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(54) **ACTIVE AIR FLAP DEVICE FOR VEHICLE**

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(57) **ABSTRACT**

An active air flap device for a vehicle is configured to prevent aerodynamic loss caused by the active air flap being twisted. The active air flap device for a vehicle has a structure in which a clutch link is connected between a drive shaft connected to an actuator and a drive link configured to rotate a flap to allow the drive shaft and the clutch link to rotate together to transmit a rotational driving force for opening and closing the flap to the drive link, allowing the clutch link to rotate up to a set angle and the drive shaft to further rotate by an arbitrary angle from the set angle to thereby compensate for a rotation loss in which another end portion of the flap rotates less than one end portion of the flap.

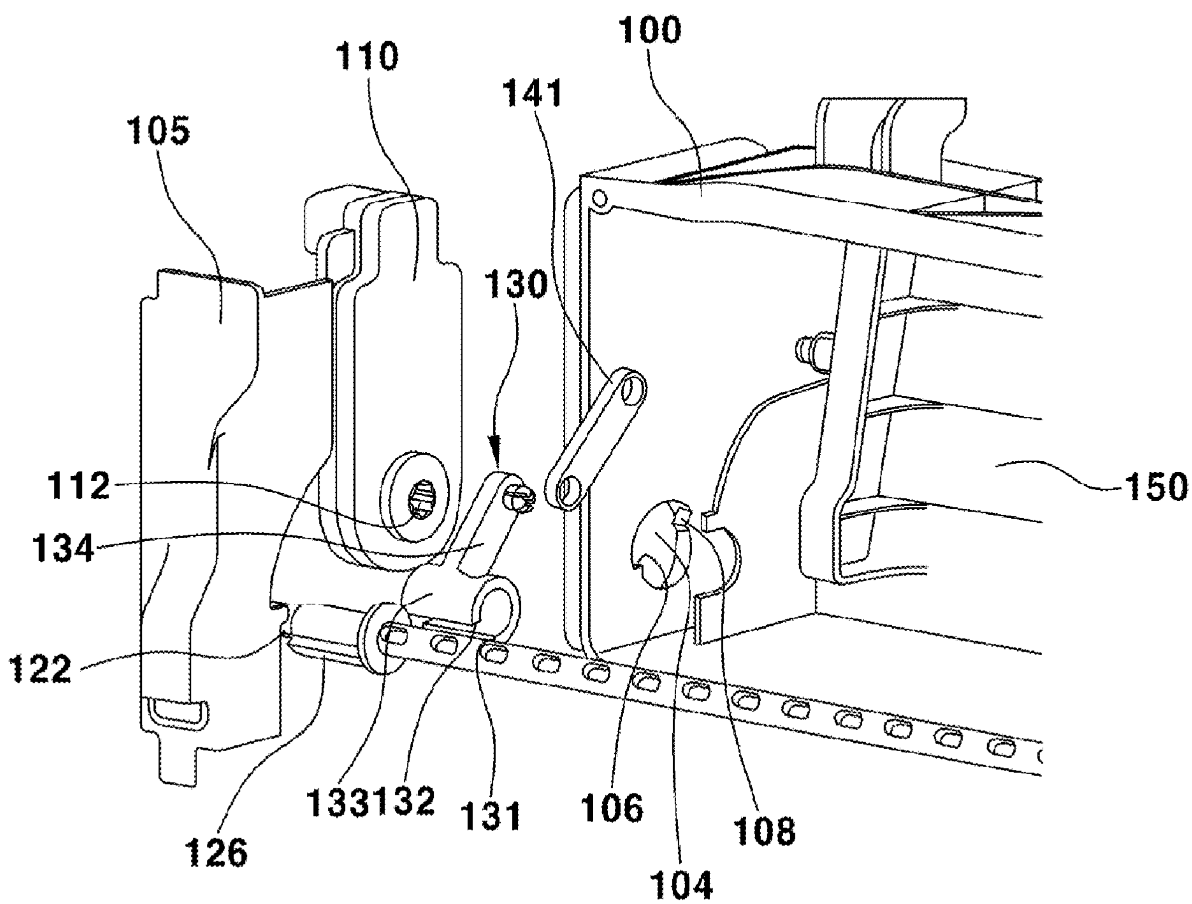


FIG. 1
RELATED ART

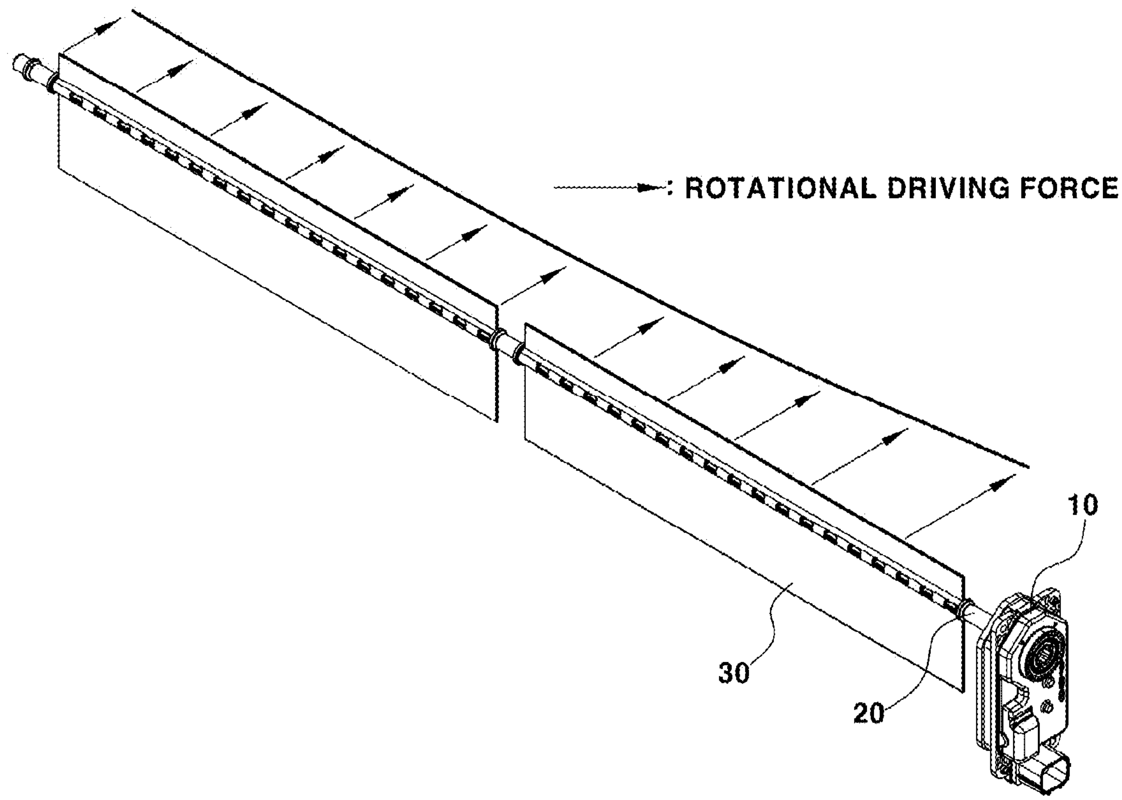


FIG. 2
RELATED ART

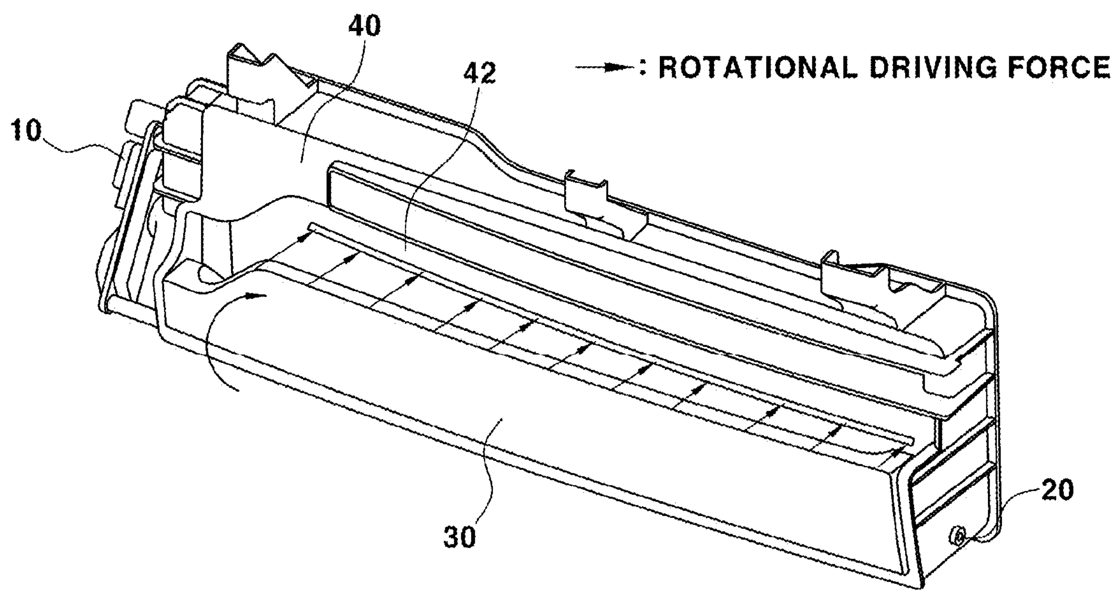


FIG. 3A

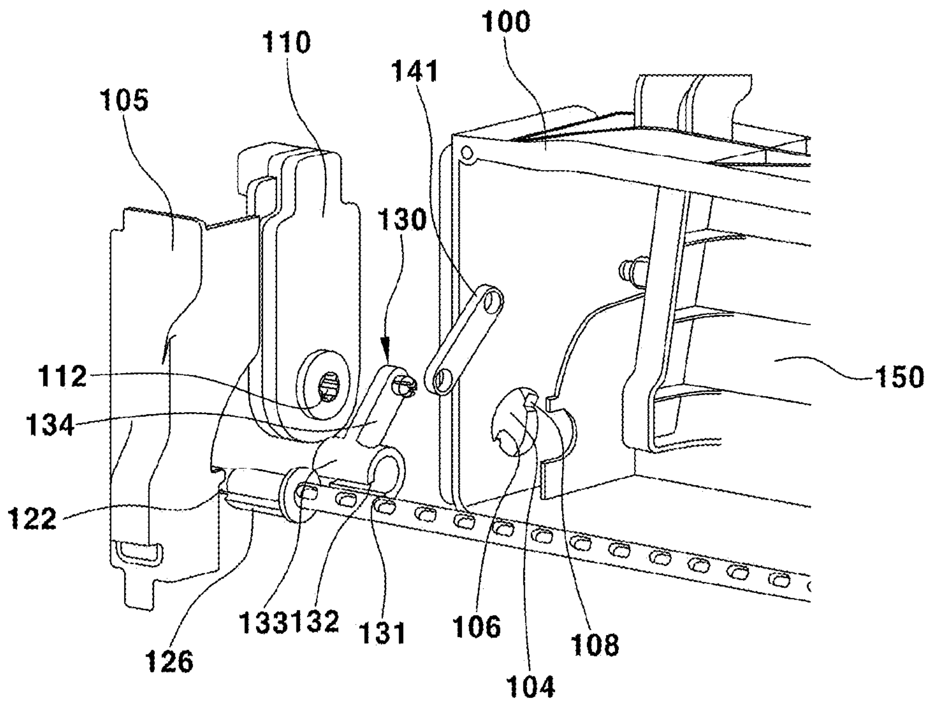


FIG. 3B

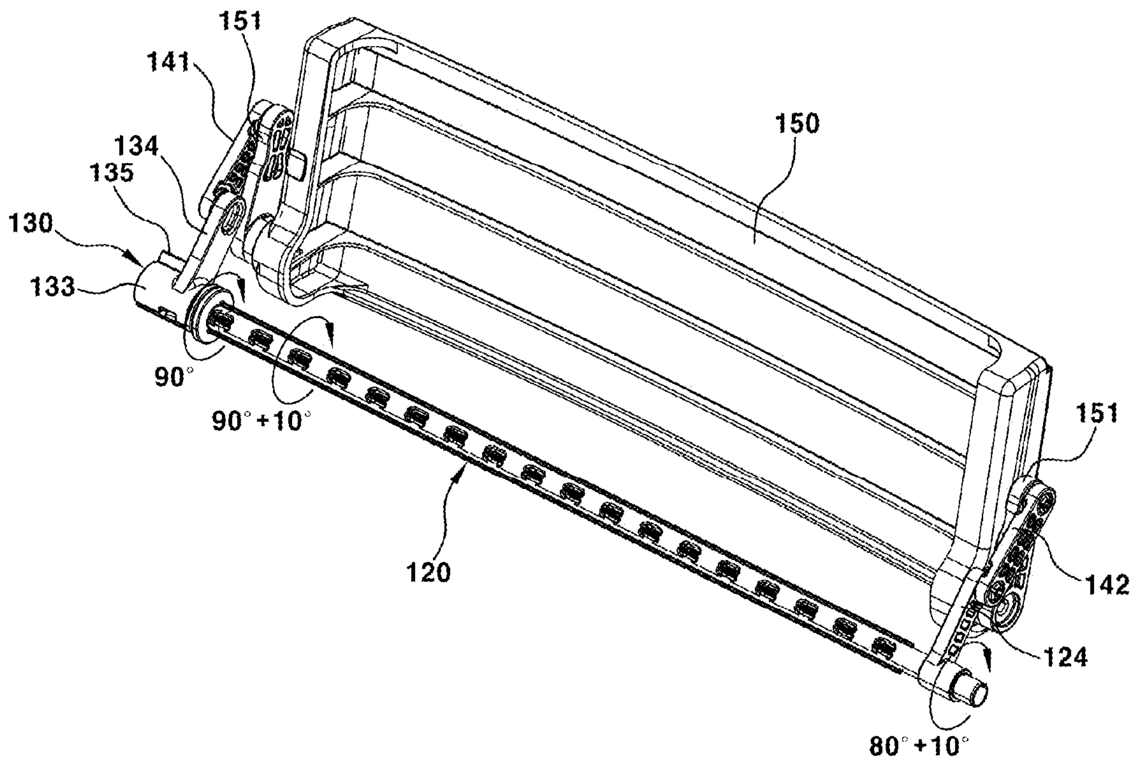


FIG. 4

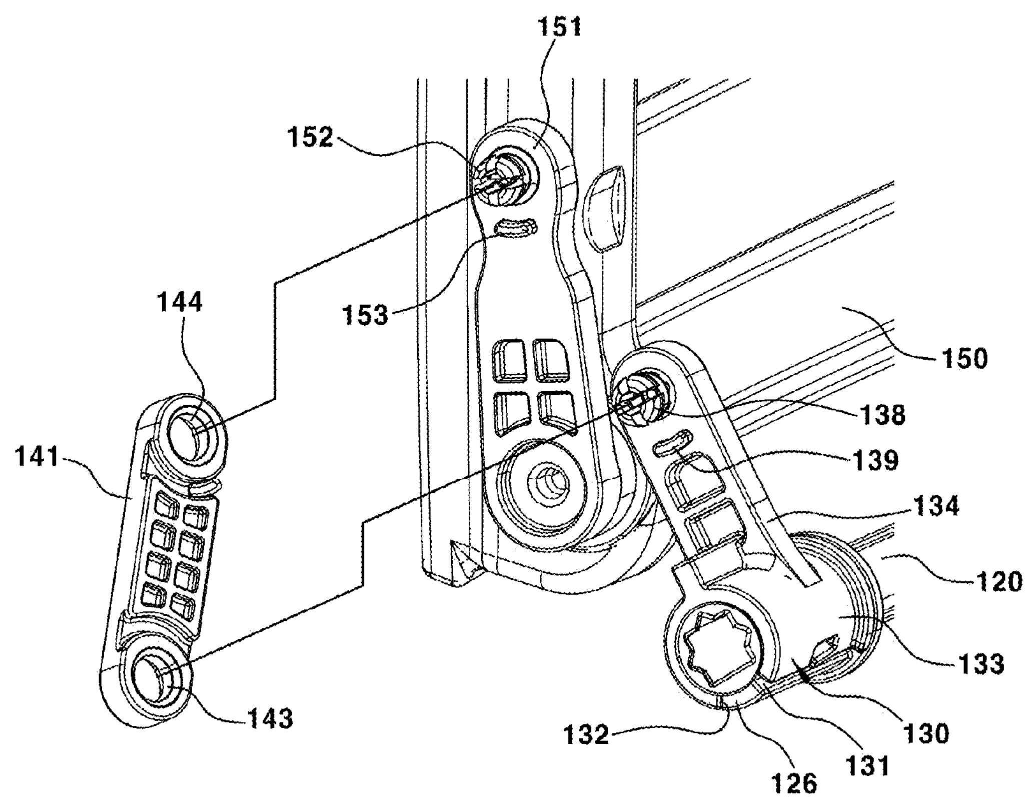


FIG. 5

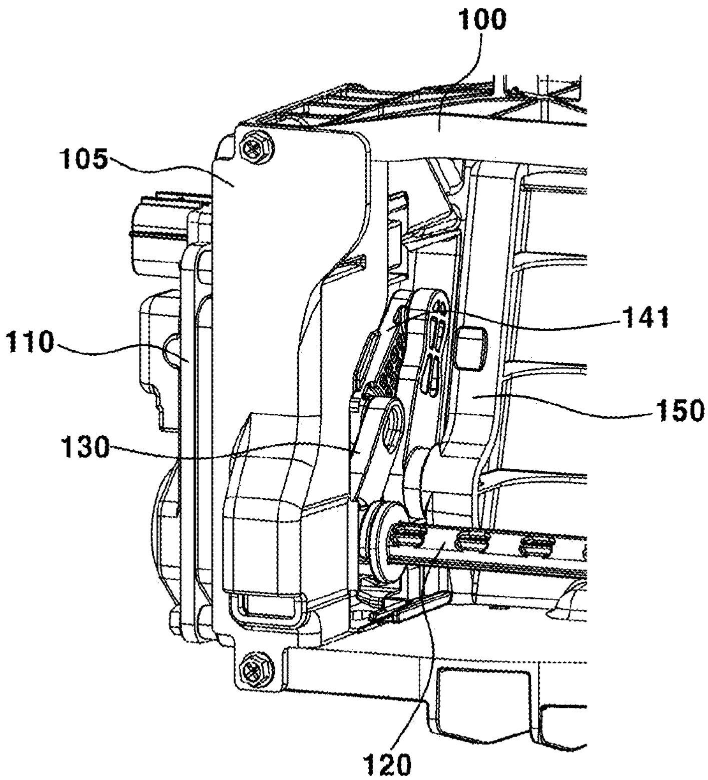


FIG. 6

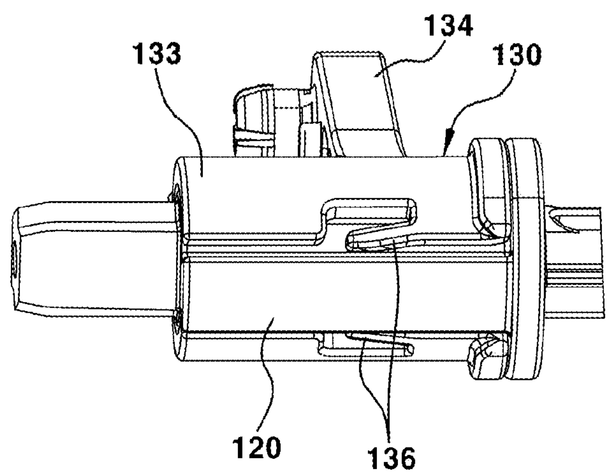


FIG. 7

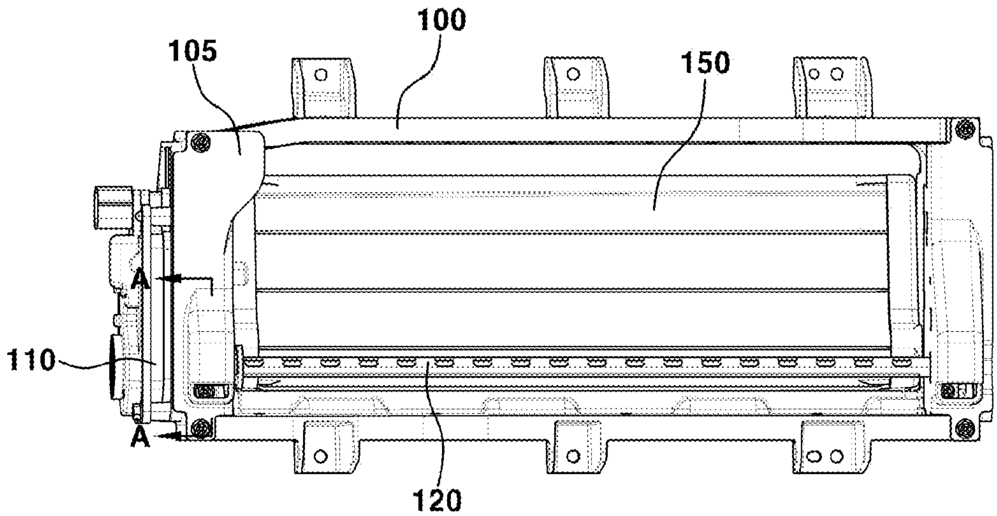


FIG. 8A

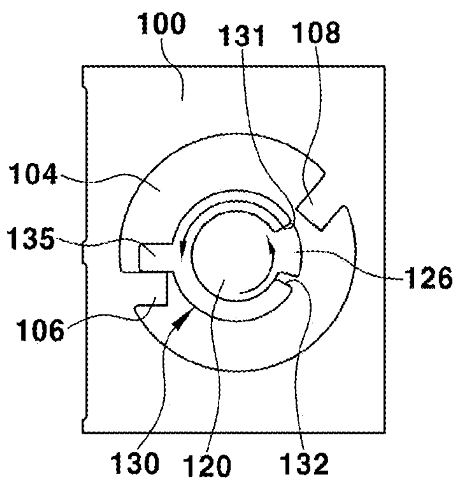
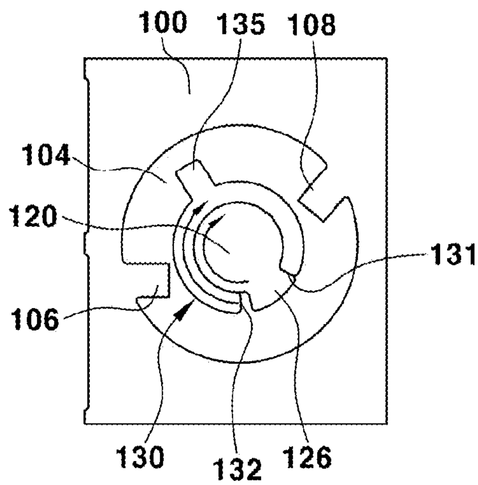
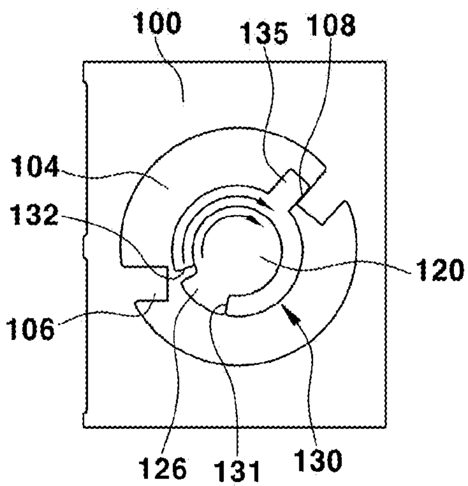


FIG. 8B



100
135
108
104
120
131
106
130
132
126

FIG. 8C



100
135
108
104
132
120
106
126
131
130

FIG. 8D

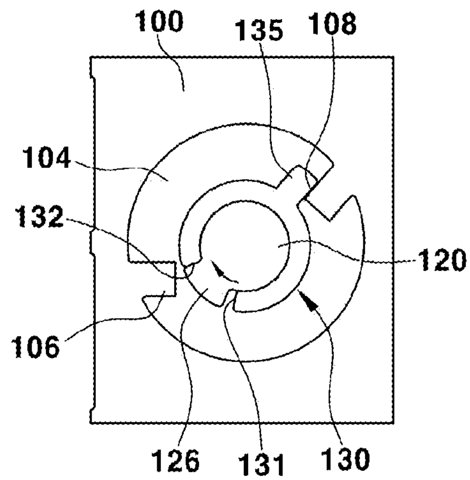


FIG. 9

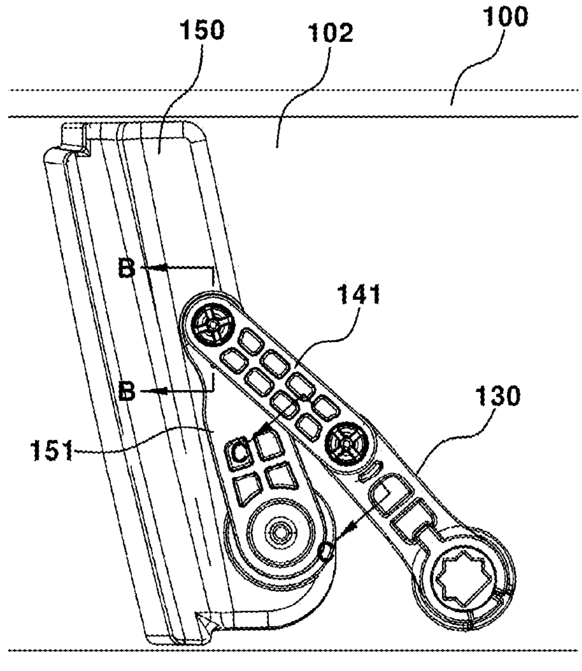


FIG. 10

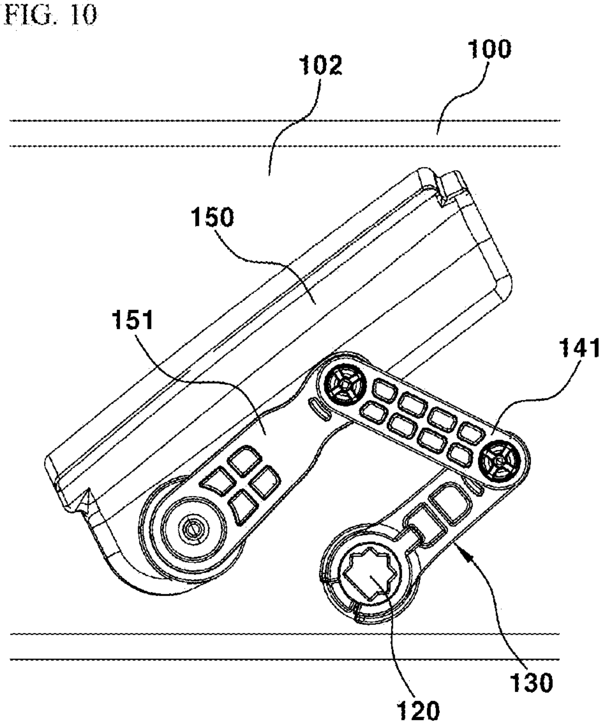


FIG. 11

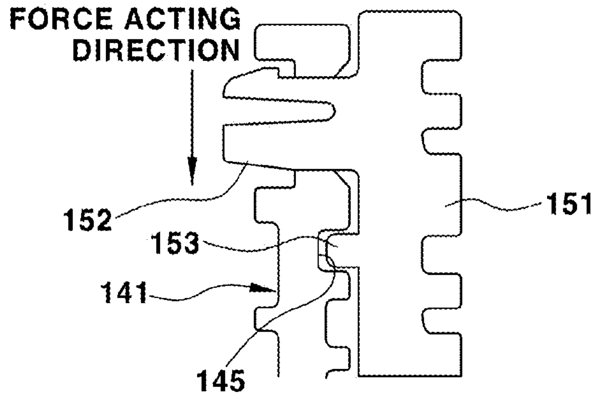
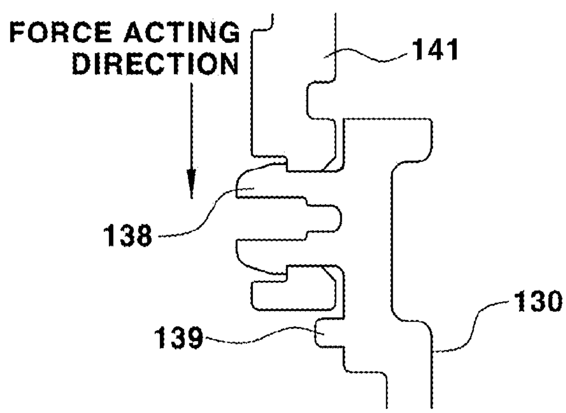

FORCE ACTING
DIRECTION
151
152
153
141
145

FIG. 12


FORCE ACTING
DIRECTION
141
138
130
139

ACTIVE AIR FLAP DEVICE FOR VEHICLE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims, under 35 U.S.C. § 119(a), the benefit of and priority to Korean Patent Application No. 10-2024-0021503, filed on Feb. 15, 2024, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to an active air flap device for a vehicle. More particularly, it relates to an active air flap device for a vehicle capable of preventing aerodynamic loss due to twisting of the active air flap.

BACKGROUND

[0003] An active air flap may be mounted at a predetermined position on a front surface portion of a vehicle and controlled to be closed to block air flowing into a radiator grille or a bumper grille when the temperature of cooling water is equal to or less than a predetermined temperature while travelling, reducing driving resistance caused by air flow to thereby improve vehicle fuel efficiency.

[0004] For example, when the temperature of cooling water for an engine exceeds a predetermined temperature in an internal combustion engine vehicle or, when the temperature of cooling water for cooling a motor or a battery exceeds a predetermined temperature in an electric vehicle, the active air flap may be controlled to be open to allow outside air, such as a travelling wind, to be introduced into a radiator and the like through which cooling water flows, thereby cooling the cooling water flowing through the radiator.

[0005] In some cases, when the temperature of cooling water for the engine is equal to or less than a predetermined temperature in the internal combustion engine vehicle or, when the temperature of cooling water for cooling the motor or the battery is equal to or less than a predetermined temperature in the electric vehicle, the active air flap may be controlled to be closed to block outside air, such as a travelling wind, from flowing into a radiator and the like through a radiator grille or a bumper grille, reducing driving resistance caused by air flow to thereby improve fuel efficiency or battery efficiency of the vehicle.

[0006] In some cases, as the number of electronic components mounted in an electric vehicle increases and thus the performance of a heat exchanger, such as a radiator, needs to be improved, the length of the air passage in the active air flap and the length of the flap are increasing in order to increase the amount of air flowing in through the opening of the radiator grille or bumper grille at the front of the vehicle.

[0007] An active air flap in related art includes a housing having formed therein an air passage, a flap disposed to be openable and closable in the air passage, a drive shaft configured to transmit a rotational driving force to the flap, and an actuator configured to rotate the drive shaft.

[0008] The flap may be rotated to be open or closed through a process of rotating the drive shaft by driving of the actuator and a process of transmitting a rotational force from the drive shaft to the flap.

[0009] In some cases, although the rotational driving force of the actuator is properly transmitted to one end portion of the drive shaft connected to the output portion of the actuator, the rotational driving force is not properly transmitted to another end portion of the drive shaft that is away from the output portion of the actuator, twisting the flap when the rotational driving force is transmitted from the drive shaft to the flap to cause aerodynamic loss.

[0010] For instance, although one end portion of the flap that receives the rotational driving force from the one end portion of the drive shaft may be rotated in a closing direction by a desired extent, the rotational driving force transmitted from the actuator gradually decreases toward the other end portion of the drive shaft, and at the same time, the rotational driving force transmitted from the drive shaft gradually decreases toward another end portion of the flap, causing twisting of the flap in which the other end portion of the flap is rotated approximately 5° to 15° less compared to the one end portion of the flap.

[0011] As such, when the other end portion of the flap is rotated less compared to the one end portion of the flap to twist the flap, a gap is generated between an air passage in a housing and the other end portion of the flap when the flap is closed. This may cause aerodynamic loss, such as, outside air being passed through the gap, thereby limiting the active air flap from performing its original function, which is to block outside air to reduce driving resistance.

SUMMARY

[0012] The present disclosure has been made in an effort to solve the above-described problems associated with the prior art, and an object of the present disclosure is to provide an active air flap device for a vehicle having a structure in which a clutch link is connected between a drive shaft connected to an actuator and a drive link configured to rotate a flap to allow the drive shaft and the clutch link to rotate together to transmit a rotational driving force for opening and closing the flap to the drive link, allowing the clutch link to rotate up to a set angle and the drive shaft to further rotate by an arbitrary angle from the set angle to thereby compensate for a rotation loss in which another end portion of the flap rotates less than one end portion of the flap.

[0013] In one aspect, the present disclosure provides an active air flap device for a vehicle, the device including a housing having formed therein an air passage, a flap disposed to be openable and closable in the air passage, an actuator mounted to one side portion of the housing, a drive shaft connected to the actuator, a clutch link, by being coupled to one end portion of the drive shaft, configured to rotate together with the drive shaft up to a set angle to transmit a rotational driving force to one end portion of the flap, and then to allow the drive shaft to rotate further by an arbitrary angle from the set angle, and a transmission link, by being coupled to another end portion of the drive shaft, configured to rotate by an angle same as the arbitrary angle to transmit the rotational driving force to another end portion of the flap when the drive shaft rotates further by the arbitrary angle.

[0014] In some implementations, the active air flap device may further include a first drive link configured to rotate the flap in an opening or closing direction by being hinged between the clutch link and one side portion of the flap, and a second drive link configured to rotate the flap in the opening or closing direction by being hinged between the transmission link and another side portion of the flap.

[0015] In some implementations, an external gear meshing with an internal gear for output of the actuator may be provided at one end of the drive shaft.

[0016] In some implementations, the clutch link may include a lower fastening tube, having a structure in which a first cut surface and a second cut surface facing each other are spaced apart from each other, being inserted into a through hole formed in one side wall of the housing, and into which the one end portion of the drive shaft is inserted to be fastened, an upper fastening rod coupled to the first drive link by extending from the lower fastening tube, and a stopper protruding from an external side end portion of the lower fastening tube.

[0017] In some implementations, the clutch link may further include an elastic pressing end being pressed to a surface of the drive shaft, at each of the first cut surface and the second cut surface of the lower fastening tube.

[0018] In some implementations, the one end portion of the drive shaft may have formed thereon a rotation compensating end, protruding therefrom and being disposed between the first cut surface and the second cut surface of the clutch link.

[0019] In some implementations, the outer circumferential portion of the through hole in the housing may have formed thereon a first rotation limiting end and a second rotation limiting end, configured to limit a rotation angle of the clutch link rotating together with the drive shaft to a set angle by being brought into contact with the stopper.

[0020] In some implementations, the external surface of the upper end portion of the upper fastening rod of the clutch link may have formed thereon a first hinge fin, and the lower end portion of the first drive link may have formed therein a first hinge hole into which the first hinge fin is inserted.

[0021] In some implementations, a first impact support rib configured to support the lower end portion of the first drive link may protrude from a position below the first hinge fin on the external surface of the upper fastening rod.

[0022] In some implementations, one side surface of the flap may have mounted thereto a fixed link including a second hinge fin, and an upper end portion of the first drive link may have formed therein a second hinge hole into which the second hinge fin is inserted.

[0023] In some implementations, a second impact support rib configured to support the upper end portion of the first drive link by being inserted into a support groove formed in an inner surface of the upper end portion of the first drive link may protrude from a position below the second hinge fin on the fixed link.

[0024] In some implementations, when the drive shaft and the clutch link rotate together, the stopper of the clutch link may be brought into contact with the first rotation limiting end or with the second rotation limiting end to allow the clutch link to rotate up to a set angle of 90°.

[0025] In some implementations, when the drive shaft and the clutch link rotate together up to the set angle and then the drive shaft rotates further by an arbitrary angle from the set angle, the drive shaft may rotate further by the arbitrary angle of 10° from the set angle due to the rotation compensating end being brought into contact with the first cut surface or with the second cut surface of the clutch link.

[0026] In some implementations, the one side portion of the housing may have mounted thereto a protection cover configured to protect the one end portion of the drive shaft, the clutch link, and the first drive link.

[0027] Other aspects and example implementations of the present disclosure are discussed infra.

[0028] It is to be understood that the term "vehicle" or "vehicular" or other similar terms as used herein are inclusive of motor vehicles in general, such as passenger automobiles including sport utility vehicles (SUV), buses, trucks, various commercial vehicles, watercraft including a variety of boats and ships, aircraft, and the like, and include hybrid vehicles, electric vehicles, plug-in hybrid electric vehicles, hydrogen-powered vehicles, and other alternative fuel vehicles (e.g., fuels derived from resources other than petroleum). As referred to herein, a hybrid vehicle is a vehicle that has two or more sources of power, for example, a vehicle powered by both gasoline and electricity.

[0029] The above and other features of the present disclosure are discussed infra.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The above and other features of the present disclosure will now be described in detail with reference to certain exemplary implementations thereof illustrated in the accompanying drawings which are given hereinbelow by way of illustration only, and thus are not limitative of the present disclosure.

[0031] FIG. **1** is a perspective view showing an example of an active air flap in related art.

[0032] FIG. **2** is a perspective view showing another example of an active air flap in related art.

[0033] FIG. **3**A and FIG. **3**B are exploded perspective views illustrating an example of an active air flap device for a vehicle according to the present disclosure.

[0034] FIG. **4** is a perspective view illustrating an example of a connection structure including a clutch link, a first drive link, and a flap of the active air flap device.

[0035] FIG. **5** is an assembled perspective view showing the active air flap device.

[0036] FIG. **6** is an enlarged perspective view showing an example of a main portion of the active air flap device, where the clutch link is coupled to the drive shaft.

[0037] FIG. **7** is a rear view showing the active air flap device.

[0038] FIGS. **8**A to **8**D are cross-sectional views taken along line A-A of FIG. **7**, which sequentially show the operating state of the active air flap device.

[0039] FIG. **9** is a side view illustrating an example of a closed state of the active air flap device.

[0040] FIG. **10** is a side view illustrating an example of an open state of the active air flap device.

[0041] FIG. **11** is a cross-sectional view taken along line B-B of FIG. **9**.

[0042] FIG. **12** is a cross-sectional view taken along line C-C of FIG. **9**.

[0043] In the figures, the reference numbers refer to the same or equivalent parts of the present disclosure throughout the several figures of the drawing.

DETAILED DESCRIPTION

[0044] To help understand the present disclosure, the configuration and operation flow of an active air flap in related art will be described with reference to FIGS. **1** and **2** as follows.

[0045] FIG. **1** illustrates a built-in type active air flap in related art, and FIG. **2** illustrates an external type active air flap in related art.

[0046] For example, the built-in type active air flap in related art includes, as illustrated in FIG. **1**, an actuator **10**, a drive shaft **20** connected to an output portion of the actuator **10**, and a flap **30** mounted to the drive shaft **20**.

[0047] The external type active air flap in related art includes, as illustrated in FIG. **2**, an actuator **10**, a drive shaft **20** connected to an output portion of the actuator **10**, a flap **30** disposed to be openable and closable at an air passage **42** in a housing **40**, and a drive link configured to transmit the rotational driving force of the drive shaft **20** to the flap **30** by being connected between the drive shaft **20** and the flap **30**.

[0048] The rotational driving force of the actuator **10** is properly transmitted to one end portion of the drive shaft **20** connected to the output portion of the actuator **10**. However, because the drive shaft **20** is long, the rotational driving force of the actuator **10** may not be properly transmitted to another end portion of the drive shaft **20** that is away from the output portion of the actuator **10**.

[0049] For example, the rotational driving force F of the actuator **10** is properly transmitted to the one end portion of the drive shaft **20**, allowing the one end portion of the drive shaft **20** to rotate at a set angle of 90°. However, because the rotational driving force F of the actuator **10** may not be properly transmitted to the other end portion of the drive shaft **20** away from the output portion of the actuator **10**, the other end portion of the drive shaft **20** may be rotated at 80°, which is smaller than the set angle.

[0050] In some cases, although one end portion of the flap **30** may be rotated at the set angle of 90° by the rotational driving force F transmitted from the one end portion of the drive shaft **20**, another end portion of the flap **30** is rotated at 80°, which is smaller than the set angle, by the rotational driving force F transmitted from the other end portion of the drive shaft **20**, twisting the flap due to the difference in rotation angle between the one end portion and the other end portion of the flap **30**.

[0051] To be more specific, although the one end portion of the flap that receives the rotational driving force F from the one end portion of the drive shaft **20** may be rotated in a closing direction by the set angle, the rotational driving force transmitted from the actuator **10** gradually decreases toward the other end portion of the drive shaft **20**, and at the same time, the rotational driving force F transmitted from the drive shaft **20** gradually decreases toward the other end portion of the flap **30**, making the other end portion of the flap **30** to rotate approximately 5° to 15° less than the set angle compared to the one end portion of the flap **30**, which may cause twisting of the flap **30**.

[0052] In the state of the flap **30** being twisted due to the other end portion thereof being rotated less than the one end portion thereof, a gap is generated between the air passage **42** in the housing **40** and the other end portion of the flap **30** when the flap **30** is closed, causing aerodynamic loss, such as, outside air being passed through the gap, thereby limiting the flap **30** from performing its original function as blocking outside air by being completely closed to reduce driving resistance.

[0053] The present disclosure provides an active air flap configured to allow not only one end portion of a flap but also another end portion of the flap to be easily rotated to a full closing position, preventing generating a gap between an air passage in a housing and the other end portion of the flap when the flap is closed, and thus preventing aerodynamic loss, such as, outside air being passed through the gap.

[0054] Hereinafter, example implementations of the present disclosure will be described in detail with reference to the accompanying drawings.

[0055] FIGS. **3**A and **3**B and FIGS. **4** and **5** are perspective views illustrating an example of an active air flap device for a vehicle according to the present disclosure.

[0056] In some implementations, as illustrated in FIGS. **3**, **4**, and **5**, a housing **100** has formed therein an air passage **102** passing through the housing **100** in a front-rear direction, and a flap **150** configured to open and close the air passage **102** is rotatably disposed in the air passage **102**.

[0057] An actuator **110** is mounted on the external surface of one side wall of the housing **100**, and a drive shaft **120** having a predetermined length is connected to the actuator **110**.

[0058] More specifically, the drive shaft **120** is disposed in a left-right direction at a position a predetermined distance away from a rear surface portion of the flap **150** and a predetermined height away from a bottom surface of the housing **100**, and one end of the drive shaft **120** passes through a through hole **104** formed in the one side wall of the housing **100** to be connected to the actuator **110**.

[0059] In some implementations, an internal gear **112**, which is an output gear, is mounted in the output portion of the actuator **110**, and an external gear **122** meshing with the internal gear **112** is provided at the one end of the drive shaft **120**.

[0060] With this structure, a rotational force resulting from the driving of the actuator **110** is output to the external gear **122** through the internal gear **112**, thereby rotating the drive shaft **120**.

[0061] Specifically, a clutch link **130** is coupled to the one end portion of the drive shaft **120** to enable simultaneous rotation thereof.

[0062] The clutch link **130** has a structure in which the clutch link **130** rotates together with the drive shaft **120** up to the set angle to transmit the rotational driving force to the one end portion of the flap **150**, and then the drive shaft **120** is further rotated by an arbitrary angle from the set angle.

[0063] In some examples, the clutch link **130** may include a lower fastening tube **133** having a structure in which a first cut surface **131** and a second cut surface **132** facing each other are spaced apart from each other, an upper fastening rod **134** extending upward from the lower fastening tube **133**, and a stopper **135** protruding from an external side end portion of the lower fastening tube **133**.

[0064] The lower fastening tube **133** of the clutch link **130** is rotatably inserted into the through hole **104** formed in the one side wall of the housing **100**, and the one end portion of the drive shaft **120** is inserted to be fastened to the lower fastening tube **133**.

[0065] Here, when the drive shaft **120** rotates as the actuator **110** is driven while the one end portion of the drive shaft **120** is inserted to be fastened to the lower fastening tube **133**, the lower fastening tube **133** may also rotate together therewith, and eventually, the drive shaft **120** and the clutch link **130** may rotate together.

[0066] In some implementations, as illustrated in FIG. **6**, the first cut surface **131** and the second cut surface **132** of the lower fastening tube **133** each may be provided with an elastic pressing end **136** being pressed to the surface of the drive shaft **120**, wherein the elastic pressing ends **136** are integrated with the first cut surface **131** and the second cut surface **132**, respectively.

[0067] Accordingly, the elastic pressing ends **136** of the lower fastening tube **133** are pressed against the surface of the drive shaft **120** by an elastic restoring force, eliminating the gap between the lower fastening tube **133** and the drive shaft **120** to allow easy rotation of the lower fastening tube **133** when the drive shaft **120** rotates as the actuator **110** is driven, and eventually, when the drive shaft **120** rotates, the clutch link **130** including the lower fastening tube **133** and the upper fastening rod **134** may rotate together therewith.

[0068] Here, the clutch link **130** is configured to rotate up to a set angle (e.g.,) 90° when rotating together with the drive shaft **120**.

[0069] In some implementations, as well shown in FIG. **4**, the stopper **135** protrudes from the external side end portion of the lower fastening tube **133**, and as well shown in FIG. **3**A, an outer circumferential portion of the through hole **104** in the housing **100** has a first rotation limiting end **106** and a second rotation limiting end **108**, separated from each other and brought into contact with the stopper **135**.

[0070] With this structure, when the drive shaft **120** rotates as the actuator **110** is driven, the clutch link **130** rotates together therewith but the stopper **135** of the clutch link **130** is brought into contact with the first rotation limiting end **106** or with the second rotation limiting end **108**, limiting the rotation angle of the clutch link **130** rotating together with the drive shaft **120** to the set angle.

[0071] For example, when the drive shaft **120** and the clutch link **130** rotate together, the stopper **135** of the clutch link **130** is brought into contact with the first rotation limiting end **106** or with the second rotation limiting end **108**, allowing the clutch link **130** to rotate only up to the set angle of 90°.

[0072] On the other hand, the drive shaft **120** is configured to rotate further by an arbitrary angle (e.g., 10°), after rotating together with the clutch link **130** up to the set angle.

[0073] In some examples, the one end portion of the drive shaft **120** has a rotation compensating end **126**, protruding therefrom and disposed between the first cut surface **131** and the second cut surface **132** formed at the lower fastening tube **133** of the clutch link **130**.

[0074] Accordingly, when the drive shaft **120** is further rotated by an arbitrary angle from the set angle after the drive shaft **120** and the clutch link **130** are rotated together up to the set angle, the rotation compensating end **126** is brought into contact with the first cut surface **131** or with the second cut surface **132** of the clutch link **130** to determine the arbitrary angle at which the drive shaft **120** is further rotated from the set angle.

[0075] For example, in the state in which the rotational driving force of the actuator **110** is continuously applied to the drive shaft **120** after the one end portion of the drive shaft **120** and the clutch link **130** are rotated together to the set angle of 90°, the one end portion of the drive shaft **120** may be further rotated by the arbitrary angle of 10° from the set angle of 90° until the rotation compensating end **126** is brought into contact with the first cut surface **131** or with the second cut surface **132** of the clutch link **130**.

[0076] Here, when the one end portion of the drive shaft **120** further rotates by the arbitrary angle of 10° from the set angle of 90°, the other end portion of the drive shaft **120** may be rotated up to the set angle of 90°.

[0077] More specifically, the rotational driving force of the actuator **110** may not be properly transmitted to the other end portion of the drive shaft **120** that is away from the output portion of the actuator **110**, rotating the other end portion of the drive shaft **120** up to about 80° when the one end portion of the drive shaft **120** and the clutch link **130** are rotated together to the set angle of 90°. However, as the drive shaft **120** continues to rotate further by the arbitrary angle of 10°, the one end portion of the drive shaft **120** may rotate up to) 100° (90°+10°), and at the same time, the other end portion of the drive shaft **120** may rotate up to the set angle of) 90° (80°+10°).

[0078] In some examples, as in FIG. **3**B, a transmission link **124** is integrally fastened to the other end portion of the drive shaft **120**, and when the other end portion of the drive shaft **120** is further rotated by an arbitrary angle (e.g., 10°), the transmission link **124** serves to transmit the rotational driving force to the other end portion of the flap **150** while rotating by the same angle as the arbitrary angle.

[0079] Therefore, when the one end portion of the drive shaft **120** rotates together with the clutch link **130**, the clutch link **130** may transmit the rotational driving force to the one end portion of the flap **150** while rotating by the set angle of 90°, and in addition thereto, the drive shaft **120** rotates further by an arbitrary angle (e.g., 10°) from the set angle, allowing the other end portion of the drive shaft **120** and the transmission link **124** to rotate by the set angle of 90° (80°+10°) to transmit the rotational driving force to the other end portion of the flap **150**.

[0080] In some examples, so as to transmit the rotational driving force to the one end portion of the flap **150**, a first drive link **141** configured to rotate the one end portion of the flap **150** in an opening or closing direction may be hinged between the upper fastening rod **134** of the clutch link **130** and a fixed link **151** mounted on one side surface of the flap **150**, and so as to transmit the rotational driving force to the other end portion of the flap **150**, a second drive link **142** configured to rotate the other end portion of the flap **150** in the opening or closing direction may be hinged between the transmission link **124** and a fixed link **151** mounted to another side surface of the flap **150**.

[0081] With this structure, as the clutch link **130** rotates forward by the set angle to rotate the first drive link **141** in a closing direction, the first drive link **141** pushes the one end portion of the flap **150** in the closing direction, and as the transmission link **124** rotates forward by the set angle to rotate the second drive link **142** in the closing direction, the second drive link **142** pushes the other end portion of the flap **150** in the closing direction. By doing so, the flap **150** may be placed in a closed position where the flap **150** closes the air passage **102** in the housing **100**, as illustrated in FIG. **9**.

[0082] In some examples, as the clutch link **130** rotates rearward by the set angle to rotate the first drive link **141** in an opening direction, the first drive link **141** pulls the one end portion of the flap **150** in the opening direction, and as the transmission link **124** rotates rearward by the set angle to rotate the second drive link **142** in the opening direction, the second drive link **142** pulls the other end portion of the flap **150** in the opening direction. Accordingly, the flap **150** may be placed in an open position where the flap **150** opens the air passage **102** in the housing **100**, as illustrated in FIG. **10**.

[0083] In some examples, as illustrated in FIG. **5**, one side portion of the housing **100** has detachably mounted thereto a protection cover **105** configured to protect the one end portion of the drive shaft **120**, the clutch link **130**, the first drive link **141**, etc.

[0084] Accordingly, the protection cover **105** may block foreign substances from being introduced into the one end portion of the drive shaft **120**, the clutch link **130**, the first drive link **141**, etc. in normal times, and may be detached during maintenance for the one end portion of the drive shaft **120**, the clutch link **130**, the first drive link **141**, etc.

[0085] Here, the operation flow for the active air flap device for a vehicle of the present disclosure having the structure as described above is as follows.

[0086] In some implementations, as illustrated in FIG. **8**A, in the state the flap **150** is in the open position where the air passage **102** in the housing **100** is open, the stopper **135** of the clutch link **130** is kept being brought into contact with the first rotation limiting end **106** of the housing **100**, and the rotation compensating end **126** of the drive shaft **120** is kept being brought into contact with the first cut surface **131** of the clutch link **130**.

[0087] Thereafter, when the rotational driving force is transmitted to the drive shaft **120** of the actuator **110** to close the flap **150**, the one end portion of the drive shaft **120** and the clutch link **130** rotate together to a set angle (e.g., 90°).

[0088] To be more specific, because the one end portion of the drive shaft **120** is inserted to be fastened to the lower fastening tube **133** of the clutch link **130**, the one end portion of the drive shaft **120** and the clutch link **130** rotate together to the set angle (e.g., 90°) as illustrated in FIGS. **8**B and **8**C, and as the stopper **135** of the clutch link **130** is brought into contact with the second rotation limiting end **108** of the housing **100** as illustrated in FIG. **8**C, the clutch link **130** rotates only up to the set angle (e.g., 90°).

[0089] Here, because the rotational driving force of the actuator **110** may not be properly transmitted to the other end portion of the drive shaft **120** that is away from the output portion of the actuator **110**, the other end portion of the drive shaft **120** is rotated up to about 80° when the one end portion of the drive shaft **120** and the clutch link **130** are rotated together to the set angle of 90°.

[0090] Subsequently, as the rotational driving force of the actuator **110** continues to be applied to the drive shaft **120** after the one end portion of the drive shaft **120** and the clutch link **130** are rotated together to the set angle of 90°, the one end portion of the drive shaft **120** is, as illustrated in FIG. **8**D, further rotated by an arbitrary angle of 10° from the set angle of 90° until the rotation compensating end **126** is brought into contact with the second cut surface **132** of the clutch link **130**.

[0091] At the same time, when the one end portion of the drive shaft **120** is further rotated by the arbitrary angle of 10° from the set angle of 90°, the other end portion of the drive shaft **120** is rotated by the set angle of 90°.

[0092] More specifically, the rotational driving force of the actuator **110** may not be properly transmitted to the other end portion of the drive shaft **120** that is away from the output portion of the actuator **110**, rotating the other end portion of the drive shaft **120** only up to about 80° when the one end portion of the drive shaft **120** and the clutch link **130** are rotated together to the set angle of 90°. However, as the drive shaft **120** continues to rotate further by the arbitrary angle of 10°, the one end portion of the drive shaft **120** may rotate up to) 100° (90°+10°), and at the same time, the other end portion of the drive shaft **120** may rotate up to the set angle of 90° (80°+10°).

[0093] Therefore, when the one end portion of the drive shaft **120** rotates together with the clutch link **130**, the clutch link **130** rotates up to the set angle of 90° to transmit the rotational driving force for full closing to the one end portion of the flap **150** via the first drive link **141** and the fixed link **151**, and together therewith, the drive shaft **120** rotates further by an arbitrary angle (e.g., 10°) from the set angle, allowing the other end portion of the drive shaft **120** and the transmission link **124** to rotate by the set angle of 90° (80°+10°) and transmitting the rotational driving force for full closing to the other end portion of the flap **150** via the second drive link **142** and the fixed link **151**.

[0094] For example, as the rotational driving force generated when the clutch link **130** rotates by the set angle of 90° is transmitted to the one end portion of the flap **150** via the first drive link **141** and the fixed link **151**, the one end portion of the flap **150** may rotate by the set angle of 90° for full closing, and together therewith, the drive shaft **120** rotates further by an arbitrary angle (e.g., 10°) from the set angle, allowing the rotational driving force generated when the other end portion of the drive shaft **120** and the transmission link **124** rotate by the set angle of 90° (80°+10°) to be transmitted to the other end portion of the flap **150** via the second drive link **142** and the fixed link **151**, so that the other end portion of the flap **150** may also rotate by the set angle of 90° for full closing.

[0095] Accordingly, the one end portion and the other end portion of the flap **150** are rotated at the same angle for opening and closing, preventing twisting of the flap due to the other end portion of the flap being rotated approximately 5° to 15° less than the set angle compared to the one end portion of the flap, which was a problem in the prior art.

[0096] Moreover, the one end portion of the flap **150** and the other end portion of the flap **150** are easily rotated at the same angle to the closed position, preventing generating a gap between the air passage **102** in the housing **100** and the other end portion of the flap **150** when the flap is closed, thereby preventing aerodynamic loss, such as, outside air passing through the gap.

[0097] As such, so as to compensate for the rotation loss in the prior art in which the other end portion of the flap rotates less than the one end portion of the flap and fails to reach the closed position, the clutch link **130** is rotated up to the set angle and the drive shaft **120** connected to the actuator **110** is further rotated by an arbitrary angle from the set angle, allowing the one end portion of the flap **150** and the other end portion of the flap **150** to rotate at the same angle to the closed position. Moreover, when closing the flap **150**, the air passage **102** in the housing **100** may be completely blocked without creating a gap, and thus the original function of the active air flap, which is to reduce driving resistance caused by air flow, may be performed accurately without any errors.

[0098] Referring to FIG. **4**, a first hinge fin **138** is formed on the external surface of the upper end portion of the upper fastening rod **134** of the clutch link **130**, and a first hinge hole **143** into which the first hinge fin **138** is inserted is formed in the lower end portion of the first drive link **141**.

[0099] Furthermore, at a position below the first hinge fin **138** on the external surface of the upper fastening rod **134**, a first impact support rib **139** configured to support the lower end portion of the first drive link **141** is formed to protrude therefrom.

[0100] With this structure, even when a vertical external force acts on the first drive link **141** in the state where the flap **150** is closed, the first impact support rib **139** performs, as illustrated in FIG. **12**, buffering and supporting actions to support the first drive link **141**, preventing damage to the first drive link **141**, the first hinge fin **138**, etc.

[0101] Referring to FIG. **4**, the one side surface of the flap **150** has mounted thereto the fixed link **151** including a second hinge fin **152**, and the upper end portion of the first drive link **141** has formed therein a second hinge hole **144** into which the second hinge fin **152** is inserted.

[0102] Moreover, at a position below the second hinge fin **152** on the fixed link **151**, a second impact support rib **153** configured to support the upper end portion of the first drive link **141** by being inserted into a support groove **145** formed in an inner surface of the upper end portion of the first drive link **141** is formed to protrude therefrom.

[0103] Therefore, even when a vertical external force acts on the first drive link **141** in the state where the flap **150** is closed, the second impact support rib **153** is inserted, as illustrated in FIG. **11**, into the support groove **145** in the first drive link **141** to perform buffering and supporting actions to support the upper end portion of the first drive link **141**, preventing damage to the first drive link **141**, the second hinge fin **152**, etc.

[0104] As is apparent from the above description, the present disclosure provides the following effects.

[0105] In some implementations, when a drive shaft connected to an actuator and a clutch link fastened to the drive shaft rotate together to transmit a rotational driving force for opening and closing a flap to a drive link, the clutch link is rotated up to a set angle, and the drive shaft is further rotated by an arbitrary angle from the set angle, compensating for a rotation loss in which another end portion of the flap rotates less than one end portion of the flap.

[0106] For example, to compensate for the rotation loss in which the other end portion of the flap rotates less than the one end portion of the flap and fails to reach a closed position, the clutch link is rotated up to the set angle, and the drive shaft connected to the actuator is further rotated by the arbitrary angle from the set angle, allowing not only the one end portion of the flap but also the other end portion of the flap to be easily rotated up to the closed position.

[0107] In some implementations, not only the one end portion of the flap but also the other end portion of the flap are easily rotated up to the closed position, preventing generating a gap between an air passage in a housing and the other end portion of the flap when the flap is closed, and thus preventing aerodynamic loss, such as, outside air passing through the gap.

[0108] In some implementations, when closing the flap, the air passage in the housing may be completely covered to block outside air, such as a travelling wind, from being introduced into a radiator, etc., allowing the original function of the active air flap, which is to reduce driving resistance caused by air flow, to be performed accurately without any errors.

[0109] Although the present disclosure has been described in detail with reference to one implementation, the scope of the present disclosure is not limited to the above-described implementation, and various modifications and improvements by those skilled in the art based on the basic concept of the present disclosure as defined in the claims below will also be included in the scope of the present disclosure.

What is claimed is:

1. An active air flap device for a vehicle, the device comprising:
- a housing that defines an air passage therein;
- a flap configured to open and close the air passage;
- an actuator disposed at a first side portion of the housing;
- a drive shaft connected to the actuator;
- a clutch link coupled to a first end portion of the drive shaft and configured rotate together with the drive shaft to a set angle to thereby transmit a rotational driving force of the actuator to a first end portion of the flap, the clutch link being configured to allow the drive shaft to rotate further by an arbitrary angle from the set angle; and
- a transmission link coupled to a second end portion of the drive shaft and configured to rotate by the arbitrary angle to thereby transmit the rotational driving force to a second end portion of the flap based on the drive shaft rotating further by the arbitrary angle from the set angle.

2. The device of claim **1**, further comprising:
- a first drive link hinged between the clutch link and the first side portion of the flap and configured to rotate the flap in an opening direction or a closing direction; and
- a second drive link hinged between the transmission link and a second side portion of the flap and configured to rotate the flap in the opening direction or the closing direction.

3. The device of claim **1**, wherein the actuator comprises an internal gear configured to output the rotational driving force, and
- wherein the drive shaft comprises an external gear that is disposed at an end of the drive shaft and meshes with the internal gear.

4. The device of claim **2**, wherein the clutch link comprises:
- a lower fastening tube that receives and fastens the first end portion of the drive shaft, the lower fastening tube having a first cut surface and a second cut surface that face each other and are spaced apart from each other, the lower fastening tube being inserted into a through hole defined at a side wall of the housing;
- an upper fastening rod that extends from the lower fastening tube and is coupled to the first drive link; and
- a stopper that protrudes from an external side end portion of the lower fastening tube.

5. The device of claim **4**, wherein the clutch link further comprises an elastic pressing end that is disposed at each of the first cut surface and the second cut surface and configured to pressed by a surface of the drive shaft.

6. The device of claim **4**, wherein the drive shaft has a rotation compensating end that protrudes from the first end portion of the drive shaft and is disposed between the first cut surface and the second cut surface of the clutch link.

7. The device of claim **4**, wherein the housing comprises a first rotation limiting end and a second rotation limiting end that are disposed at an outer circumferential portion of the through hole of the housing and configured to contact the stopper to thereby limit a rotation angle of the clutch link rotating together with the drive shaft to the set angle.

8. The device of claim **4**, wherein the clutch link further comprises a first hinge fin disposed at an external surface of an upper end portion of the upper fastening rod of the clutch link, and

wherein the first drive link defines a first hinge hole at a lower end portion of the first drive link, the first hinge hole receiving the first hinge fin.

9. The device of claim **8**, wherein the clutch link further comprises a first impact support rib that is disposed below the first hinge fin on the external surface of the upper fastening rod and configured to support the lower end portion of the first drive link.

10. The device of claim **4**, further comprising a fixed link that is disposed at a side surface of the flap and comprises a second hinge fin,

wherein the first drive link define a second hinge hole at an upper end portion of the first drive link, the second hinge hole receiving the second hinge fin.

11. The device of claim **10**, wherein the fixed link further comprises a second impact support rib that is disposed at a position below the second hinge fin and configured to support the upper end portion of the first drive link, the second impact support rib protruding from the fixed link, and

wherein the first drive link defines a support groove at an inner surface of the upper end portion of the first drive link, the support groove receiving the second impact support rib.

12. The device of claim **7**, wherein the stopper of the clutch link is configured to, based on the drive shaft and the clutch link rotating together, be brought into contact with the first rotation limiting end or the second rotation limiting end to thereby allow the clutch link to rotate to the set angle of 90°.

13. The device of claim **6**, wherein the drive shaft is configured to rotate further by the arbitrary angle of 10° from the set angle based on the rotation compensating end being brought into contact with the first cut surface or the second cut surface of the clutch link.

14. The device of claim **4**, further comprising a protection cover that is disposed at the first side portion of the housing and covers the first end portion of the drive shaft, the clutch link, and the first drive link.

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