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(72) Inventors:
• **Hencke, Marc**
21129 Hamburg (DE)
• **Gibbert, Markus**
21129 Hamburg (DE)
• **Gehle, Florian**
21129 Hamburg (DE)

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(74) Representative: **LKGLOBAL**
Lorenz & Kopf PartG mbB Patentanwälte
Brienner Straße 11
80333 München (DE)

(71) Applicant: **Airbus Operations GmbH**
21129 Hamburg (DE)

(54) **LINKAGE MECHANISM FOR LINKING A FLAPERON TO A DROOP PANEL OF AN AIRCRAFT**

(57) The invention relates to a linkage mechanism (12) for linking a flaperon (40) to a droop panel (30) of an aircraft (10), the linkage mechanism (12) comprising a support structure linkage (62), a droop panel linkage (32), and a flaperon linkage (42), wherein the support structure linkage (62) is pivotally attached at a pivot end (64) to a support structure (60) of a wing (20) of an aircraft (10), wherein the droop panel linkage (32) is pivotally attached at a first end (34) to a droop panel (30), wherein the flaperon linkage (42) is pivotally attached at a first end (44) to a flaperon (40), and wherein a second end

(36) of the droop panel linkage (32) and a second end (46) of the flaperon linkage (42) are pivotally attached to a connecting section (66) of the support structure linkage (62), wherein the connecting section (66) is spaced apart from the pivot end (64) of the support structure linkage (62), such that the linkage mechanism (12) is configured to transfer a pivoting motion from the flaperon (40) into a pivoting motion of the droop panel (30). The invention provides an improved linkage mechanism (12) for linking the flaperon (40) and the droop panel (30).

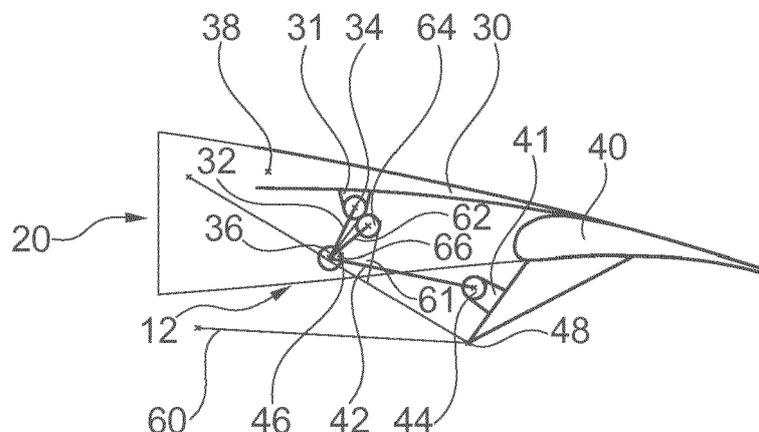


Fig. 2a

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Description

[0001] The invention relates to a linkage mechanism for linking a flaperon to a droop panel of an aircraft, a wing of an aircraft, and an aircraft.

[0002] Flaperons are flight controlling devices at a wing of an aircraft having the combined function of a flap and an aileron. Like ailerons and flaps, flaperons may be mounted on a wing with or without a droop panel. If the flaperon is mounted with a droop panel, the droop panel may adjust the gap which opens between the wing structure and the flaperon when a flaperon is pivoted. Due to the adjustment, the gap may be maintained at a desired level.

[0003] To ensure and guide the motion of the droop panel when the flaperon is pivoted, it is known to use a linkage between the flaperon and the panel which slides along a track in the wing structure. The main disadvantages of this mechanism are that the track may jam and that the manufacturing effort is high.

[0004] US 2013/0112814 A1 describes a droop panel linkage including a lever arm, a main lever, a main tube and at least one drive strut. A first end of the lever arm is pivotally attached to a flap and a second end is pivotally connected to a first end of the main lever. A second end of the main lever is provided with a first engagement element for engaging with a second engagement element incorporated into or associated with the main tube. The main tube is pivotally connected to a proximal end of the drive strut. A distal end of the drive strut is pivotally attached to the droop panel. However, a flaperon needs a higher flexibility than a flap.

[0005] Thus, there is the need for providing an improved linkage mechanism for linking the flaperon and the droop panel.

[0006] The object is solved by the features of the independent claims. Advantageous embodiments are subject matter of the dependent claims and the following description.

[0007] According to the invention, a linkage mechanism for linking a flaperon to a droop panel of an aircraft is provided. The linkage mechanism comprises a support structure linkage, a droop panel linkage, and a flaperon linkage, wherein the support structure linkage is pivotally attached at a pivot end to a support structure of a wing of an aircraft, wherein the droop panel linkage is pivotally attached at a first end to a droop panel, wherein the flaperon linkage is pivotally attached at a first end to a flaperon, and wherein a second end of the droop panel linkage and a second end of the flaperon linkage are pivotally attached to a connecting section of the support structure linkage, wherein the connecting section is spaced apart from the pivot end of the support structure linkage, such that the linkage mechanism is configured to transfer a pivoting motion from the flaperon into a pivoting motion of the droop panel.

[0008] The linkage mechanism according to the invention provides just linkages for connecting the flaperon to

the droop panel. Thus, the flaperon linkage and the droop panel linkage are pivotally linked and provide a direct linkage connection between the flaperon and the droop panel. At the linking point between the flaperon linkage and the droop panel linkage, both linkages are pivotally connected to the support structure linkage. Due to the connection of the support structure linkage to the support structure of the wing, furthermore, both linkages are connected to the support structure of the wing. The support structure therefore provides a static support location for the linkage mechanism which may serve as reference point for the motion of the linkage mechanism. Therefore, the actuation of the droop panel by the motion of the flaperon may be adjusted by choosing the length of the linkages and the attachment position of the support structure linkage at the support structure. Since all connections between the linkages of the linkage mechanism are pivoting connections, jam failure cases are prevented. Furthermore, since the linkage mechanism is trackless the manufacturing and installation of a track is avoided which reduces the manufacturing effort and cost. Additionally, rigging can be implemented with the linkage mechanism inside each linkage.

[0009] In an example, the droop panel and the flaperon each comprise a lever arm, wherein the first end of the droop panel linkage and the first end of the flaperon linkage are pivotally attached to the lever arm of the droop panel and the lever arm of the flaperon, respectively. The lever arms on the flaperon and the droop panel increase the adjustability of the motion of the droop panel in response to the motion of the flaperon.

[0010] According to an example, the connecting section is configured to pivot around the pivot end of the support structure linkage. This means that the bearing of the pivot end on the support structure is static and that the connecting section of the support structure linkage may perform a motion along a curvature. This simplifies the installation effort and the function of the linkage mechanism.

[0011] According to an example, the pivot end of the support structure linkage is pivotally attached to a lever arm of the support structure. This further increases the adjustability of the relative motion of the droop panel that is induced by the motion of the flaperon.

[0012] According to an example, the connecting section of the support structure linkage is arranged below the pivot end of the support structure linkage. The support structure linkage then performs a pivotal motion around the connection between the pivot end and the support structure. Furthermore, the connection point between the pivot end and the support structure may be located close to the droop panel such that the motion range of the droop panel may be increased.

[0013] According to another example, the connecting section of the support structure linkage is arranged above the pivot end of the support structure linkage. In this exemplary embodiment, the pivot end of the support structure linkage may be connected close to the support struc-

ture. This may reduce the forces on the connection between the support structure linkage and the support structure.

[0014] According to an example, the connecting section comprises at least two lever arms, wherein the second end of the flaperon linkage is pivotally attached to a first lever arm of the at least two lever arms and the second end of the droop panel linkage is pivotally attached to a second lever arm of the at least two lever arms. Due to the two lever arms, the connecting section may transfer the motion of the flaperon to the panel with a high motion range for the droop panel and the flaperon. Furthermore, the arrangement and the shape of the two lever arms with respect to each other may provide an adjustment means for adjusting the relative motion velocity between the droop panel and the flaperon and their motion ranges.

[0015] According to an example, the at least two lever arms of the connecting section are arranged in an L-shape, wherein the first lever arm of the at least two lever arms points to the droop panel and the second lever arm of the at least two lever arms points to the flaperon.

[0016] In an example, a pivot motion of the support structure linkage, a pivot motion of the droop panel linkage, and a pivot motion of the flaperon linkage each define a separate surface which may be a movement plane. The motion of the linkages in their own surfaces will avoid clashes of the linkages during the motion of the flaperon. In a preferable exemplary embodiment, the surfaces may be non-parallel, and/or curved, wherein the surfaces comprise a common cross line, wherein the linkages are spaced apart from that cross line. In another exemplary embodiment, each surface is parallel to the further surfaces. The parallel arrangement of the surfaces will prevent clashes between the linkages. Both exemplary embodiments may improve the prevention of clashes between the linkages.

[0017] In an example, the linkage mechanism is configured to allow a pivot motion of the flaperon for an angle within the range from 30° up to 70° down, preferably within the range from 20° up to 50° down, from a normal position of the flaperon. The normal position of the flaperon is determined by a lack of air deflection from a wing by the flaperon. In the normal position a chord line of the flaperon is defined to be in a 0° position, the chord line connecting a leading edge of the flaperon to a trailing edge of the flaperon. A pivot motion of the flaperon of for example 10° up means that the flaperon is moved such that the chord line of the flaperon deviates by 10° upward from the normal position. The motion of the flaperon of for example 30° down means that the flaperon is moved such that the chord line of the flaperon deviates by 30° downward from the normal position.

[0018] According to the invention, also a wing of an aircraft is provided, the wing comprising a droop panel, a flaperon, a support structure, and a linkage mechanism according to the above description, wherein the droop panel is pivotally attached at a connection point to the wing, wherein the flaperon is pivotally attached at a con-

nection point to the wing, wherein the support structure is rigidly attached to the wing, wherein the first end of the droop panel linkage is pivotally attached to the droop panel and is spaced apart from the connection point of the droop panel, and wherein the first end of the flaperon linkage is pivotally attached to the flaperon and is spaced apart from the connection point of the flaperon.

[0019] According to an example, a deflection range of the flaperon is within the range from 30° up to 70° down, preferably within the range from 20° up to 50° down, from a normal position of the flaperon in which no deflection occurs.

[0020] The effects and further embodiments of the wing of an aircraft according to the present invention are analogous to the effects and embodiments of the linkage mechanism. Thus, it is referred to the above description of the linkage mechanism.

[0021] According to the invention, also an aircraft is provided, the aircraft comprising a linkage mechanism according to the above description or a wing according to the above description.

[0022] In the following the invention is described by the means of an exemplary embodiment using the attached drawing.

Fig. 1 shows a schematic drawing of an aircraft with the linkage mechanism;

Fig. 2a-c show schematic drawings of the linkage mechanism in exemplary embodiments;

Fig. 3 shows a schematic drawing of the linkage mechanism in another exemplary embodiment; and

Fig. 4a-f show schematic drawings of the linkage mechanism with different surfaces of motion for the linkages.

[0023] Fig. 1 shows an aircraft 10 comprising at least one wing 20. The wing comprises a droop panel 30 and the flaperon 40.

[0024] The droop panel 30 is pivotally connected to the wing 20 at a connection point 38. Furthermore, the flaperon 40 is pivotally connected to the wing 20 at a connection point 48. The flaperon 40 may be connected to the support structure 60, wherein the support structure 60 may be rigidly connected to the wing 20. A pivoting device 50 may pivot the flaperon 40 around the pivotal connection to the wing 20 such that the flaperon 40 pivots around a hinge line.

[0025] The droop panel 30 and the flaperon 40 are connected by a linkage mechanism 12. The linkage mechanism 12 transfers the motion of the flaperon 40 to the droop panel 30. Thus, due to the linkage mechanism 12, the droop panel 30 automatically adjusts the gap which opens when the flaperon 40 pivots around the connection point 48 to the wing 20.

[0026] The linkage mechanism 12 is shown in Figs. 2A to 2C. The linkage mechanism 12 comprises a droop panel linkage 32, a support structure linkage 62, and a flaperon linkage 42.

[0027] The droop panel linkage 32 comprises a first end 34 and a second end 36. The first end 34 and the second end 36 form opposite ends of the droop panel linkage 32, i.e. the first end 34 of the droop panel linkage 32 is opposite to the second end 36 of the droop panel linkage 32. The first end 34 is pivotally connected to the droop panel 30. This means, that the droop panel linkage 32 may pivot around the connection to the droop panel 30.

[0028] The pivotal connection to the droop panel 30 of the first end 34 is spaced apart from the connection point 38. Thus, the droop panel linkage 32 may provide a momentum to the droop panel 30 such that the droop panel 30 pivots around the connection point 38.

[0029] The droop panel 30 further comprises a lever arm 31 for connecting to the first end 34 of the droop panel linkage 32. Thus, the first end 34 of the droop panel linkage 32 does not directly connect to the droop panel 30 but spaced apart from the droop panel 30 by the lever arm 31.

[0030] The flaperon linkage 42 comprises a first end 44 and a second end 46. The first end 44 of the flaperon linkage 42 is opposite to the second end 46 of the flaperon linkage 42. The first end 44 is pivotally connected to the flaperon 40, i.e. the flaperon linkage 42 may pivot around the pivotal connection of the first end 44.

[0031] The connection of the first end 44 to the flaperon 40 is spaced apart from the connection point 48 of the flaperon 40 to the wing 20. This means a pivotal motion of the flaperon 40 around the connection point 48 will result in a momentum on the flaperon linkage 42.

[0032] The flaperon 40 further comprises a lever arm 41 for connecting to the first end 44 of the flaperon linkage 42. Thus, the first end 44 of the flaperon linkage 42 does not directly connect to the flaperon 40 but is spaced apart from the flaperon 40 by the lever arm 41.

[0033] The support structure linkage 62 comprises a pivot end 64 and a connecting section 66. The pivot end 64 of the support structure linkage 62 is opposite to the connecting section 66 of the support structure linkage 62. The pivot end 62 is pivotally connected to the support structure 60.

[0034] The support structure 60 comprises a bearing arm 61 which provides the connection to the pivot end 64 of the support structure linkage 62. Bearing arm 61 spaces apart the pivot end 64 of the support structure linkage 62 from the support structure 60. Since the pivot end 64 is spaced apart from the support structure 60, the connecting section 66 of the support structure linkage 62 may be arranged below the pivot end 64 of the support structure linkage 62.

[0035] The second end 36 of the droop panel linkage 32 and the second end 46 of the flaperon linkage 42 are pivotally connected to the connecting section 66 of the

support structure linkage 62. This means, that the linkage mechanism 12 connects the droop panel 30 and the flaperon 40 to the support structure 60. Since the support structure 60 is rigidly connected to the wing 20, a momentum being applied by the pivotal motion of the flaperon 40 on the linkage mechanism 12 will not result in a motion of the support structure 60. The support structure linkage 62 rather forces the second end 36 of the droop panel linkage 32 and the second end 46 of the flaperon linkage 42 on a predetermined trajectory around the pivot end 64 of the support structure linkage 62.

[0036] In an exemplary embodiment, the second end 36 of the droop panel linkage 32 may be pivotally connected to the second end 46 of the flaperon linkage 42. Thus, the droop panel linkage 32 and the flaperon linkage 42 directly link the flaperon 40 to the droop panel 30. In this example, the end section 66 of the support structure linkage 62 may be formed by a single end of the support structure linkage 62.

[0037] In an example, the flaperon linkage 42 and the droop panel linkage 32 may be connected to the support structure linkage 62 at a common connection point. In another example, the flaperon linkage 42 and the droop panel linkage 32 may be connected to the support structure linkage 62 at separate connection points, the connection points being spaced apart from each other.

[0038] Fig. 2A shows the flaperon 40 in the normal position. In this position, the flaperon 40 does not deflect the airflow which flows along and around the wing 20. Thus, the flaperon 40 does not provide any momentum for controlling the aircraft 10 nor any braking force for decelerating the aircraft 10.

[0039] Figs. 2B and 2C show the flaperon 40 in a pivoted position. Further shown is a static portion 22 of the wing 20 which is laterally arranged to the flaperon 40. That static portion 22 also marks the normal position of the flaperon 40 with respect to the wing 20.

[0040] In Fig. 2B, the flaperon 40 is pivoted downwards, such that the flaperon 40 deflects the airstream flowing below the wing 20 downwards. Furthermore, the flaperon 40 has an angle of 50° with respect to the normal position.

[0041] The motion of the flaperon 40 turns the support structure linkage 62 around the pivot end 64 and further provides a pulling force on the droop panel linkage 32 which pulls down the droop panel 30. Thus, due to the linkage mechanism 12, the droop panel 30 is also pivoted downwards and closes the gap which results from the downward motion of the flaperon 40.

[0042] In Fig. 2C, the flaperon 40 is pivoted upwards, such that the flaperon 40 deflects the airstream flowing above the wing 20 upwards. Furthermore, the flaperon 40 has an angle of 20° with respect to the normal position.

[0043] The motion of the flaperon 40 turns the support structure linkage 62 around the pivot end 64 and provides a pushing force on the droop panel linkage 32 which pushes up the droop panel 30. Thus, due to the linkage mechanism 12, the droop panel 30 is pivoted upwards

to increase the range of the upward motion of the flaperon 40.

[0044] Fig. 3 shows a further exemplary embodiment of the linkage mechanism 12. The main difference between the embodiment of Fig. 3 to the embodiment of Figs. 2A to C is the connection of the pivot end 64 of the support structure linkage 62 to the support structure 60. In Fig. 3, the pivot end 64 is directly attached to the support structure 60. Thus, the support structure 60 does not comprise a bearing arm 61.

[0045] The connecting section 66 of the support structure linkage 62 is therefore arranged above the pivot end 64 of the support structure linkage 62. Thus, when the connecting section 66 is pivoted around the pivot end 64, the connecting section 66 travels on a curvature around the pivot end 64, wherein the curvature is located above the pivot end 64.

[0046] The support structure linkage 62 comprises a connecting section 66 which comprises a first lever arm 65 and a second lever arm 67. The first lever arm 65 is pivotally connected to the second end 46 of the flaperon linkage 42. The second lever arm 67 is pivotally connected to the second end 36 of the droop panel linkage 32.

[0047] In the embodiment shown in Fig. 3, the lever arms 65 and 67 form an L-shape, wherein the first lever arm 65 points to the droop panel 30 and the second lever arm 67 points to the flaperon 40. However, the lever arms 65 and 67 may be arranged in any shape, e.g. V-shaped or T-shape.

[0048] The further difference to the embodiment being shown in Figs. 2A to C is that the first end 34 of the droop panel linkage 32 is directly attached to the droop panel 30. The lever arm 31 is omitted in the embodiment of Fig. 3 with respect to the embodiment of Figs. 2A to C. Furthermore, the first end 44 of the flaperon linkage 42 is directly connected to the flaperon 40. Here, the lever arm 41 is omitted in the embodiment of Fig. 3 with respect to the embodiment of Figs. 2A to C.

[0049] In the embodiment of Fig. 3, a pivotal motion of the flaperon 40 around the connection point 48 connecting the flaperon 40 to the support structure 60 of the wing 20 is transferred via the flaperon linkage 42 to the first lever arm 65 of the connecting section 66. This causes the support structure linkage 62 to pivot around the pivot end 64. This pivot motion of the support structure linkage 62 results in a pivot motion of the second lever arm 67 of the connecting section 66. The pivot motion of the second lever arm 67 is transferred via the droop panel linkage 32 to the droop panel 30 such that the droop panel 30 is pivoted around the connection point 38 connecting the droop panel 30 to the wing 20.

[0050] Figs. 4A to 4F show schematic views of different exemplary embodiments of the arrangement of the linkages 32, 42, 62 with respect to each other. The droop panel linkage 32 is arranged such that it pivotally moves inside a surface 33. The flaperon linkage 42 is arranged such that it pivotally moves inside a surface 43. The support structure linkage 62 is arranged such that it pivotally

moves inside a surface 63. The surfaces 33, 43, 63 may be curved and/or twisted surfaces if the hinge lines of the flaperon 40 and the droop panel 30 are non-parallel.

[0051] In Fig. 4A, the surfaces 33, 43, 63 are parallel to each other. This means that the surface 33 of the droop panel linkage 32 is spaced apart by a distance d_1 from the surface 63 of the support structure linkage 62. Furthermore, the surface 63 of the support structure linkage 62 is spaced apart by a distance d_2 from the surface 43 of the flaperon 40.

[0052] Furthermore, in this embodiment, distance elements 70 are arranged between the second end 36 of the droop panel linkage 32 and the connecting section 66 of the support structure linkage 62, and between the second end 46 of the flaperon linkage 42 and the connecting section 66 of the support structure linkage 62. The distance elements 70 shall avoid friction or clashing between linkages during a pivotal motion.

[0053] Figs. 4B and 4C show further embodiments, in which the surfaces 33, 43, and 63 are crossing each other. In Fig. 4B the crossline 72 of the surfaces 33, 43 and 63 is a common crossline in which all surfaces 33, 43 and 63 cross each other. However, in another embodiment, there may be three cross lines each marking a cross line of a pair of the three surfaces. In further embodiments two surfaces may be parallel and one surface may be angled to those two surfaces.

[0054] According to Fig. 4B, the surfaces 33, 43, 63 are angled such that the first ends 34 and 44 of the droop panel linkage 32 and the flaperon linkage 42, respectively, and the pivot end 64 of the support structure linkage 62 point away from the crossline 72.

[0055] In another embodiment being shown in Fig. 4C, the surfaces 33, 43, and 63 are angled such that the first ends 34 and 44 of the droop panel linkage 32 and the flaperon linkage 42, respectively, and the pivot end 64 of the support structure linkage 62 point towards the crossline 72.

[0056] In the embodiment being shown in Fig. 4D, the linkages are arranged parallel to each other but omitting the distance elements 70.

[0057] Although in the embodiments shown in Figs. 4A to 4D, the support structure linkage 62 is arranged in a sandwich position between the droop panel linkage 32 and the flaperon linkage 42, also the droop panel linkage 32 or the flaperon linkage 42 may be arranged between the further linkages. Such embodiments are shown in Figs. 4E and 4F.

Claims

1. Linkage mechanism for linking a flaperon (40) to a droop panel (30) of an aircraft (10), the linkage mechanism (12) comprising a support structure linkage (62), a droop panel linkage (32), and a flaperon linkage (42),

- wherein the support structure linkage (62) is pivotally attached at a pivot end (64) to a support structure (60) of a wing (20) of an aircraft (10), wherein the droop panel linkage (32) is pivotally attached at a first end (34) to a droop panel (30), wherein the flaperon linkage (42) is pivotally attached at a first end (44) to a flaperon (40), and wherein a second end (36) of the droop panel linkage (32) and a second end (46) of the flaperon linkage (42) are pivotally attached to a connecting section (66) of the support structure linkage (62), wherein the connecting section (66) is spaced apart from the pivot end (64) of the support structure linkage (62), such that the linkage mechanism (12) is configured to transfer a pivoting motion from the flaperon (40) into a pivoting motion of the droop panel (30).
2. Linkage mechanism according to claim 1, wherein the connecting section (66) is configured to pivot around the pivot end (64) of the support structure linkage (62).
 3. Linkage mechanism according to claim 1 or 2, wherein the pivot end of the support structure linkage (62) is pivotally attached to a bearing arm (61) of the support structure (60).
 4. Linkage mechanism according to one of claims 1 to 3, wherein the connecting section (66) of the support structure linkage (62) is arranged below the pivot end (66) of the support structure linkage (62).
 5. Linkage mechanism according to one of claims 1 to 3, wherein the connecting section (66) of the support structure linkage (62) is arranged above the pivot end (66) of the support structure linkage (62).
 6. Linkage mechanism according to one of claims 1 to 5, wherein the connecting section (66) comprises at least two lever arms (65, 67), wherein the second end (46) of the flaperon linkage (42) is pivotally attached to a first lever arm (65) of the at least two lever arms (65, 67) and the second end (36) of the droop panel linkage (32) is pivotally attached to a second lever arm (67) of the at least two lever arms (65, 67).
 7. Linkage mechanism according to claim 6, wherein the at least two lever arms (65, 67) of the connecting section (66) are arranged in an L-shape, and wherein the first lever arm (65) of the at least two lever arms (65, 67) points to the droop panel (30) and the second lever arm (67) of the at least two lever arms (65, 67) points to the flaperon (40).
 8. Wing of an aircraft comprising a droop panel (30), a flaperon (40), a support structure (60), and a linkage mechanism (12) according to one of claims 1 to 7, wherein the droop panel (30) is pivotally attached at a connection point (38) to the wing (20), wherein the flaperon (40) is pivotally attached at a connection point (48) to the wing (20), wherein the support structure (60) is rigidly attached to the wing (20), wherein the first end (34) of the droop panel linkage (32) is pivotally attached to the droop panel (30) and is spaced apart from the connection point (38) of the droop panel (30), and wherein the first end (44) of the flaperon linkage (42) is pivotally attached to the flaperon (40) and is spaced apart from the connection point (48) of the flaperon (40).
 9. Wing according to claim 8, wherein a deflection range of the flaperon (40) is within the range from 30 ° up to 70 ° down, preferably within the range from 20 ° up to 50 ° down, from a normal position of the flaperon (40) in which no deflection of air occurs.
 10. Aircraft comprising a linkage mechanism (12) according to one of claims 1 to 7 or a wing (20) according to claim 8 or 9.

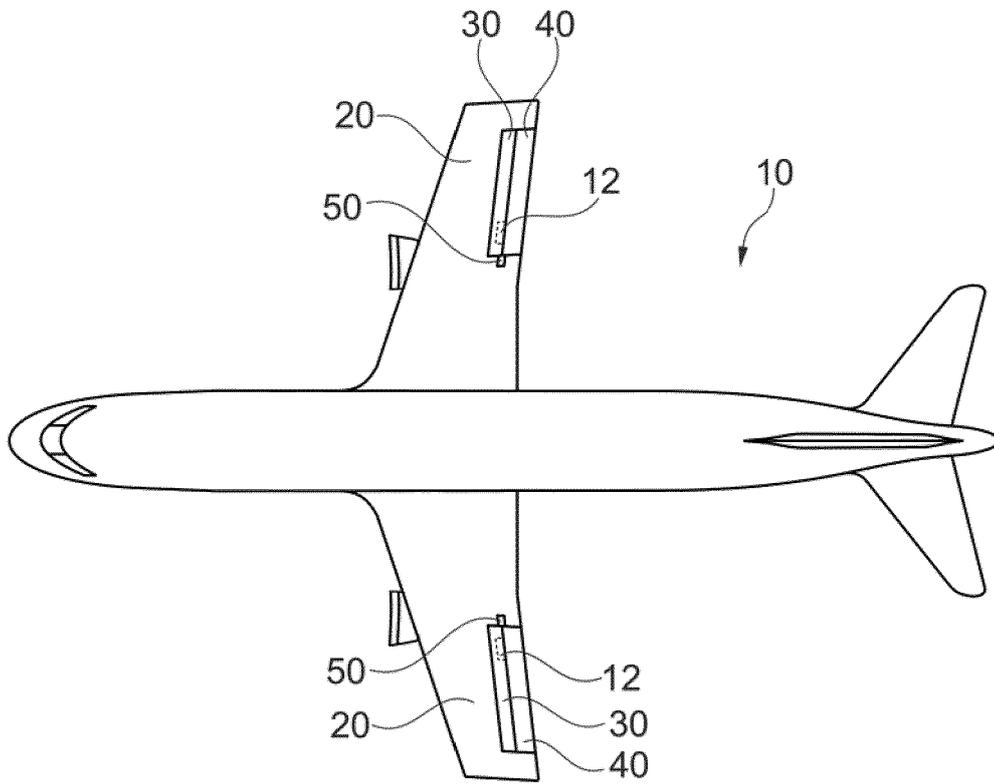


Fig. 1

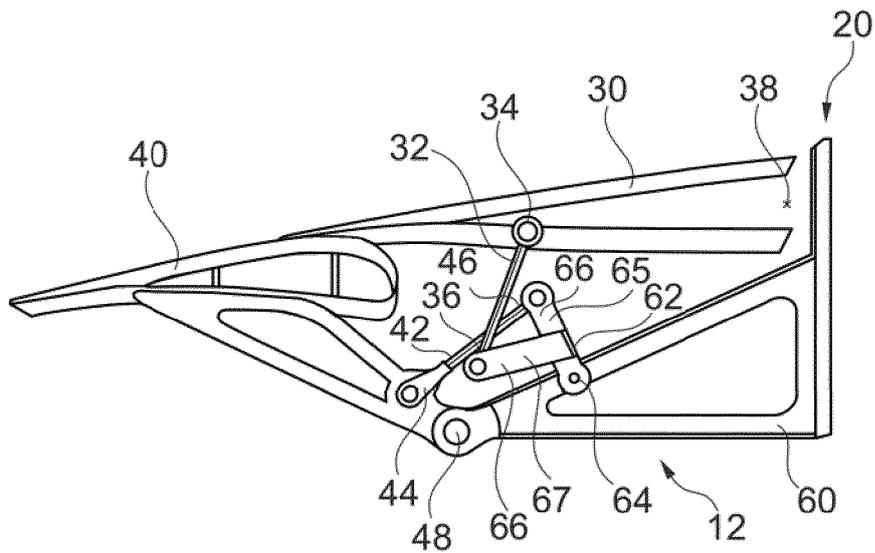


Fig. 3

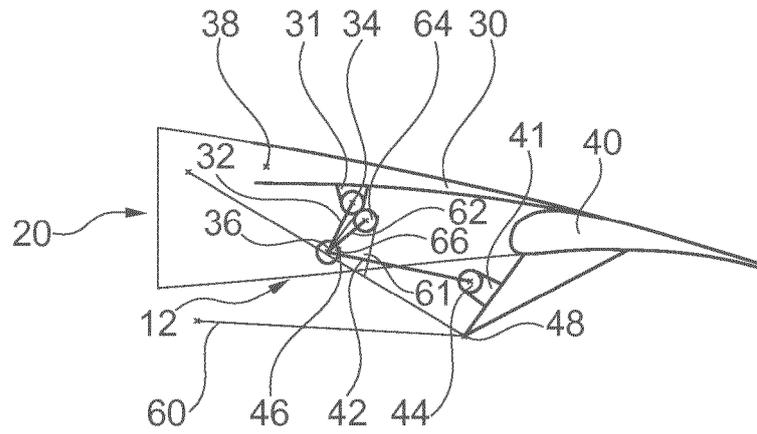


Fig. 2a

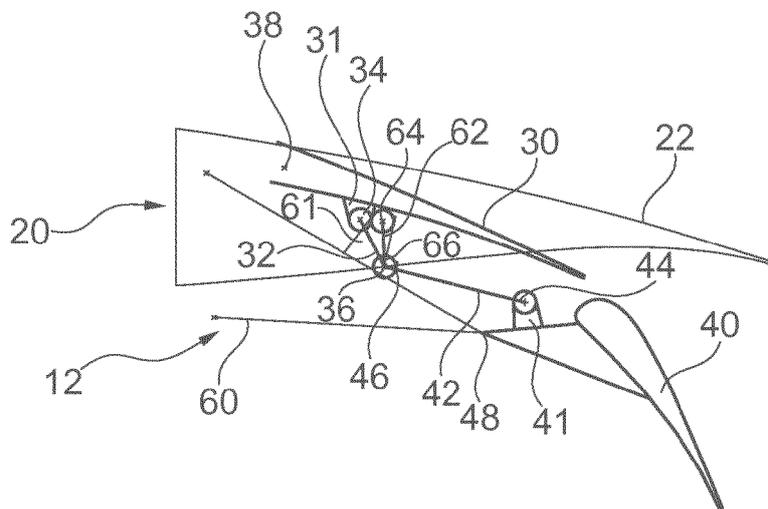


Fig. 2b

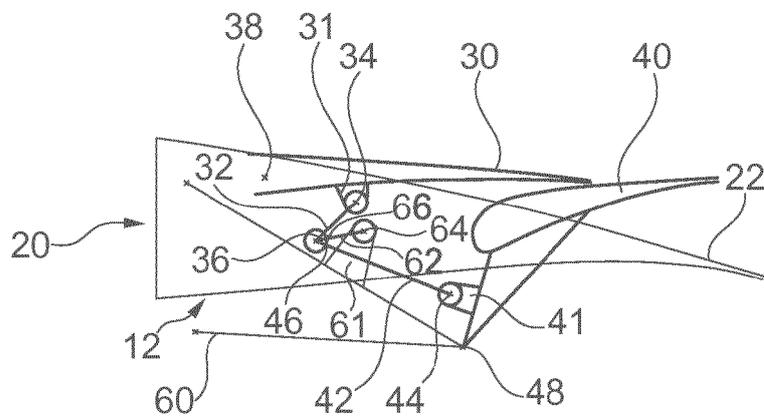


Fig. 2c

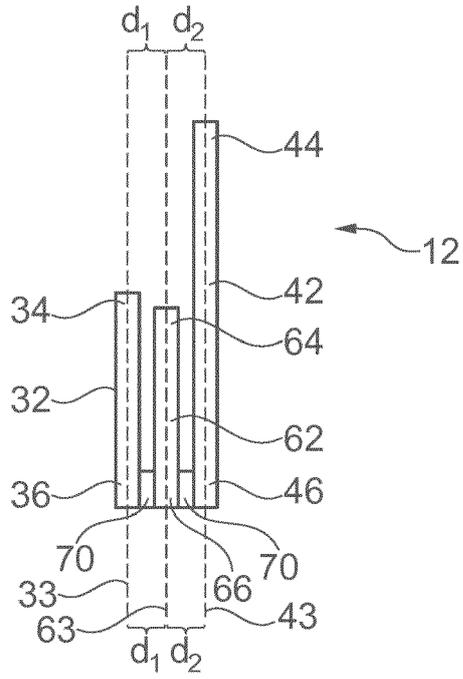


Fig. 4a

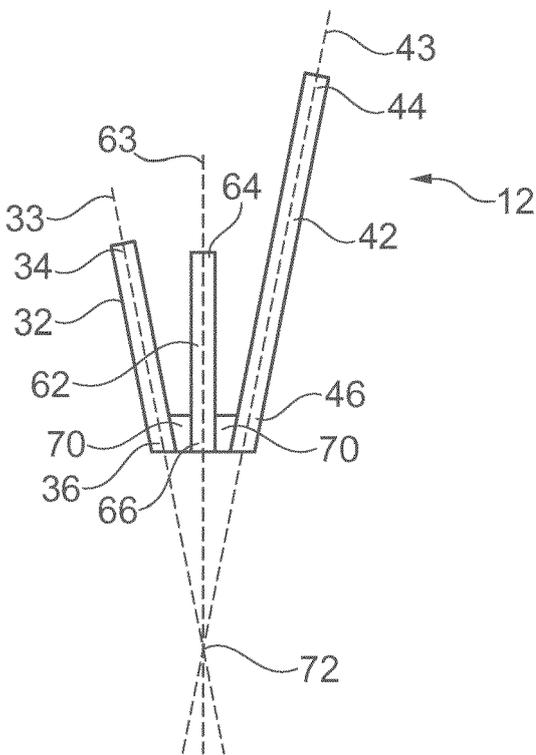


Fig. 4b

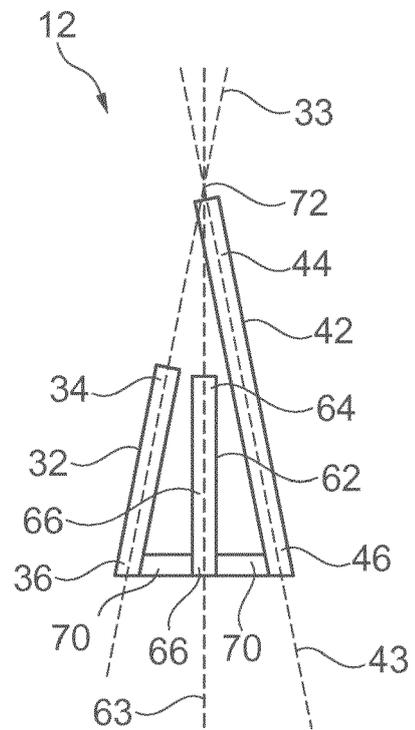


Fig. 4c

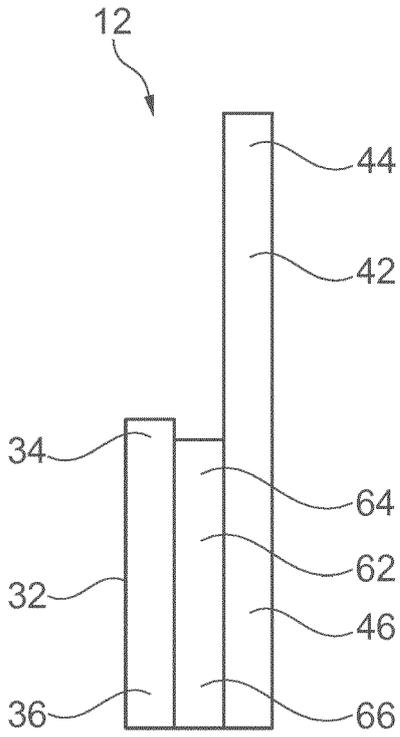


Fig. 4d

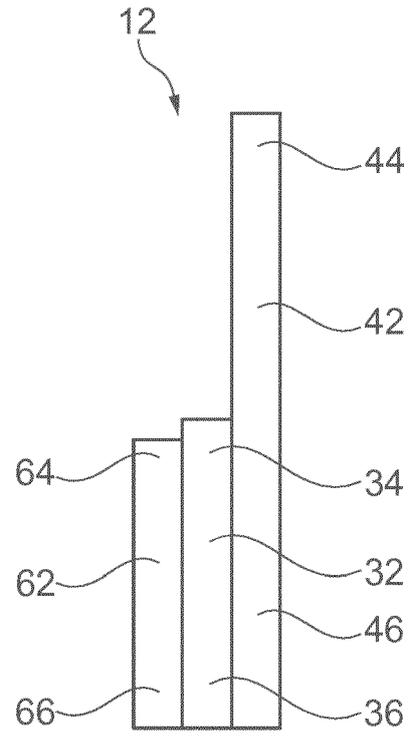


Fig. 4e

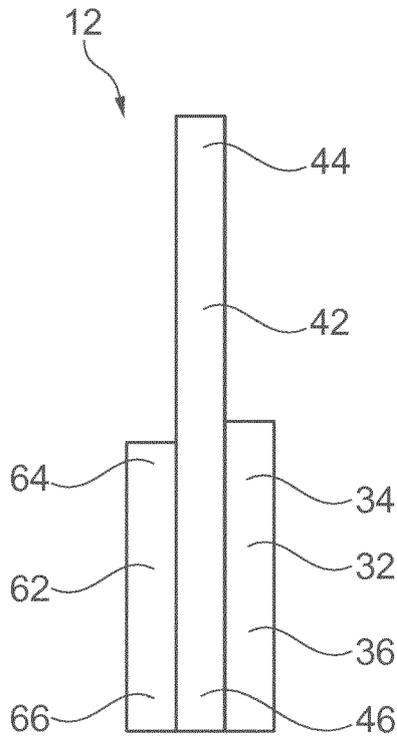


Fig. 4f



EUROPEAN SEARCH REPORT

Application Number
EP 19 15 3887

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 669 189 A1 (BOEING CO [US]) 4 December 2013 (2013-12-04) * paragraph [0057] - paragraph [0058]; figures 4-8 *	1-4,8-10	INV. B64C9/02 B64C9/04 B64C9/16
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<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>& : member of the same patent family, corresponding document</p>			

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