embodiments, the clutch may comprise a force-limiting clutch.

[0020] In some embodiments, the clutch may comprise a one-way clutch.

15 [0021] In certain embodiments, the actuator may comprise an electrically powered actuator.

[0022] In some embodiments, the electrically powered actuator may comprise an electric motor and gearing system to provide a torque to the deployable leg rest.

20 [0023] In certain embodiments, the electrically powered actuator may comprise an electric motor and lead screw.

[0024] In certain embodiments, the actuator may provide a deploying force to deploy the deployable leg rest.

[0025] In some embodiments, the actuator may provide a retracting force to retract the deployable leg rest.

25 [0026] In some embodiments, the deployable leg rest may rotate and extend between a stowed position and a deployed position.

[0027] According to certain embodiments of the present invention, a passenger seat may comprise a deployable leg rest coupled to a seat bottom, a gas-charged cylinder providing a motive force, a locking mechanism, and a control button in communication with
30 the locking mechanism. The gas-charged cylinder may be coupled to the deployable leg rest and the seat bottom and the locking mechanism may lock the deployable leg rest in a stowed

position. The control button may release the locking mechanism and allow the motive force of the gas-charged cylinder to deploy the deployable leg rest.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0028] Figure 1 is a side elevation view of an integrated deployable leg rest in a stowed position, according to certain embodiments of the present invention.

[0029] Figure 2 is a side elevation view of an integrated deployable leg rest in a deployed position, according to certain embodiments of the present invention.

10 [0030] Figure 3 is a perspective view of an integrated deployable leg rest in a deployed position, according to certain embodiments of the present invention.

[0031] Figure 4 is a perspective view of an integrated deployable leg rest shown in relation to a passenger seat in a deployed position, according to certain embodiments of the present invention.

15 DETAILED DESCRIPTION

[0032] The subject matter of embodiments of the present invention is described here with specificity to meet statutory requirements, but this description is not necessarily intended to limit the scope of the claims. The claimed subject matter may be embodied in other ways, may include different elements or steps, and may be used in conjunction with
20 other existing or future technologies. This description should not be interpreted as implying any particular order or arrangement among or between various steps or elements except when the order of individual steps or arrangement of elements is explicitly described.

[0033] The described embodiments of the invention provide a deployable leg rest for reclining passenger seats. While the leg rests are discussed for use with aircraft seats, they
25 are by no means so limited. Rather, embodiments of the leg rest may be used in passenger seats or other seats of any type or otherwise as desired.

[0034] In some embodiments of the present invention, as shown in Figures 1 and 2, a passenger seat bottom with an integrated deployable leg rest 1 comprises a deployable leg rest 10 coupled to a seat bottom 30 through a leg rest hinge 15. In Figure 1, the deployable
30 leg rest 10 is shown in a stowed position. Figure 2 shows the deployable leg rest 10 in a deployed position. The leg rest hinge 15 is comprised of a leg rest bracket 11 and a seat bottom bracket 31 coupled to one another by a pin, bolt, screw, rivet, or other suitable

component to serve as the axle or pivot of the leg rest hinge 15. The deployable leg rest 10 may then pivot around the leg rest hinge 15.

[0035] Still referring to Figures 1 and 2, an actuator 20 is mounted between the seat bottom 30 and the deployable leg rest 10. In certain embodiments, the actuator 20 may be coupled at one end to the seat bottom 30, which may be stationary or moveable as the passenger seat reclines, through a rear actuator bracket 24. The rear actuator bracket 24 connects to the actuator 20 at a rear actuator pivot 25. As the actuator 20 moves through its range of motion, it may pivot around the rear actuator pivot 25 and the rear actuator bracket 24. Similarly, the actuator 20 is coupled to the deployable leg rest 10 through a front actuator bracket (not shown) that provides a front actuator pivot 23. As the actuator 20, here shown as a gas-charged cylinder, expands and contracts through its range of motion, it will pivot around the front actuator pivot 23 and rear actuator pivot 25. In certain embodiments, the actuator 20 may also include an actuator release 21. The actuator release 21 may be manipulated by a wire, lever, or other mechanism (not shown) to allow the actuator 20 to move through its range of motion. When the actuator release 21 is not engaged, the actuator 20 may provide a self-locking function to hold the deployable leg rest 10 steady at any point between a deployed position and a stowed position.

[0036] Figure 3 is a bottom perspective view of an embodiment of the integrated deployable leg rest 1. In certain embodiments, the deployable leg rest 10 is coupled to the seat bottom 30 through a pair of leg rest hinges 15. The leg rest hinges 15 may be composed of a leg rest bracket 11 pivotally coupled to a seat bottom bracket 31 with a pin, rivet, bolt, screw, or other suitable component to serve as the axle or pivot point of the leg rest hinges 15. The integrated deployable leg rest 1 also includes an actuator 20 coupled to both the deployable leg rest 10 and the seat bottom 30. The actuator 20 is disposed between the deployable leg rest 10 and the seat bottom 30 so that as the actuator 20 moves through its range of motion, the deployable leg rest 10 will move between a stowed position and a deployed position. The actuator 20 is coupled to the deployable leg rest 10 with a front actuator bracket 22. The front actuator bracket 22 is coupled to the deployable leg rest 10 and the actuator 20 such that the actuator 20 may pivot around the front actuator pivot 23. The pivoting movement of the actuator 20 around the front actuator pivot 23 allows the actuator 20 to move the deployable leg rest 10 freely through its range of motion without binding. Similarly, the actuator 20 is coupled to the seat bottom 30 through a rear actuator

bracket 24 that provides a rear actuator pivot 25. If the actuator 20 is a linear actuator as shown in Figure 3 (here, a gas-charged cylinder), the use of a front actuator pivot 23 and a rear actuator pivot 25 allows the actuator 20 to move through its range of motion without having to support any twisting or moment loads about the front actuator bracket 22 or rear actuator bracket 24. The actuator 20 will only support a linear force as it moves the deployable leg rest 10, as it will pivot about the front actuator pivot 23 and rear actuator pivot 25. This type of motion, where the actuator 20 need not support any twisting or moment forces, allows for the use of a smaller, lighter actuator 20. Furthermore, in the case of a gas-charged cylinder serving as the actuator 20, the lack of twisting or moment forces about the front actuator pivot 23 and rear actuator pivot 25 will reduce strain on the cylinder seals, helping to prevent leakage and allow for a longer service life with reduced maintenance costs. The actuator 20 also may include an actuator release 21. The actuator release 21, which may be activated by a cable, lever, or other means of articulation, can be controlled through a button or lever mounted on the console or armrest of the passenger chair (not shown). The passenger may then use the button or lever to activate the actuator release 21 to allow the deployable leg rest 10 to move between the stowed and deployed positions.

[0037] Figure 4 is a perspective view of an embodiment of the integrated deployable leg rest 1 shown in relation to a passenger seat. The deployable leg rest 10, shown here in a deployed position, is coupled to a seat bottom 30. The seat back 40, seat console 41, and seat tubes 42 are also shown for context. The deployable leg rest 10 is coupled to the seat bottom 30 through leg rest hinges 15, which are comprised of leg rest brackets 11 and seat bottom brackets 31 (not shown, Figure 3). The deployable leg rest 10 may pivot around the leg rest hinges 15 to move between a stowed and deployed position.

[0038] Still referring to Figure 4, the integrated deployable leg rest 1 also includes an actuator 20 which is coupled to the deployable leg rest 10 with a front actuator bracket 22. The front actuator bracket 22 provides a front actuator pivot 23 that allows the actuator 20 to rotate around the front actuator pivot 23 as it moves the deployable leg rest 10 between stowed and deployed positions. Similarly, the actuator 20 may be coupled to the seat bottom 30 through a rear actuator bracket 24 that provides a rear actuator pivot 25. The actuator 20 may also have an actuator release 21. The actuator 20 may have an internal locking mechanism that prevents the actuator 20, and subsequently the deployable leg rest 10, from moving when the actuator release 21 is not engaged. The actuator release 21 may be

controlled by a cable, lever, or other suitable mechanism that may be connected to a control button or lever mounted on the passenger seat console or arm rest. A passenger may then use the control button or lever to activate the actuator release 21 to allow the movement of the actuator 20 and deployable leg rest 10.

5 **[0039]** Figures 1-4 illustrate the integrated deployable leg rest 1 according to certain embodiments of the present invention. However, a number of alterations, modifications, or adaptations may be made to suit particular applications or design requirements. For example, in Figures 1-4 above, the actuator 20 is generally shown as a gas-charged cylinder. In certain
10 embodiments, the gas-charged cylinder would exert a linear force through expansion to move the deployable leg rest 10 from a stowed position to a deployed position. Normally, the actuator release 21 may serve a locking function to hold the actuator 20, such as a gas-charged cylinder, in place. A passenger may then engage the actuator release 21 to allow movement of the actuator 20 and the deployable leg rest 10. The passenger can then control the movement of the deployable leg rest 10 by either allowing the deployable leg rest 10 to be
15 extended into a deployed position by the actuator 20, or by pressing down on the deployable leg rest 10 to overcome the force of the actuator 20 and return the deployable leg rest 10 to a stowed position. The passenger may then disengage the actuator release 21 to lock the deployable leg rest 10 in the desired position.

[0040] In certain embodiments, the actuator 20 may take on any number of different
20 mechanisms or configurations. For example, the actuator 20 may be a spring mechanism. The actuator 20 may comprise a linear spring, such as a coil spring, that is mounted or attached to the deployable leg rest 10 and seat bottom 30 in a similar manner as that shown in Figures 1-4. In other embodiments, the actuator 20 may comprise a torsion spring that provides a torque to rotate the deployable leg rest 10 about the leg rest hinge 15. In certain
25 embodiments, a torsion spring actuator may be mounted directly to one or more leg rest hinges 15, or another point of rotation, to provide the force to deploy or stow the deployable leg rest 10. In other embodiments, the actuator 20 may comprise a gas-charged cylinder and a spring, either linear or torsion, working in combination to provide the motive force to deploy or stow the deployable leg rest 10.

30 **[0041]** In some embodiments, the actuator 20 may comprise an electrically powered actuator. Electric actuators may either provide a rotational or linear force to the deployable leg rest 10. In certain embodiments, the electric actuator may comprise an electric motor

coupled to the leg rest hinge 15 either directly or through a gearing system. In other embodiments, the actuator 20 may be an electrically powered linear actuator. For example, an electric motor may be coupled to a lead screw or lead screw collar. An electric motor may then rotate either the lead screw or the lead screw collar to cause an extension or retraction of the lead screw. The extension or retraction of the lead screw may provide a linear motion that deploys or stows the deployable leg rest 10. Electrically powered actuators may offer a number of advantages over other mechanical actuator systems. In some embodiments, the electrically powered actuators may not require the use of a locking mechanism or actuator release 21 because the electric motor or gearing system provides a locking function without the use of an extra component. Also, in certain embodiments, the electrically powered actuator may provide both deploying and stowing forces to move the deployable leg rest 10 in both directions without the need for a passenger to exert any pressure on the deployable leg rest 10 or overcome the force of a purely mechanical actuator 20.

[0042] In certain embodiments, the integrated deployable leg rest 1 may include a number of different locking and release mechanisms to selectively hold or allow for the movement of the deployable leg rest 10. As shown in Figures 1-4, a gas-charged cylinder may have an integrated locking function that is released with an actuator release 21. In some embodiments, regardless of the type of actuator 20 used, a separate locking mechanism may be used to stabilize the deployable leg rest 10. In some embodiments, a ratcheting mechanism may be used to prevent the deployable leg rest 10 from moving in one direction while allowing it to move freely in another direction. The locking mechanism, or ratchet, may be connected to a control button allowing the passenger to release the locking mechanism or ratchet so that the deployable leg rest 10 may move in either direction. For example, a ratcheting mechanism may be used to oppose the deployment force of an actuator 20. A passenger may press a control button mounted on the arm rest or seat console to release the ratcheting mechanism allowing the actuator 20 to deploy the deployable leg rest 10. When the deployable leg rest 10 is at a desired height, the passenger may release the control button engaging the ratchet or locking mechanism to prevent further deployment of the deployable leg rest 10. In this intermediate or deployed position, the ratchet will prevent further deployment of the deployable leg rest 10, and the actuator 20 will prevent retraction of the deployable leg rest 10 providing a stable platform for the passenger. In certain embodiments, the force of the actuator 20 may be enough to stabilize the deployable leg rest

10 and support the weight of the passenger's lower legs, but is still low enough that the passenger may press down on the deployable leg rest 10 to return it to a stowed position. The passenger would not need to use the control button to stow the deployable leg rest 10 because the ratchet or locking mechanism would not oppose movement in that direction.

5 [0043] Additional locking mechanisms may be useful or preferable in other embodiments of the present invention. For example, a one-way clutch may be used in a similar manner as the ratchet locking mechanism described above. In some embodiments, a force-limiting clutch may provide certain advantages and additional functionality. Force-limiting clutches provide a certain degree of locking force that, once exceeded, will release
10 the clutch or allow for slippage between clutch elements. A force-limiting clutch may be used to stabilize the deployable leg rest 10 up to a certain amount of force or pressure, but break away and allow movement if that amount of force or pressure is exceeded. In the case of a deployable leg rest 10, a force-limiting clutch may be used to lock the deployable leg rest 10 into a desired position under normal circumstances and use. However, if the amount of
15 locking force provided by the force-limiting clutch is exceeded, like when a passenger may attempt to stand on the deployable leg rest 10, the force-limiting clutch will slip or release and allow the deployable leg rest 10 to move and prevent damage to the deployable leg rest 10, actuator 20, or other parts of the passenger seat.

[0044] In certain embodiments, the motion of the deployable leg rest 10 may not be
20 exclusively rotational about an axis. The deployable leg rest 10 may rotate, translate, or both rotate and translate through a range of motion between a stowed and deployed position. In some embodiments, the connection between the deployable leg rest 10 and the seat bottom 30 may include a rotating element, such as a hinge, and a translating element like a carriage and track.

25 [0045] Any of the above described components, parts, or embodiments may take on a range of shapes, sizes, or materials as necessary for a particular application of the described invention. The components, parts, or mechanisms of the described invention may be made of any materials selected for the suitability in use, cost, or ease of manufacturing. Materials including, but not limited to aluminum, stainless steel, fiber reinforced plastics, composites,
30 polycarbonate, polypropylene, other metallic materials, or other polymers may be used to form any of the above described components.

[0046] Different arrangements of the components depicted in the drawings or described above, as well as components and steps not shown or described are possible. Similarly, some features and sub-combinations are useful and may be employed without reference to other features and sub-combinations. Embodiments of the invention have been
5 described for illustrative and not restrictive purposes, and alternative embodiments will become apparent to readers of this patent. Accordingly, the present invention is not limited to the embodiments described above or depicted in the drawings, and various embodiments and modifications may be made without departing from the scope of the claims below.

CLAIMS

That which is claimed is:

1. A passenger seat comprising:
 - a deployable leg rest coupled to a seat bottom; and
 - an actuator coupled to the deployable leg rest and the seat bottom;
 - wherein the actuator induces deployment of the deployable leg rest.
2. The passenger seat of claim 1, wherein the seat bottom is moveable during reclining of the passenger seat.
3. The passenger seat of claim 1, wherein the actuator comprises a gas-charged cylinder.
4. The passenger seat of claim 1, wherein the actuator comprises a spring.
5. The passenger seat of claim 4, wherein the spring comprises a coil spring.
6. The passenger seat of claim 4, wherein the spring comprises a torsion spring.
7. The passenger seat of claim 1, wherein the actuator comprises a spring in combination with a gas-charged cylinder.
8. The passenger seat of claim 1, further comprising a control button to initiate deployment of the deployable leg rest.
9. The passenger seat of claim 1, further comprising a locking mechanism to maintain a position of the deployable leg rest in a deployed position, a stowed position, or an intermediate position.
10. The passenger seat of claim 9, wherein the locking mechanism comprises a ratchet.
11. The passenger seat of claim 9, wherein the locking mechanism comprises a clutch.

12. The passenger seat of claim 11, wherein the clutch comprises a force-limiting clutch.

13. The passenger seat of claim 11, wherein the clutch comprises a one-way clutch.

5 14. The passenger seat of claim 1, wherein the actuator comprises an electrically powered actuator.

15. The passenger seat of claim 14, wherein the electrically powered actuator comprises an electric motor and gearing system to provide a torque to the deployable leg rest.

10

16. The passenger seat of claim 14, wherein the electrically powered actuator comprises an electric motor and a lead screw.

15 17. The passenger seat of claim 1, wherein the actuator provides a deploying force to deploy the deployable leg rest.

18. The passenger seat of claim 17, wherein the actuator provides a retracting force to retract the deployable leg rest.

20 19. The passenger seat of claim 1, wherein the deployable leg rest rotates and extends between a stowed position and a deployed position.

20. A passenger seat comprising:

25 a deployable leg rest coupled to a seat bottom;
a gas-charged cylinder providing a motive force;
a locking mechanism;
a control button in communication with the locking mechanism;
wherein the gas-charged cylinder is coupled to the deployable leg rest and the seat bottom;

30

wherein the locking mechanism locks the deployable leg rest in a stowed position; and

wherein the control button releases the locking mechanism and the motive force of the gas-charged cylinder deploys the deployable leg rest.

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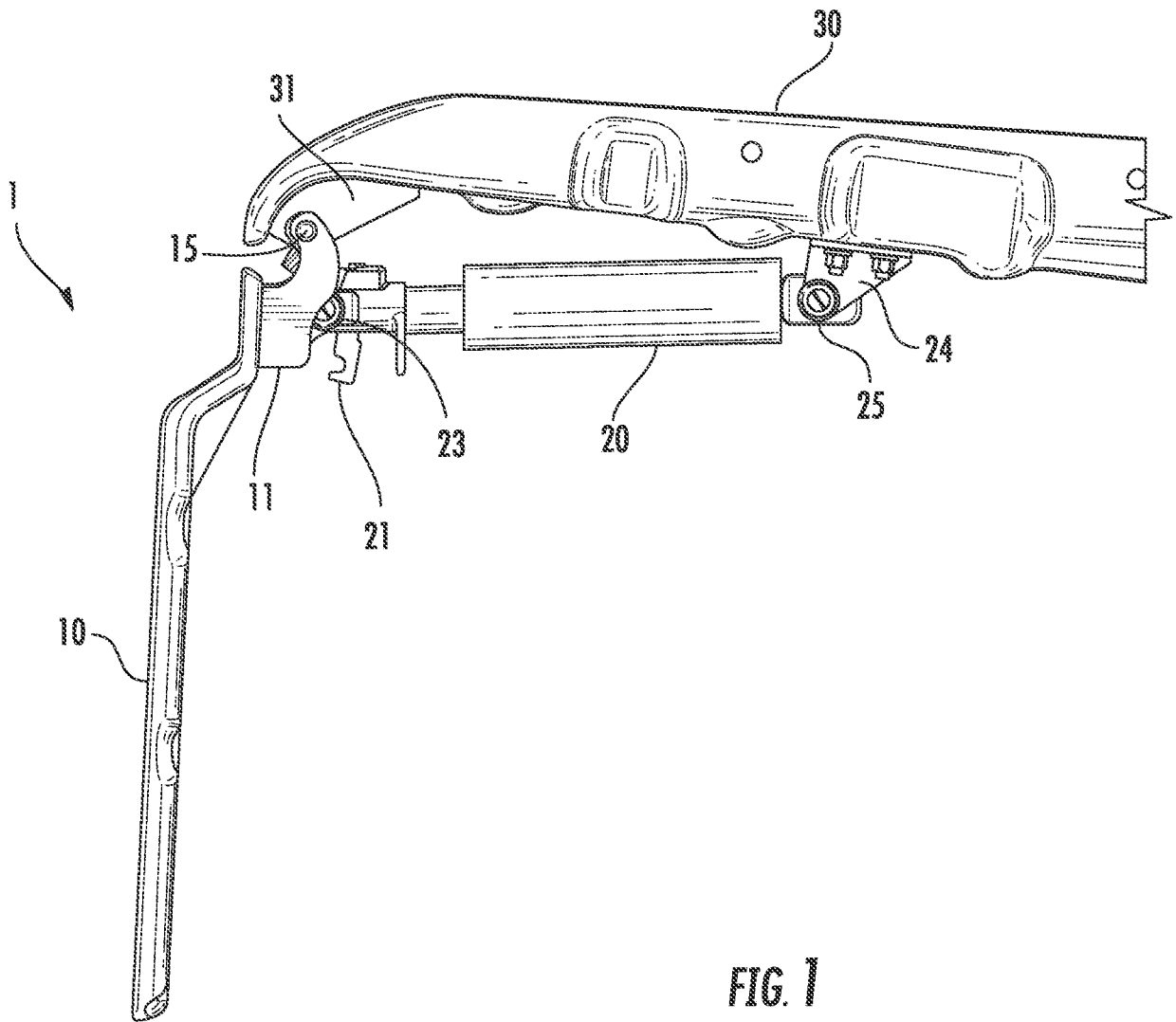


FIG. 1

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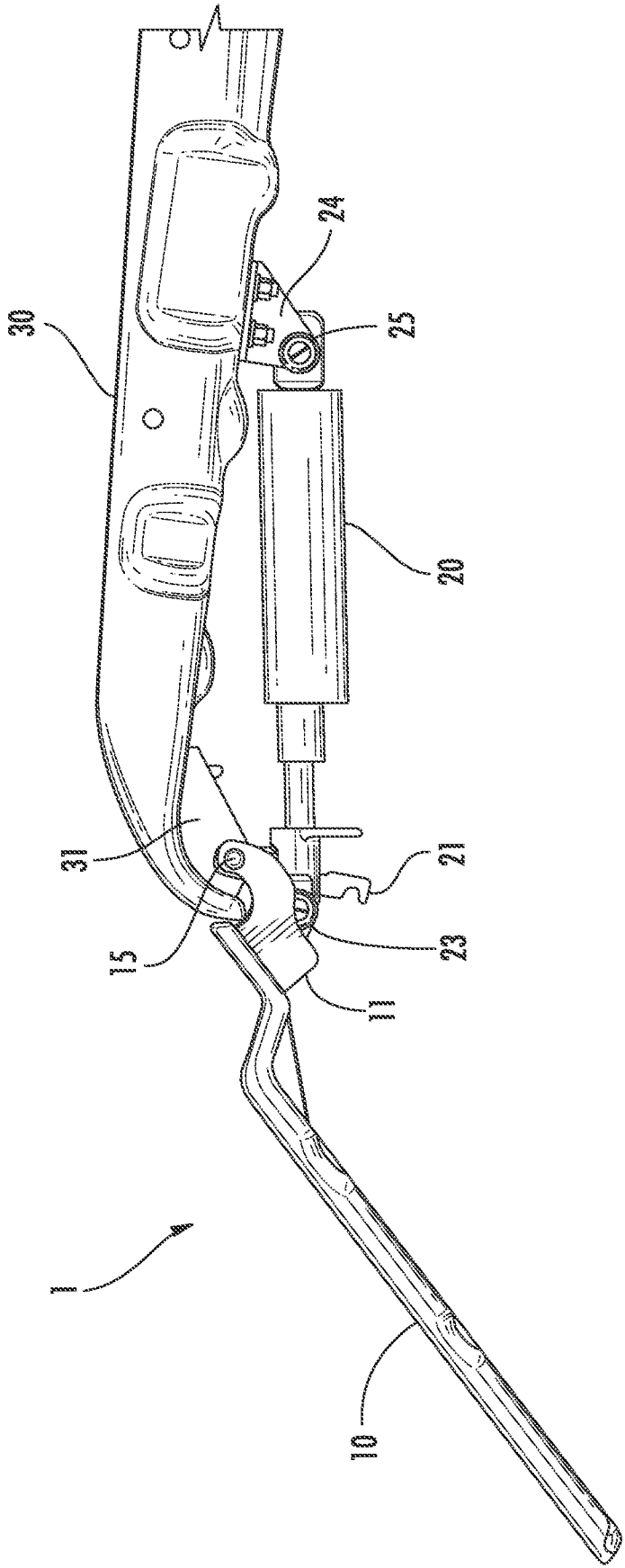


FIG. 2

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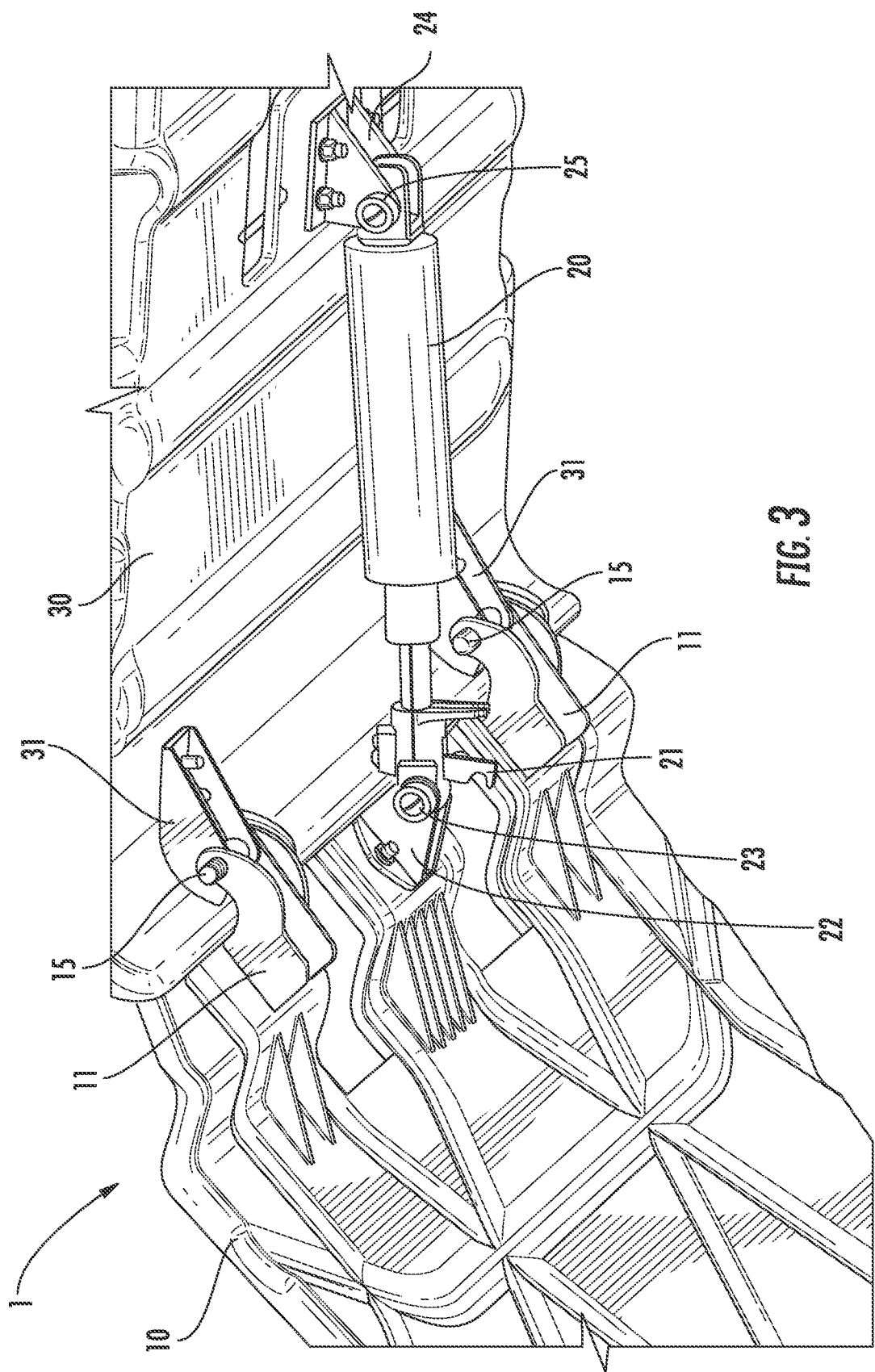
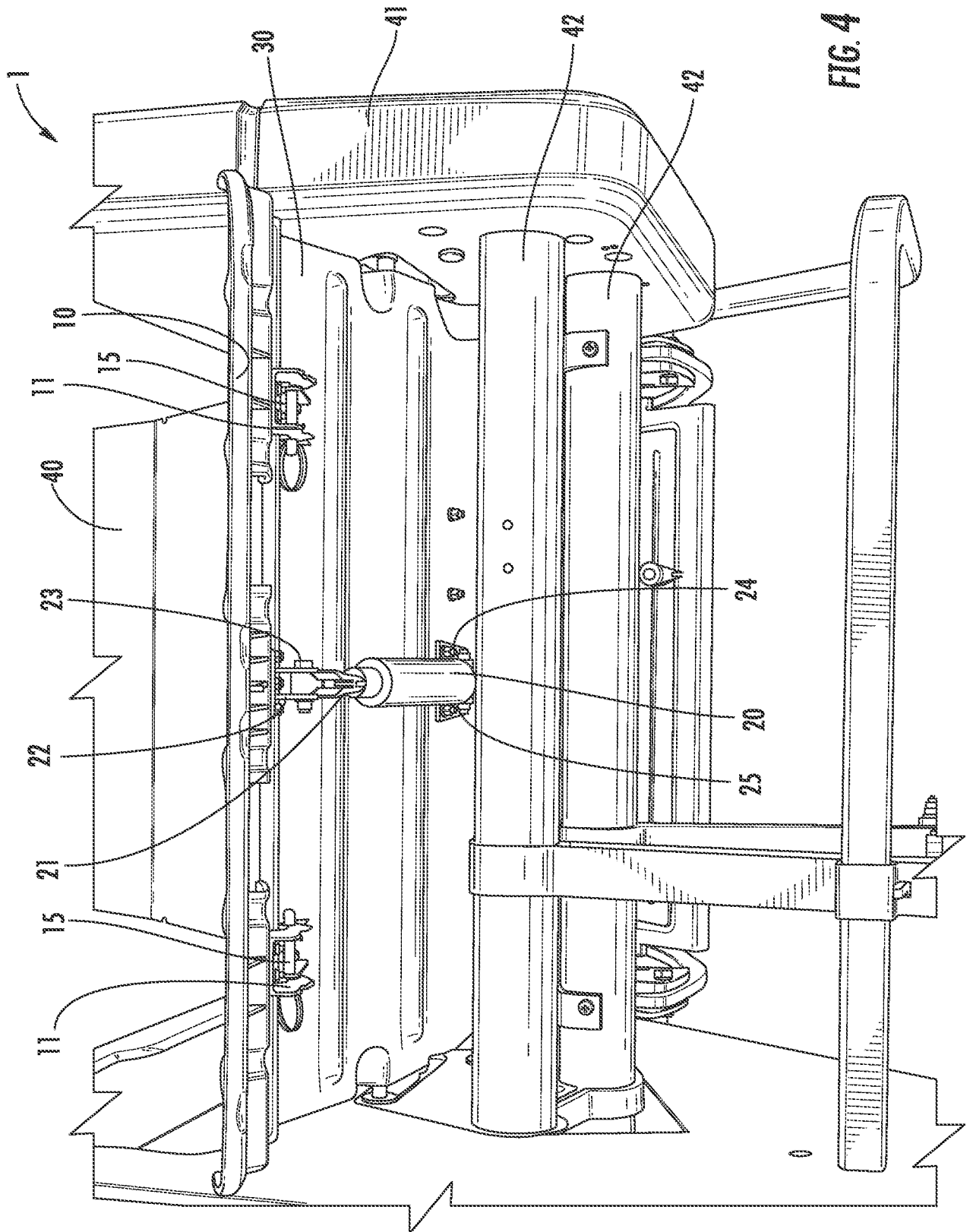


FIG. 3

4/4



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/024123

A. CLASSIFICATION OF SUBJECT MATTER
INV. B64D11/06 B60N2/44
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B64D B60N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/070531 A1 (AIR NEW ZEALAND LTD [NZ]; MEJUHAS MARSEL [DE]) 16 June 2011 (2011-06-16) page 1, lines 4-6 page 2, line 2 - page 13, line 28 page 15, line 19 - page 27, line 16 figures 1-16 -----	1-9,17, 19,20
X	US 4 509 795 A (BRENNAN EDWARD J [US] ET AL) 9 April 1985 (1985-04-09) column 1, line 42 - column 3, line 5 column 3, line 20 - column 5, line 25 figures 1-5 ----- -/--	1,2,4,5, 8-13,17, 19



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

8 July 2015

Date of mailing of the international search report

16/07/2015

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/024123

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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