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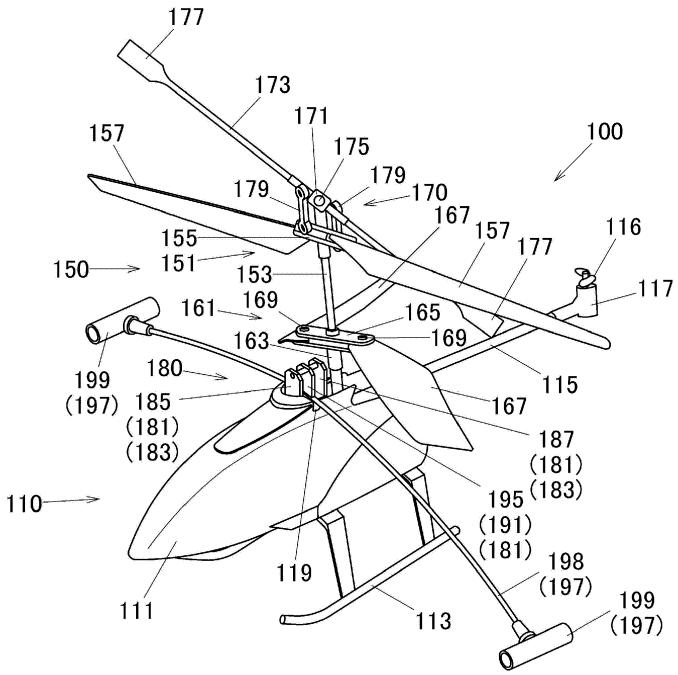
## (54) TOY HELICOPTER AND BALANCING DEVICE THEREFOR

(57) A toy helicopter configured to enhance a lateral stability by eliminating quickly a lateral tilt of a fuselage to restore its normal state includes a fuselage having a main body portion, a main rotor disposed above the main body portion and a balancing device fixed to an upper portion of the main body portion, the balancing device includes a long balance rod extending laterally across the fuselage, the balance rod has a protuberant portion at each end thereof and is allowed to oscillate so as to be held horizontal even though the fuselage is caused to tilt, and the balance rod is supported at a central portion thereof by a support portion.

FIG.1

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## Description

**[0001]** This application is based upon and claims the benefit of priority under 35 USC 119 of Japanese Patent Application No. 2016-205065 filed on October 19, 2016, the entire disclosure of which, including the specification, claims, drawings and abstract, is incorporated herein by reference.

**[0002]** The present invention relates to a toy helicopter which is remote controlled to fly and a balancing device which enables the toy helicopter to fly in a stabilized fashion.

**[0003]** In these days, various types of helicopter toys which are flown inside or outside a building have been proposed and provided in reality.

**[0004]** In many cases, these toy helicopters are radio controlled using infrared radiation or the like to operate in several ways or to rise, descend, hover, travel forwards and turn (for example, refer to Japanese Unexamined Patent Application No. 2010-075568 or JP-A-2010-075568, Japanese Unexamined Patent Application No. 2007-191144 or JP-A-2007-191144, and Japanese Unexamined Patent Application No. 2007-130200 or JP-A-2007-130200).

**[0005]** In remote-controlled toy helicopters which are flown indoors, various devices are provided to enhance the flying stability in hovering, for example.

**[0006]** For example, a toy helicopter described in JP-A-2010-075568 has main rotors provided left and right above a fuselage of the toy helicopter. Rotor masts or shafts of the right rotor and the left rotor are provided right and left of the fuselage while being inclined in such a way that the rotor shafts open laterally greater at tops than at bottoms so that the rotor shafts are formed into a V-like shape. Consequently, the toy helicopter can rise, descend, hover, travel forwards and turn in the air stably with the simple construction.

**[0007]** In addition, a toy helicopter described in JP-A-2007-191144 has an auxiliary rotor above a main rotor which is provided on an upper portion of a fuselage of the toy helicopter in place of a stabilizer. Then, the auxiliary rotor is attached to a rotating shaft of the main rotor at such an angle that center axes of the auxiliary rotor and the main rotor intersect each other. Additionally, the auxiliary rotor is attached to the rotating shaft of the main rotor so that the center axis thereof can oscillate in an up-down direction. Further, the main rotor is attached to the rotating shaft thereof so that a pitch angle is variable which enables a horizontal height of the main rotor to differ between a front end and a rear blade end of the main rotor.

**[0008]** In this toy helicopter described in JP-A-2007-191144, the main rotor and the auxiliary rotor are connected together by a linking device, whereby the pitch angle of the main rotor is changed based on the rotating position of the main rotor when the center axis of the auxiliary rotor oscillates relative to the rotating shaft of the main rotor. Consequently, when the fuselage of the toy helicopter or the rotating plane of the main rotor is inclined, the pitch angle is changed based on the rotating position of the main rotor by the auxiliary rotor which always rotates in a horizontal plane so that the inclined rotating shaft of the main rotor, that is, the inclined fuselage of the toy helicopter is corrected, thereby making it possible for the toy helicopter to rise, descend, hover, travel forwards and turn in a stable fashion.

**[0009]** A toy helicopter described in JP-A-2007-130200 has an upper main rotor and a lower main rotor which rotate in opposite directions at an upper portion of a fuselage of the toy helicopter. Then, a stabilizer is provided below the upper main rotor so as to control a pitch angle of the upper main rotor to thereby enhance the flying stability of the toy helicopter. Further, the lower main rotor is constructed so that a pitch angle thereof can be changed in four or front, rear, left and right directions. Consequently, the toy helicopter can fly to rise, descend, hover, travel forwards and rearwards and turn. Further, the toy helicopter can fly laterally to the left and right while kept at the same height.

**[0010]** As described above, the toy helicopters can easily be controlled to fly indoors in a stable fashion.

**[0011]** Even inside a building, when the fuselage of the toy helicopter is caused to lose the stability in flight by such disturbance as a flow or air resulting from convection or a gentile wind, the flight of the toy helicopter is destabilized, resulting in a risk of the toy helicopter colliding against a wall or crashing onto a floor of the building.

**[0012]** In addition, when controlling the toy helicopter to take off, in the event that the main rotor is radically rotated at quick speeds in an attempt to ascend the fuselage of the toy helicopter quickly, vibrations or oscillations are generated in the fuselage of the toy helicopter by the reaction of the rotating main rotor, whereby the balance of the fuselage of the toy helicopter is lost, making it difficult for the toy helicopter to take off.

**[0013]** Many of those toy helicopters can be controlled to rise, descend, travel forwards and rearwards, hover and turn. However, only some of those toy helicopters can be controlled to fly laterally to the left and right while kept at the same height. Owing to this, when the fuselage of the toy helicopter is caused to tilt laterally to the left or right due to the disturbance or the lost of its balance, the toy helicopter cannot be controlled to restore its proper posture, resulting in a crash in many cases.

**[0014]** The present invention has been made in view of these situations, and an object thereof is to provide a toy helicopter which can enhance the stability in flight in lateral directions by reducing the inclination of a fuselage thereof to the left or right and restoring its proper posture from an inclined state in case the fuselage is inclined, while solving the problem described above.

**[0015]** According to an aspect of the invention, there is provided a toy helicopter including a fuselage which includes a main body portion and a balancing device which is fixed to the main body portion, wherein the balancing device includes a long balance rod which extends

in a left-right direction of the fuselage, and wherein the balance rod has a protuberant portion at each end thereof and is provided so as to oscillate on the fuselage.

**[0016]** According to another aspect of the invention, there is provided a balancing device for a toy helicopter having a support main body portion having a flat fixing plate and an oscillating support portion which is configured to oscillate relative to the support main body portion, wherein a long balance rod having a protuberant portion at each end thereof is supported at a central portion thereof by the oscillating support portion to thereby allow the balance rod to be attached to the support main body portion so as to oscillate.

**[0017]** Since the toy helicopter according to the invention has the long balance rod extending in the left-right direction of the fuselage and having the protuberant portion as each end thereof which is provided thereon so as to oscillate, the inclination of the fuselage to the left or right can be stabilized by the balance rod which maintains the horizontality.

**[0018]** In addition, the toy helicopter balancing device in which the long balance rod having the protuberant portion at each end thereof is supported in an oscillating fashion by the support main body portion having the fixing plate can easily be attached to an upper portion of the fuselage of the toy helicopter by the fixing plate to thereby enhance the stability in flight of the toy helicopter.

Fig. 1 is a perspective view of a toy helicopter according to an embodiment of the invention.

Fig. 2 is a front view of the toy helicopter according to the embodiment of the invention.

Fig. 3A is a plan view of the toy helicopter according to the embodiment of the invention.

Fig. 3B is an enlarged view of a circle portion A in Fig. 3A which shows main parts of a stabilizer and an upper rotor.

Fig. 4 is a partially sectional side view showing the toy helicopter according to the embodiment of the invention.

Figs. 5A to 5C show modified examples of protuberant portions which are provided on a balance rod of a balancing device which is used for the toy helicopter according to the embodiment of the invention.

Fig. 6 is a perspective view showing a main part of the balancing device provided on the toy helicopter according to the embodiment of the invention.

Fig. 7A shows an oscillating state of the balancing device provided on the toy helicopter according to the embodiment of the invention, in which an oscillating support portion oscillates to the right (a fuselage of the toy helicopter, that is, a fixed support portion tilts to the left).

Fig. 7B shows a state in which the oscillating support portion oscillates to the left (the fuselage, that is, the fixed support portion tilts to the right).

Fig. 8A shows a tilting state of the toy helicopter according to the embodiment of the invention, in which the toy helicopter stays horizontal.

Fig. 8B shows a tilting state of the toy helicopter according to the embodiment of the invention, in which the toy helicopter tilts to one side.

**[0019]** As shown in Figs. 1 and 2, a toy helicopter according to an embodiment of the invention is a toy helicopter 100 which has a twin-rotor, oppositely rotating main rotor 150 provided at an upper central portion of a fuselage 110 of the toy helicopter 100. The toy helicopter 100 also includes a rear rotor 116 at a rear end portion of a tail boom 115, and this rear rotor 116 rotates on a horizontal plane. The toy helicopter 100 further includes a balancing device 180 provided at an upper portion of a main body portion 111 which simulates a cabin, and in this balancing device 180, a balance rod 197, which extends from the main body portion 111 laterally to the left and right, is supported so as to oscillate by a support portion 181.

**[0020]** When a front-rear or up-down direction is referred to in the description of the embodiment, these directions are determined based on an understanding that a nose side of the toy helicopter 100 is referred to as a front and a side of the toy helicopter 100 where the main rotor 150 is provided is referred to as an upper side. In addition, when the left or right is referred to in relation to the toy helicopter 100 in the description, although the toy helicopter 100 has a laterally symmetrical external appearance, the left and right are referred to based on a state in which the fuselage 110 is seen from a front thereof.

**[0021]** The toy helicopter 100 has a landing member 113 which takes the form of a skid below the main body portion 111 which simulates a cabin and includes the fuselage 110 having the main body portion 111 and the pipe-shaped tail boom 115 provided at the rear of the main body portion 111. In addition, the toy helicopter 100 has a rear rotor motor 117 at a rear end of the tail boom 115 and the rear rotor 116 which is fixed to a motor shaft of the rear rotor motor 117.

**[0022]** The main rotor 150 above the fuselage 110 is made up of an upper rotor 151 and a lower rotor 161 which is disposed below the upper rotor 151, and the upper rotor 151 and the lower rotor 161 rotate in opposite directions.

**[0023]** The lower rotor 116 has a lower rotor shaft 163 which projects upwards from the main body portion 111 in a position which lies slightly rearwards of a center of the main body portion 111, and two lower rotor blades 167 are attached to the lower rotor shaft 163 by a lower rotor head 165 which is provided at an upper end of the lower rotor shaft 163.

**[0024]** The upper rotor 151 has an upper rotor shaft 153 which is concentric with the lower rotor shaft 163 and which penetrates the lower rotor shaft 163, and two upper rotor blades 157 are attached to the upper rotor shaft 153 by an upper rotor head 155 which is provided near an upper end of the upper rotor shaft 153.

**[0025]** In attaching the two lower rotor blades 167 to the lower rotor shaft 163 by the lower rotor head 165, the lower rotor head 165 is used in which short side portions which constitute longitudinal end portions of a rectangular shape are formed into semi-circular arc-like shapes, and the lower rotor blades 167 are attached rotatably to the lower rotor head 165 in positions lying near longitudinal end portions thereof by blade pins 169. Namely, respective distal end portions of the lower rotor blades 167 are allowed to rotate back and forth relative to the lower rotor head 165 in a horizontal plane about the corresponding blade pins 169.

**[0026]** Similarly, in attaching the two upper rotor blades 157 to the upper rotor shaft 153 by the lower rotor head 155, too, the upper rotor head 155 is used in which short side portions which constitute longitudinal end portions of a rectangular shape are formed into semi-circular arc-like shapes, and the upper rotor blades 157 are attached rotatably to the upper rotor head 155 in positions lying near longitudinal end portions thereof by blade pins 169, whereby respective distal end portions of the upper rotor blades 157 are allowed to rotate back and forth relative to the upper rotor head 155 about the corresponding blade pins 169.

**[0027]** Consequently, while the upper rotor 151 and the lower rotor 161 are rotating, the two upper rotor blades 157 and the two lower rotor blades 167 rotate about the upper rotor head 155 and the lower rotor head 165, respectively, in such a way that the two upper rotor blades 157 and the two lower rotor blades 167 both extend into a straight line due to a centrifugal force acting thereon by means of their own weights. Then, when a distal end of one of the upper rotor blades 157 or the lower rotor blades 167 hits an obstacle such as a wall, the upper rotor blade 157 or the lower rotor blade 167 which hits the obstacle rotates about the blade pin 169 in such a way that a rotating speed at the distal end of the rotor blade in question becomes slower due to an external force exerted thereon by the obstacle. Because of this, an impact generated by the external force can be prevented from being exerted on the upper rotor head 155 or the lower rotor head 165 and hence to the upper rotor shaft 153 or the lower rotor shaft 163.

**[0028]** In the upper rotor 151, the rectangular upper rotor head 155 whose longitudinal ends are formed semi-circular is attached to the upper rotor shaft 153 so as to rotate about a longitudinal axis (a major axis) which passes a center of the upper rotor head 155 as a rotating axis. Consequently, a pitch angle or an angle of elevation of the upper rotor blades 157 can be varied by the oscillation of the upper rotor head 155 about the rotating shaft.

**[0029]** Namely, in the case of the upper rotor head 155 staying horizontal, the two upper rotor blades 157 which are attached to the upper rotor head 155 by the blade pins 169 are given the same pitch angle, so that a front end edge of each rotor blade is positioned higher than a rear end edge thereof.

**[0030]** However, in the event that the upper rotor head 155 is rotated about the major axis of the upper rotor head 155 to be tilted, of the two upper rotor blades 157, one upper rotor blade 157 rotates so to raise its front end edge to thereby increase the pitch angle. The other upper rotor blade 157 rotates so as to lower its front end edge to thereby decrease the pitch angle.

**[0031]** Then, a stabilizer 170 is provided at the upper end of the upper rotor shaft 153. The stabilizer 170 is such that a stabilizer rod 173 which is shorter in length than overall lengths of the upper rotor 151 and the lower rotor 161 is attached to the upper end of the upper rotor shaft 153 by a stabilizer head 171.

**[0032]** Further, counterweights 177 are provided individually at ends of the stabilizer rod 173, and additionally, rod-like link shafts 179 are provided so as to connect sides of the stabilizer head 171 and sides of the upper rotor head 155 together.

**[0033]** As shown in Fig. 3A and more particularly in an ellipse A in Fig. 3B which is an enlarged view showing main parts of the stabilizer 170 and the upper rotor 151, the stabilizer head 171 is attached to a boss 176 which is provided at the upper end of the upper rotor shaft 153 by using a stabilizer pin 175, so that an axial direction of the stabilizer rod 173 intersects an axial direction of the stabilizer pin 175 at right angles, whereby the ends of the stabilizer rod 173 can oscillate up and down about the stabilizer pin 175 as an oscillation center.

**[0034]** Then, a direction which intersects both the axial directions of the stabilizer rod 173 and the stabilizer pin 175 which are at right angles to each other is referred to as the major axis direction of the upper rotor head 155, and the link shafts 179 are disposed on the sides of the upper rotor head 155.

**[0035]** Consequently, when the stabilizer rod 173 oscillates about the stabilizer pin 175 as an oscillation center, for example, causing a right end portion of the stabilizer rod 173 to tilt downwards in Fig. 3B, a right obliquely upper straight-line edge 155a of the upper rotor head 155 which is connected to the stabilizer head 171 with the link shafts 179 is pushed downwards, while a left obliquely lower straight-line edge 155b of the upper rotor head 155 is pulled upwards.

**[0036]** Owing to this, in the upper rotor 151, the pitch angle is decreased as a result of a front end edge of the right upper rotor blade 157 shown in Figs. 3A and 3B being pushed downwards, while the pitch angle is increased as a result of a rear end edge of the left upper rotor blade 157 being pushed downwards.

**[0037]** Further, as shown in Fig. 1 and the like, the balancing device 180 is attached to an upper portion of the main body portion 111 of the fuselage 110 in a position lying extremely near and ahead of the lower rotor shaft 163.

**[0038]** In this balancing device 180, the long rod-like balance rod 197 including a protuberant portion 199 at each end thereof is fixed to the upper portion of the fuselage 110 so as to oscillate by the support portion 180.

**[0039]** The balance rod 197 is disposed so as to extend

by the same distance to the right and left so as to intersect a longitudinal center axis of the fuselage 110 at right angles and is able to oscillate in such a way that the left and right ends of the balance rod 197 move in the up-down direction, whereby the balance rod 197 can hold a horizontally balanced state in which both the ends of the balance rod 197 are situated in the same horizontal plane by means of the weight balance of the balance rod 197.

**[0040]** This balancing device 180 will be described in detail later.

**[0041]** As shown in Fig. 4, main motors 141, 142 which drive to rotate the main rotor 150, a control circuit, a battery 123 and the like are incorporated in an interior of the main body portion 111.

**[0042]** Namely, a power supply switch 133 is provided on a lower surface of the main body portion 111, and by operating this power supply switch 133, a control signal can be received to thereby activate the constituent components of the toy helicopter 100 based on the control signal so received.

**[0043]** A power supply jack socket 131 is provided on the lower surface of the main body portion 111, so that the battery 123 which is incorporated in the main body portion 111 can be charged by inserting a power supply jack plug is inserted into the power supply jack socket 131 for connection.

**[0044]** The battery 123 is disposed near a nose of the main body portion so as to hold a weight balance of the toy helicopter 100.

**[0045]** An infrared radiation receiving unit as a receiver unit 135 which receives control signals is provided on the lower surface of the main body portion 111 so as to receive control signals sent from a transmitter unit.

**[0046]** The first main motor 141, the second main motor 142 and further a control circuit board 121 are accommodated in the interior of the main body portion 111, and this control circuit board 121 includes a control circuit which controls the rotation of the first main motor 141, the second main motor 142 and the rear rotor motor 117 by control signals received by the receiver unit 135.

**[0047]** Further, an upper rotor gear 145 which is provided at a lower end of the upper rotor shaft 153 is provided in the interior of the main body portion 111, and this upper rotor gear 145 is caused to mesh with a pinion attached to a motor shaft of the first main motor 141. A lower rotor gear 146 is provided at a lower end of the lower rotor shaft 163 and is caused to mesh with a pinion attached to a motor shaft of the second main motor 142.

**[0048]** The rear rotor motor 117 which is provided at the rear end of the tail boom 115 has the motor shaft which stands vertical to a horizontal plane, and the rear rotor 116 is attached to an upper end of the motor shaft. The rear rotor motor 117, the first main motor 141 and the second main motor 142 are connected to the control circuit board 121 by power lines 125.

**[0049]** Rotating speeds of the first main body 141 and the second main motor 142 and the start and stop of rotation of the first main motor 141 and the second main motor 142 are controlled by the control circuit of the control circuit board 121, whereby rotating speeds of the upper rotor 151 and the lower rotor 161 can be controlled. Similarly, the rear rotor motor 117 is controlled to rotate forwards or backwards by the control circuit of the control circuit board 121, and the start and stop of rotation of the rear rotor motor 117 is also controlled by the control circuit, whereby the rear rotor 116 can be controlled to rotate forwards or backwards and the start and stop of rotation of the rear rotor 116 can also be controlled.

**[0050]** In this way, the toy helicopter 100 includes the main rotor 150 having the upper rotor 151 and the lower rotor 161 above the main body portion 111, and the upper rotor 151 and the lower rotor 116 are caused to rotate in the opposite directions, whereby the orientation of the fuselage 110 can be fixed in one direction in the air by matching the rotating speed of the upper rotor 151 with the rotating speed of the lower rotor 161.

**[0051]** Then, when the rotating speeds of the upper rotor 151 and the lower rotor 161 are both made faster, the fuselage 110 is caused to ascend, whereas when the rotating speeds of the upper rotor 151 and the lower rotor 161 are both made slower, the fuselage 110 is caused to descent. In addition, the rotating speed of the upper rotor 151 and the rotating speed of the lower rotor 161 are controlled in association with each other, whereby the ascending speed and the descending speed of the fuselage 110 can be controlled without changing the direction of the fuselage 110, and the fuselage 110 can be caused to hover in the air.

**[0052]** When a difference in rotating speed is generated between the upper rotor 151 and the lower rotor 161 in such a way that the rotating speed of the upper rotor 151 becomes slightly faster while the rotating speed of the lower rotor 161 becomes slightly slower, the fuselage 110 can be turned so as to direct the nose thereof to the left, for example, while maintaining the height of the fuselage 110 or holding the ascent or descent of the fuselage 110. Then, when a difference in rotating speed is generated between the upper rotor 151 and the lower rotor 161 in such a way that the rotating speed of the upper rotor 151 becomes slightly slower while the rotating speed of the lower rotor 161 becomes slightly faster, the fuselage 110 can be turned so as to direct the nose thereof to the right, for example, while maintaining the height of the fuselage 110 or holding the ascent or descent of the fuselage 110.

**[0053]** Since the rear rotor 116 is mounted horizontally, when the rear rotor 116 is caused to rotate forwards, for example, the fuselage 110 is allowed to travel forwards while the fuselage 110 is being tilted slightly forwards so as to lift up the tail boom 115. On the other hand, when the rear rotor 116 is caused to rotate backwards, the fuselage 110 can travel backwards while the fuselage 110 is being tilted slightly backwards so as to push down the tail boom 115.

**[0054]** Consequently, the toy helicopter 100 can be controlled freely by control signals so as to ascend, de-

scend, hover at a predetermined height, travel forwards, travel backwards and turn, whereby the toy helicopter 100 is allowed to fly in a stable fashion in a space free from wind or a flow of air as inside a building, and the controlling operation can be performed relatively easily.

**[0055]** As shown in Fig. 3A, in the balancing device 180, a length L2 of the balance rod 197 is longer than an overall length L1 of the fuselage 110, and a resin pipe is provided at each end of the balance rod 197 as the protuberant portion 199.

**[0056]** The balance rod 197 has a rod main body 198 which is made of a thin and long pipe or solid rod-like body of aluminum and is curved into an arc-like shape as a whole in such a way that both ends are situated lower than a central portion.

**[0057]** The resin pipes constituting the protuberant portions 199 intersect axial directions of end portions of the rod main body 198 of the balance rod 197 at right angles with center axes thereof directed horizontal in a front-rear direction.

**[0058]** There may be a situation where the center axes of the resin pipes constituting the protuberant portions 199 are directed vertical not horizontal or are inclined in the front-rear direction. Thus, the axial directions of the resin pipes constituting the protuberant portions 199 should at least intersect the axes of the end portions of the rod main body 198 of the balance rod 197 at right angles while being matched to anyone of those flight directions in which the toy helicopter 100 rises, descends, travels forwards and travels backwards and the like.

**[0059]** The shape of the protuberant portion 199 is not limited to the pipe shape. There may be a situation where the protuberant portion 199 is formed into a spindle shape or a teardrop shape, whose center axis is caused to intersect the axis of the end portion of the curved, thin rod-shaped rod main body 198.

**[0060]** Further, there may be a situation where the protuberant portion 199 is formed into a spherical shape. In addition, as shown in Fig. 5A, the protuberant portion 199 may be formed into a deformed spherical shape which can be formed by extending the end portion of the rod main body 198 along the axis thereof with a diameter of the end portion gradually increased as the end portion is so extended. Additionally, as shown in Fig. 5B, the protuberant portion 199 may be formed into a cylindrical shape or a prism shape having a diameter greater than that of the rod main body 198 which can be formed by extending the end portion of the rod main body 198 along the axis thereof into such a shape. Further, as shown in Fig. 5C, the protuberant portion 199 may be formed into a conical shape which can be formed by extending the end portion of the rod main body 198 of the balance rod 197 along the axis thereof into such a shape. Further, although not shown, the protuberant portion 199 can take various forms including a flat triangular or circular plate body which extends in the front-rear direction of the fuselage 110.

**[0061]** The support portion 181 by which the balance rod 197 is fixed to the upper portion of the main body portion 111 so as to oscillate has, as shown in Fig. 6, a support main body portion 183 which is formed into an upwardly open U-like shape by a front support plate 185 and a rear support plate 187 which are provided parallel on a flat fixing plate 189 so as to rise vertically therefrom.

**[0062]** The support portion 181 has an oscillating support portion 191 between the front support plate 185 and the rear support plate 187, and the oscillating support portion 191 is made up of a rod support plate 195 and a support pin 193 which penetrates a portion of the rod support plate 195 which lies near an upper end of the rod support plate 195. In this oscillating support portion 191, front and rear ends of the support pin 193 are attached rotatably to a portion of the front support plate 185 which lies near an upper end thereof and a portion of the rear support plate 187 which lies near an upper end thereof, so that a lower end of the rod support plate 195 can rotate or oscillate to the left and right about the support pin 193 as an oscillating center.

**[0063]** There may be a case where the support pin 193 is fixed to the portion of the front support plate 185 which lies near the upper end thereof and the portion of the rear support plate 187 which lies near the upper end thereof, and the rod support plate 195 is allowed to rotate or oscillate relative to or on the support pin 193, whereby the portion of the rod support plate 195 which lies near the upper end thereof is supported by the support pin 193.

**[0064]** Then, a vertical length of the rod support plate 195 is made shorter than vertical lengths of the front support plate 185 and the rear support plate 187, and a central portion of the balance rod 197 is fixed to the lower end of the rod support plate 195. Normally, a balance is kept between the left and right ends of the balance rod 197 so that both the ends of the balance rod 197 stay horizontal at the same height.

**[0065]** In this way, in the balance rod 197 of the balancing device 180, a leftward length and a rightward length from a support point where the balance rod 197 is supported are equal to each other, whereby the balance rod 197 is normally held horizontal. In addition, as shown in Figs. 7A and 7B, the balance rod 197 is allowed to oscillate to the left and right with the fixing plate 189 of the support main body portion 183 held horizontal.

**[0066]** Then, the fixing plate 189 of the support main body portion 183 is fixed to an upper surface of a chassis of the main body portion 111 of the fuselage 110 where the first main motor 141, the second main motor 142, the battery 123, the control circuit board 121 and the like which are accommodated in the main body portion 111 are fixed or an upper surface of an external cover of the main body portion 111 of the fuselage 110, whereby the balancing device 180 is attached to the fuselage 110.

**[0067]** Consequently, even in the event that the fuselage 110 tilts to the left or right, causing the support main body portion 183 to tilt accordingly, the balance rod 197 which is fixed to the lower end of the rod support plate 195 of the oscillating support portion 191 can be held

horizontal.

**[0068]** In event that the fixing plate 189 of the support main body portion 183 is fixed to the chassis which is accommodated in the main body portion 111, as shown in Figs. 1 and 4, a groove portion 119 is formed on the external cover at an upper end thereof so as to ensure a vertical oscillating width for the balance rod 197 which projects from the external cover.

**[0069]** In the event that the balancing device 180 is attached to the upper surface of the chassis or the upper surface of the external cover of the main body portion 111, the balancing device 180 can be fixed to an upper portion of the fuselage 110 extremely simply by applying an adhesive to a lower surface of the fixing plate 189.

**[0070]** As described above, the toy helicopter 100 includes the balancing device 180 on the fuselage 110 and can freely be controlled to rise, descend, hover at a predetermined height, travel forwards, travel backwards, turn and the like by control signals, whereby the toy helicopter 100 can fly stably in a space free from a flow of air or wind as inside a building, and the controlling operation can be performed relatively easily.

**[0071]** However, this toy helicopter 100 is normally fabricated small in size and light in weight and therefore, there is a risk of the fuselage 110 being caused to vibrate back and force or from side to side by such a slight disturbance as a flow of air generated by convection.

**[0072]** With a skilled operator, the vibration of the fuselage 110 occurring back and forth can be eliminated so that the toy helicopter 100 can restore its proper flight by controlling the toy helicopter 100 to travel forwards or backwards. However, the vibration of the fuselage 110 occurring from side to side cannot be eliminated, and hence, it is difficult to control the toy helicopter 100 so as to prevent a fall or a crash thereof.

**[0073]** With the toy helicopter 100 according to this embodiment, however, as described above, the toy helicopter 100 includes the stabilizer 170 and the balancing device 180. Owing to this, when the fuselage 10 is caused to change its flight state from a normal state shown in Fig. 8A to a tilting state as shown in Fig. 8B by such disturbance as turbulence or the like, the support point of the balance rod 197 which is situated in a position lying above on a vertical line of a center of gravity of the fuselage 110 deviates from the vertical line. Consequently, for the fuselage 110 to tilt, a force is necessary which moves laterally the balance rod 197 having the protuberant portion 199 at each end from the position lying above the position of the center of gravity of the fuselage 110.

**[0074]** Owing to this, the weight of the balance rod 197 constitutes resistance to an external force which attempts to tilt the fuselage 110, whereby the tilt of the fuselage 110 can be reduced.

**[0075]** As shown in Fig. 8B, even in the event that the fuselage 110 is caused to tilt abruptly by disturbance, the fuselage 110 can be returned to the normal state shown in Fig. 8A quickly by the balancing device 180.

**[0076]** Namely, when the fuselage 110 is caused to tilt laterally, since the stabilizer 170 is kept rotating in the horizontal plane by means of the rotational inertia, the upper rotor 155 which is connected to the stabilizer head 171 with the link shafts 179 tilts, and the upper rotor head 155 tilts alternately in opposite directions every time the upper rotor shaft 153 rotates 180 degrees.

**[0077]** Owing to this, the pitch angle of the upper rotor blade 157, which is the angle of elevation thereof, becomes great on a tilting side (a right side in Fig. 8B), whereas the pitch angle becomes small on an opposite side (a left side in Fig. 8B), whereby a lift F1 by the upper rotor 151 is generated much on the tilting side, and as shown in Fig. 8B, an obliquely upward lift F1' is generated so as to restore the normal state from the tilting state.

**[0078]** Since the balance rod 197 of the balancing device 180 is held horizontal, a triangle formed by the ends of the balance rod 197 and the upper rotor head 155 becomes a scalene triangle, whereby it is possible to make a great action to return the upper rotor head 155 which constitutes the center of the lift F1 on to the central portion of the balance rod 197.

**[0079]** Consequently, as shown in Fig. 8A, the lift F1 by the upper rotor 151, a lift F2 by the lower rotor 161 and the gravity G of the whole of the fuselage 110 including the balancing device 180 are aligned with one another on the vertical line, whereby the fuselage 110 can be returned quickly to the stable state where an isosceles triangle is formed by the ends of the balance rod 197 and the center of the upper rotor head 155.

**[0080]** Restoring the stability is not limited to the period of flight but may be applied to a period of starting or taking off where the main rotor 150 is started to rotate at quick speeds to cause the toy helicopter 100 to take off quickly. Even though the fuselage 110 vibrates due to vibrations generated in the fuselage 110 when the motors and rotors are started, the vibration of the fuselage 110 can be restricted to a low level, and the tilt of the fuselage 110 to the left or right can be returned to the stable state by the balancing device 180, whereby a posture of the fuselage 110 resulting immediately after the take-off can be quickly returned to the stable state, so that the controlling operation of the toy helicopter 100 can continue to be performed easily.

**[0081]** In this way, according to the embodiment, even though the fuselage 110 tilts to the left or right, the balance rod 197 of the balancing device 180 is allowed to oscillate so that the balance rod 197 is held horizontal. In addition, the material of the protuberant portions 199 which are formed at both the ends of the balance rod 197 is not limited to resin, and there may be a case where the protuberant portions 199 are formed of a light metal such as aluminum so as to reduce the weight of the balancing device 180, whereby the increase in weight of the toy helicopter 100 is suppressed.

**[0082]** Then, the length L2 of the balance rod 197 is preferably equal to or longer than the overall length L1 of the fuselage 110. The length L2 of the balance rod 197 should be at least substantially equal to the overall length

L1 of the fuselage 110 and may be longer than the overall length L1 of the fuselage 110.

**[0083]** Although the balance rod 197 is curved so that the central portion is situated higher than the ends thereof, in the case of the balance rod 197 being suspended from the support pin 193 which constitutes the oscillation center as shown in Fig. 6 or the like, there may also be a case where the balance rod 197 is formed into a straight-line shape.

**[0084]** The balance rod 197 is fixed to the main body portion 111 in such a way that the balance rod 197 is suspended by the support main body portion 183 such as the fixing plate 189 and the oscillating support portion 191 such as the rod support plate 195. In addition to this configuration, the balance shaft 197 may be attached to the upper portion of the main body portion 111 so as to oscillate in such a way that the balance rod 197 is suspended from the chassis incorporated in the main body portion 111 of the fuselage 110.

**[0085]** Further, in the event that the balance rod 197 having the protuberant portion 199 at each end thereof is curved, so that the center of gravity of the balance rod 197 is situated below the central portion of the balance rod 197, there may be a case where the support point of the balance rod 197 which acts as the oscillating center is situated below the balance rod 197 so as to lift up the balance rod 197 from therebelow. Namely, the balance rod 197 of the balancing device 180 should at least be held horizontal with the center of gravity of the balance rod 197 lying below the support point which acts as the oscillating center while the central position of the balance rod 197 is raised higher and both the ends of the balance rod 197 kept at the same height.

**[0086]** The position where the stabilizer 170 is provided is not limited to the position lying above the upper rotor 151. There may be a case where the stabilizer 170 is provided between the upper rotor 151 and the lower rotor 161 in such a way that the stabilizer 170 is situated below the upper rotor 151 but above the lower rotor 161 with the upper rotor 151 attached to the upper end of the upper rotor shaft 153.

**[0087]** In this way, with the toy helicopter 100 according to the embodiment of the invention, since the long balance shaft 197 which is provided so as to extend laterally to the left and right across the fuselage 110 is provided on the fuselage 110 so as to oscillate, even when the fuselage 110 is caused to oscillate sideways, the balance rod 197 having the protuberant portion 199 at each end thereof is held horizontal, so that the tilt of the fuselage 110 is suppressed to a small level by this balance rod 197 and the tilt of the fuselage 110 is corrected quickly to restore the stable state, thereby enabling the toy helicopter 100 to fly in a stable fashion.

**[0088]** With the toy helicopter 100 having the balance rod 197 which can oscillate up and down at the left and right ends thereof on the upper portion of the main body portion 111, even though the fuselage 110 is caused to tilt, the balance rod 197 which is held horizontal is kept at the height of the fuselage 110. Thus, even when the toy helicopter flies low near the ground or a floor, the balance rod 197 is prevented from hitting an obstacle. In addition, even though the balance rod 197 is curved in such a way that the ends are situated lower than the center thereof, the balance rod 197 can be attached to the fuselage 110 in a stable fashion.

**[0089]** Then, with the toy helicopter 100 having the twin-rotor, oppositely rotating main rotor 150 which is made up of the upper rotor 151 and the lower rotor 161, the nose can easily be kept staying in a desired direction in a stable fashion and can easily be turned so as to change the direction thereof by controlling individually the rotating speeds of the upper rotor 151 and the lower rotor 161.

**[0090]** With the toy helicopter 100 in which the pitch angle of the upper rotor blades 157 of the upper rotor 151 is made variable in such a way that the pitch angle can be controlled by the stabilizer 170, the vibrations of the fuselage 110 occurring back and forth and from side to side can be eliminated by the main rotor 150 so that the toy helicopter 100 can fly in a stable fashion, whereby the control of the flight of the toy helicopter 100 can be facilitated.

**[0091]** Further, with the toy helicopter 100 having the rear rotor 116 which is disposed horizontal, the fuselage 110 can be caused to tilt forwards or backwards by rotating the rear rotor 116 forwards or backwards, whereby the fuselage 110 can easily be controlled to travel forwards and rearwards by the simple mechanism with the nose directed in a desired direction in a stable fashion by the main rotor 150.

**[0092]** Although the balancing device 180 such as the balance rod 197 is light in weight, the length L2 of the balance rod 197 which is held horizontal is made equal to or longer than the overall length L1 of the fuselage 110, whereby it is possible to restrict effectively the occurrence of lateral vibration of the fuselage 110 which is attributed to the narrow transverse width thereof.

**[0093]** In addition, since the balancing device 180 supports the balance rod 197 by using the support main body portion 183 having the flat fixing plate 189 so as to oscillate, the balancing device 180 can easily be attached and fixed to the upper portion or the like of the fuselage 110 of the toy helicopter 100 by the fixing plate 189.

**[0094]** Then, the support portion 181 of the balancing device 180 is made up of the support main body 183 and the oscillating support portion 191, and the balance rod 197 is supported at the central portion thereof by the oscillating support portion 191, whereby the balance rod 197 can be laterally symmetrical with respect to the support point and hence can be supported horizontally while being allowed to oscillate easily.

**[0095]** Further, with the supporting portion 181 in which the rod support plate 195, which functions as the oscillating support portion 191, is disposed between the front support plate 185 and the rear support plate 187 of the support main body portion 183 and the rod support plate

195 is supported in the position thereon which lies near the upper end thereof by the support pin 193 so as to oscillate, the rod support plate 195 and the balance rod 197 can be suspended so as to oscillate in an ensured fashion. In addition, the centers of gravity of the rod support plate 195 and the balance rod 197 are caused to lie lower than the support point, whereby the balance rod 197 can easily be held horizontal.

**[0096]** Then, the balance rod 197 having the protuberant portion 199 at each end of the rod main body 198 is curved so that both the ends are situated lower than the central portion thereof. By adopting this configuration, the position of the center of gravity of the balance rod 197 can be caused to lie lower than the central portion of the balance rod 197 which constitutes the support portion, whereby the balance rod 197 which can oscillate can be held horizontal in a more ensured fashion.

**[0097]** In addition, the rod main body 198 of the balance rod 197 is made of aluminum, whereby the balance rod 197 and hence the balancing device 180 can be made light in weight, thereby allowing the toy helicopter 100 to fly in a stable fashion while the increase in weight of the toy helicopter 100 is suppressed to a low level.

**[0098]** Further, the resin pipes which are thicker in diameter than the rod main body 198 of the balance rod 197 are used as the protuberant portions 199, and the pipes are disposed so that the axes thereof stay horizontal. By adopting this configuration, the horizontality maintaining capability of the balance rod 197 can easily be enhanced while suppressing the increase in weight of the balance rod 197, and the stability in appearance of the balance rod 197 can also be maintained.

**[0099]** In this way, the toy helicopter 100 according to the embodiment of the invention has the upper rotor 151 and the lower rotor 161 which make up the twin-rotor, oppositely rotating main rotor to thereby be allowed to rise, descend, hover and the like. The toy helicopter 100 also has the stabilizer 170 which controls the pitch angle of the upper rotor blades 175 to thereby be allowed to fly in a stable fashion. The toy helicopter 100 has further the balancing device 180 so as to enhance further the lateral stability, whereby the toy helicopter 100 is allowed to fly in a stable fashion more easily.

**[0100]** Thus, while the embodiment of the invention has been described heretofore, the invention is not limited to the embodiment, and hence, the invention can be carried out in various forms.

## Claims

**1.** A toy helicopter comprising:

a fuselage comprising a main body portion; and
a balancing device which is fixed to the main body portion,

wherein

the balancing device comprises a long balance rod which is provided so as to extend laterally across a the fuselage, and wherein
the balance rod has a protuberant portion at each end thereof and is provided on the fuselage so as to oscillate.

**2.** The toy helicopter according to Claim 1, wherein
the balance rod can oscillate up and down at the left and right ends thereof, can be held horizontal even though the fuselage is caused to tilt to the left or right and is provided on an upper portion of the main body portion.

**3.** The toy helicopter according to Claim 1 or 2, comprising:

a main rotor which is disposed above the main body portion,

wherein

the main rotor has an upper rotor and a lower rotor, and the upper rotor and the lower rotor rotate in opposite directions.

**4.** The toy helicopter according to Claim 3, wherein
the upper rotor can vary a pitch angle of a blade and has a stabilizer above or below the upper rotor, and the pitch angle of the blade of the upper rotor can be controlled by the stabilizer.

**5.** The toy helicopter according to Claim 3 or 4, wherein
the fuselage has a rear rotor which rotates in a horizontal plane to the rear of the main body portion.

**6.** The toy helicopter according to anyone of Claims 1 to 5, wherein
the balance rod has a length which is almost equal to a longitudinal length of the fuselage or is longer than the longitudinal length of the fuselage.

**7.** A balancing device for a toy helicopter, comprising:

a support main body portion having a flat fixing plate; and
an oscillating support portion which can oscillate relative to the support main body portion, wherein
a long balance rod having a protuberant portion at each end thereof is supported at a central portion thereof by the oscillating support portion, and the balance rod is attached to the support main body portion so as to oscillate.

**8.** The balancing device for a toy helicopter according to Claim 7, wherein
the support main body portion has a front support

plate and a rear support plate which are provided on the fixing plate so as to rise parallel to each other therefrom, wherein
a rod support plate is provided between the front support plate and the rear support plate as the oscillating support portion, wherein
both front and rear ends of a support pin which supports the rod support plate in a position lying near an upper end thereof are attached to the front support plate in a position lying near an upper end thereof and the rear support plate in a position lying near an upper end thereof, respectively, so as to allow a lower end of the rod support plate to oscillate sideways relative to the support main body portion, and wherein
the balance rod is fixed to the lower end of the rod support plate, and the balance rod is suspended therefrom.

**9.** The balancing device for a toy helicopter according to Claim 7 or 8, wherein
the balance rod has a curved shape in which the ends are situated lower than a center thereof.

**10.** The balancing device for a toy helicopter according to anyone of Claims 7 to 9, wherein
a rod main body of the balance rod is an aluminum pipe or a rod-like body of aluminum.

**11.** The balancing device for a toy helicopter according to anyone Claims 7 to 10, wherein
the protuberant portion is a resin pipe whose diameter is thicker than a diameter of the rod main body of the balance rod, and an axial direction of the resin pipe stays horizontal while intersecting an axial direction of an end portion of the rod main body.

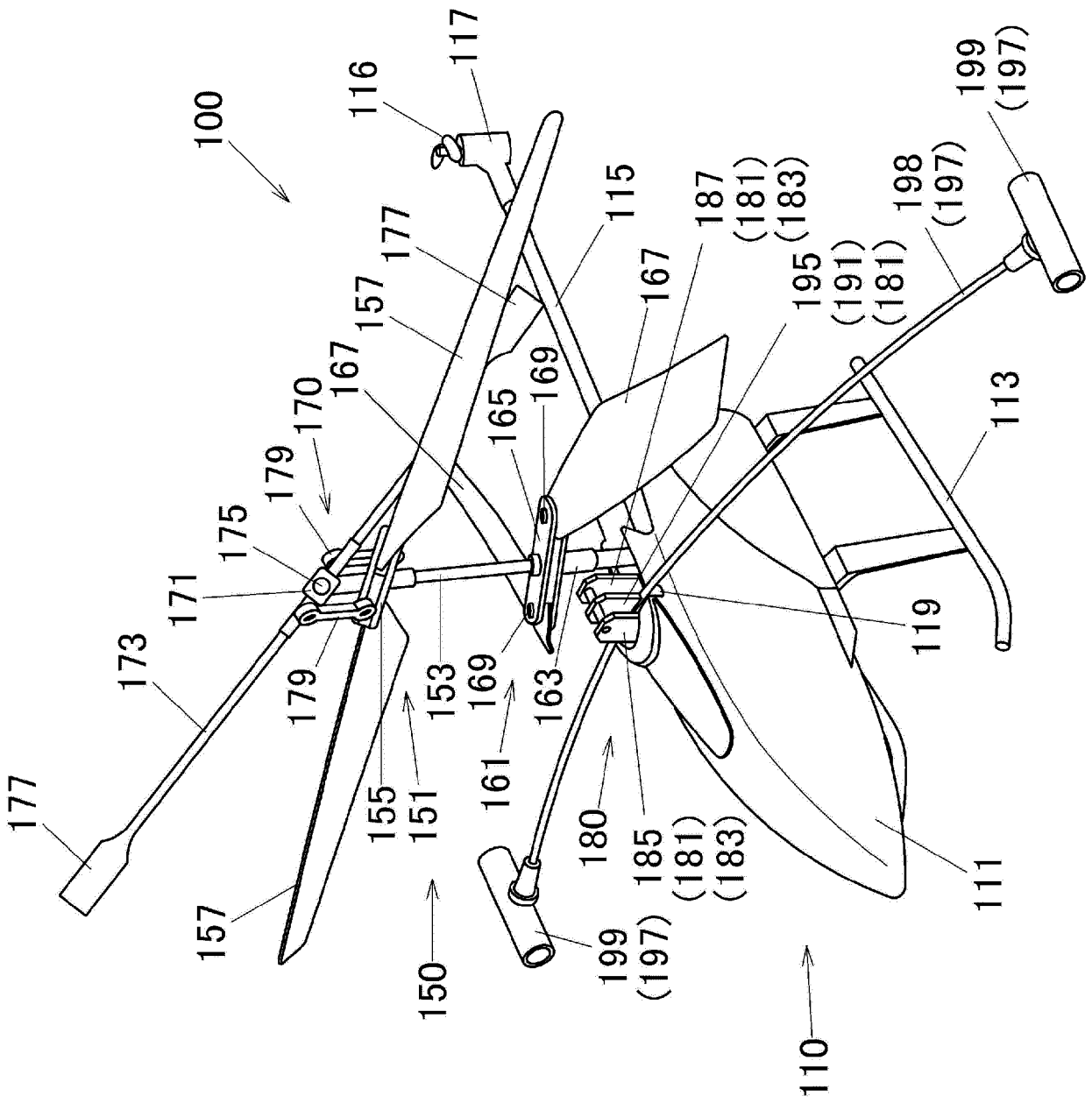
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FIG.1

FIG.2

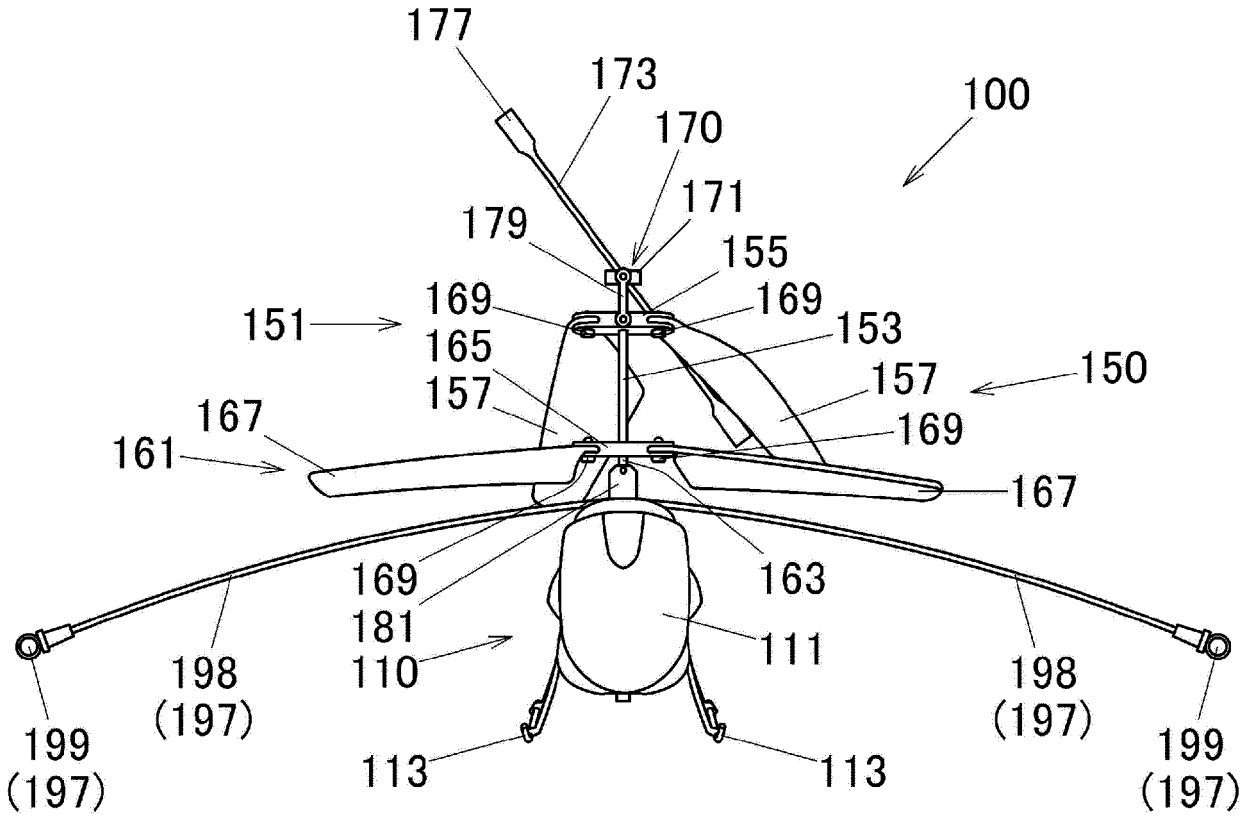
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FIG.3A

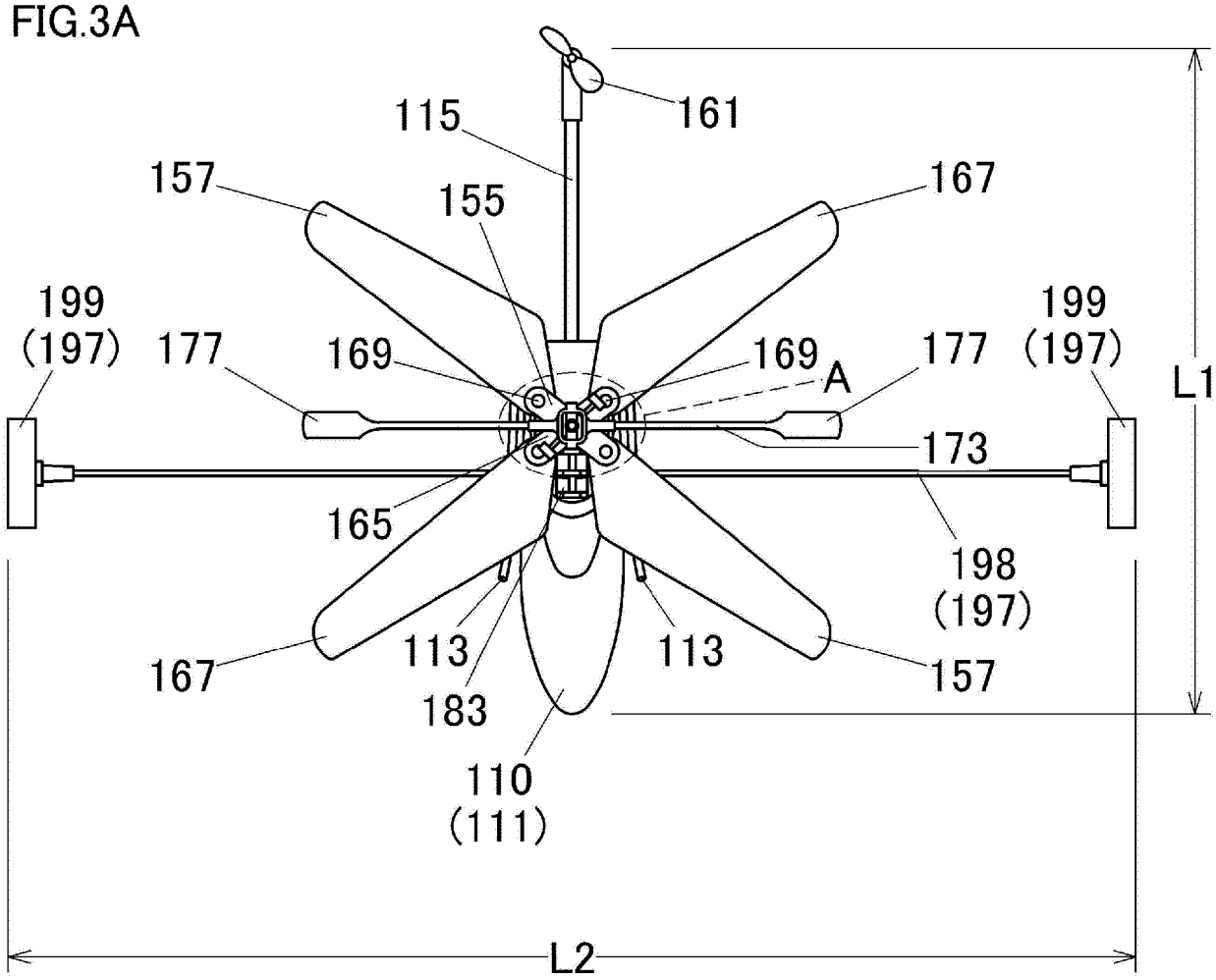
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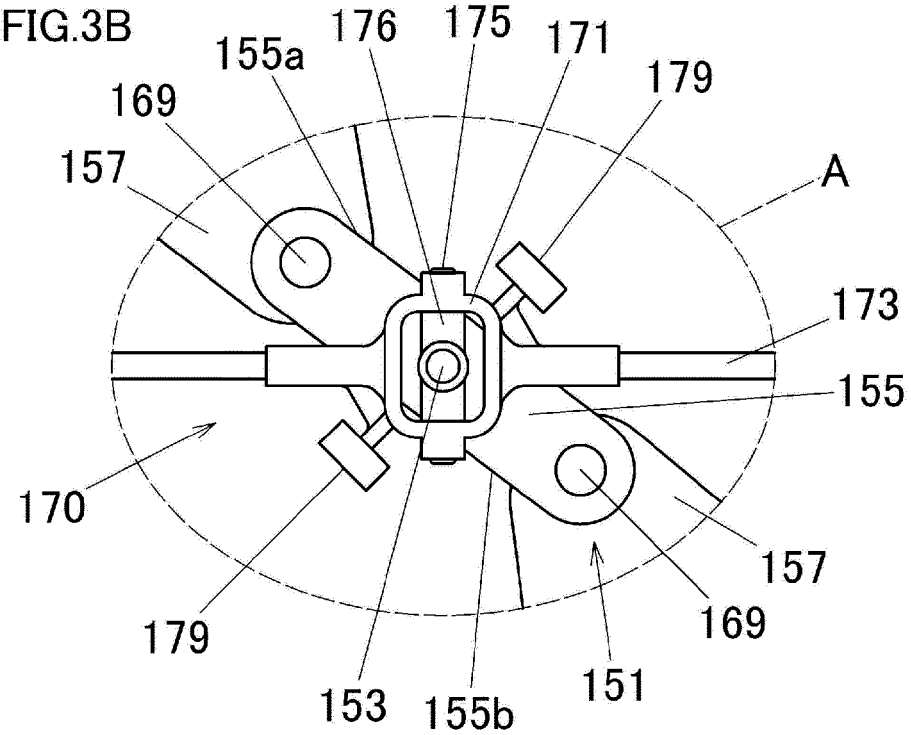
FIG.3B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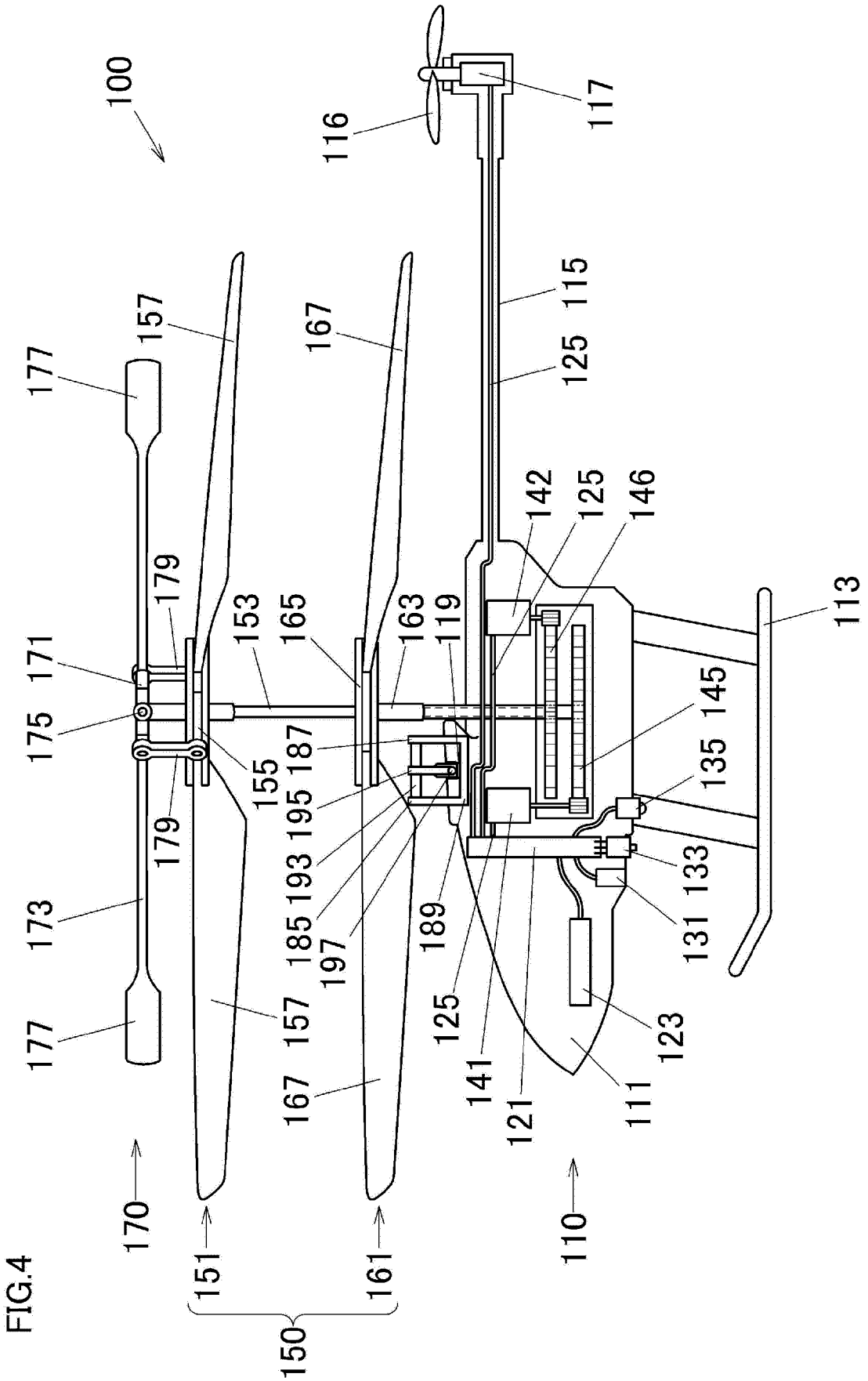
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FIG.4

FIG.5A

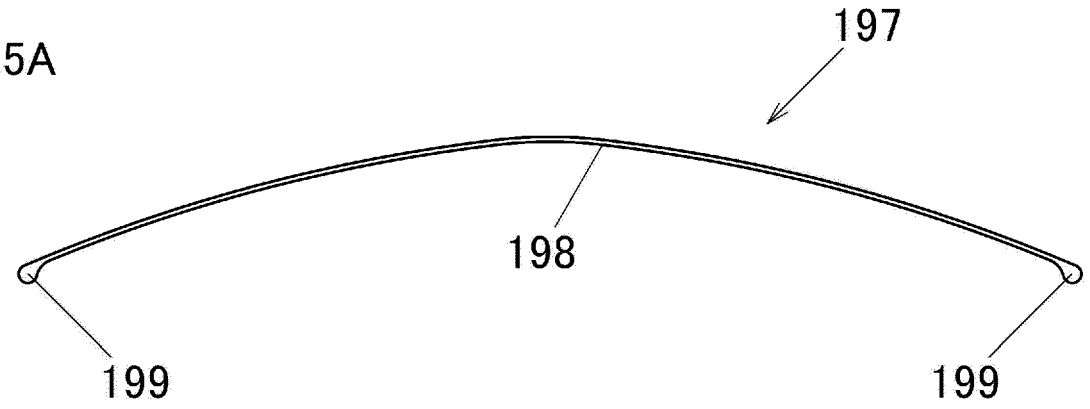


FIG.5B

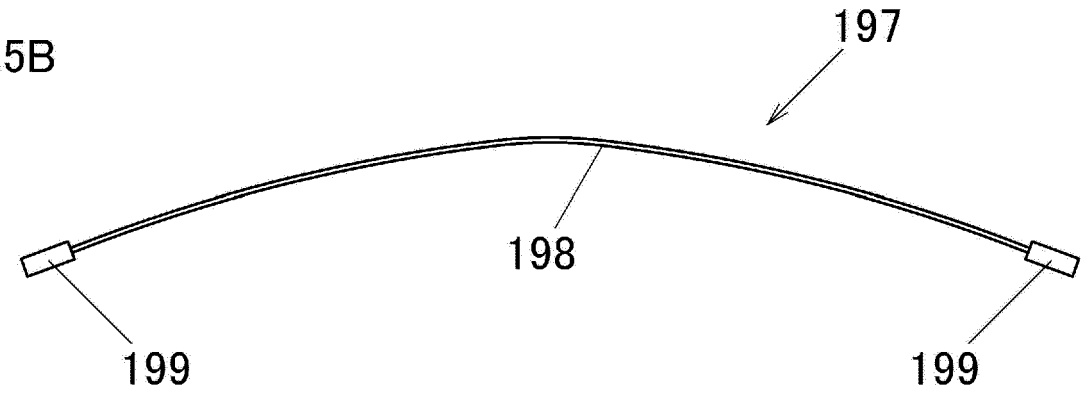


FIG.5C

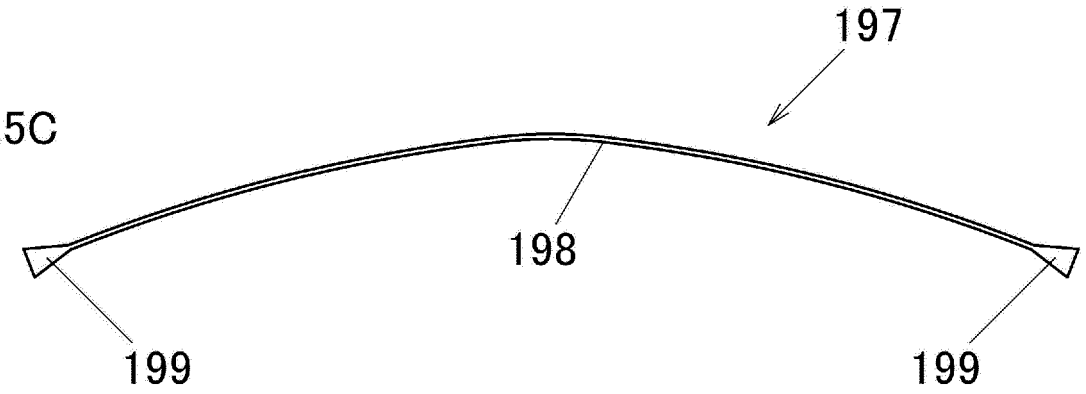

FIG.6

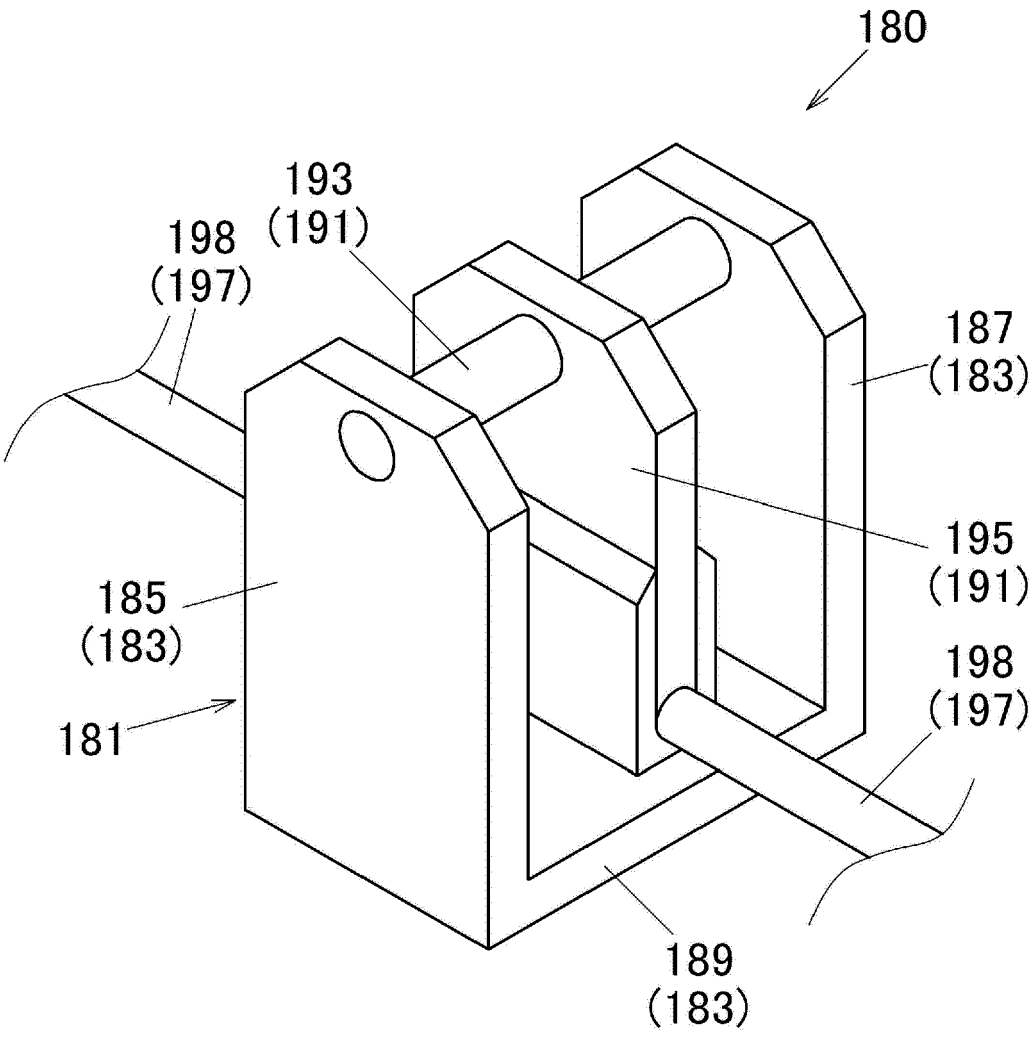

FIG.7A

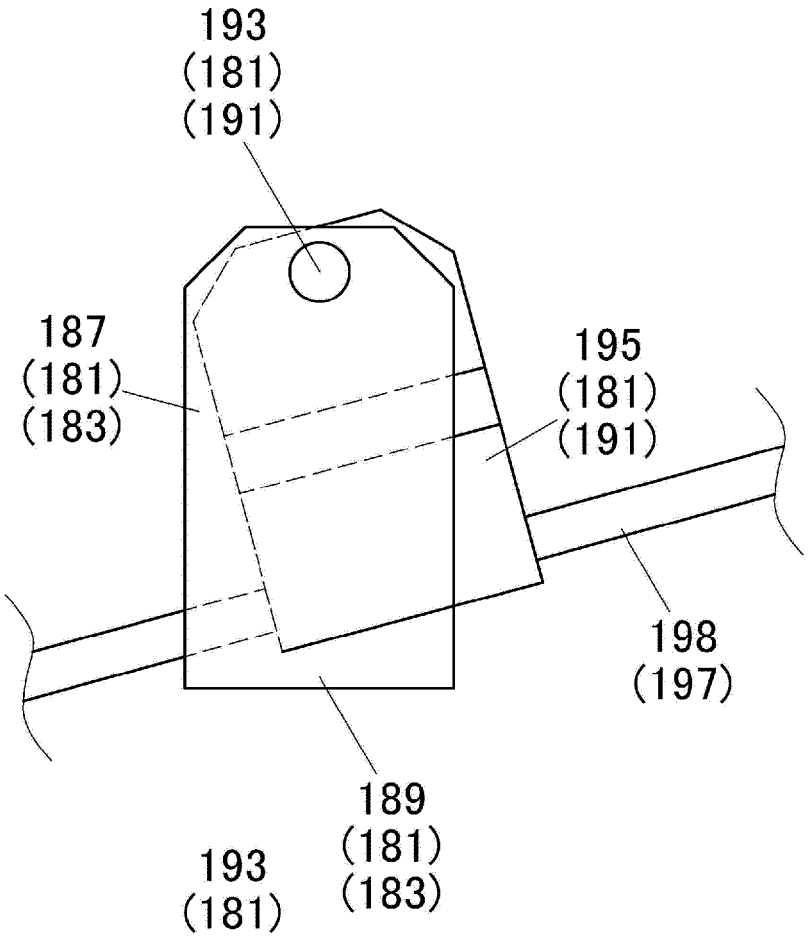
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FIG.7B

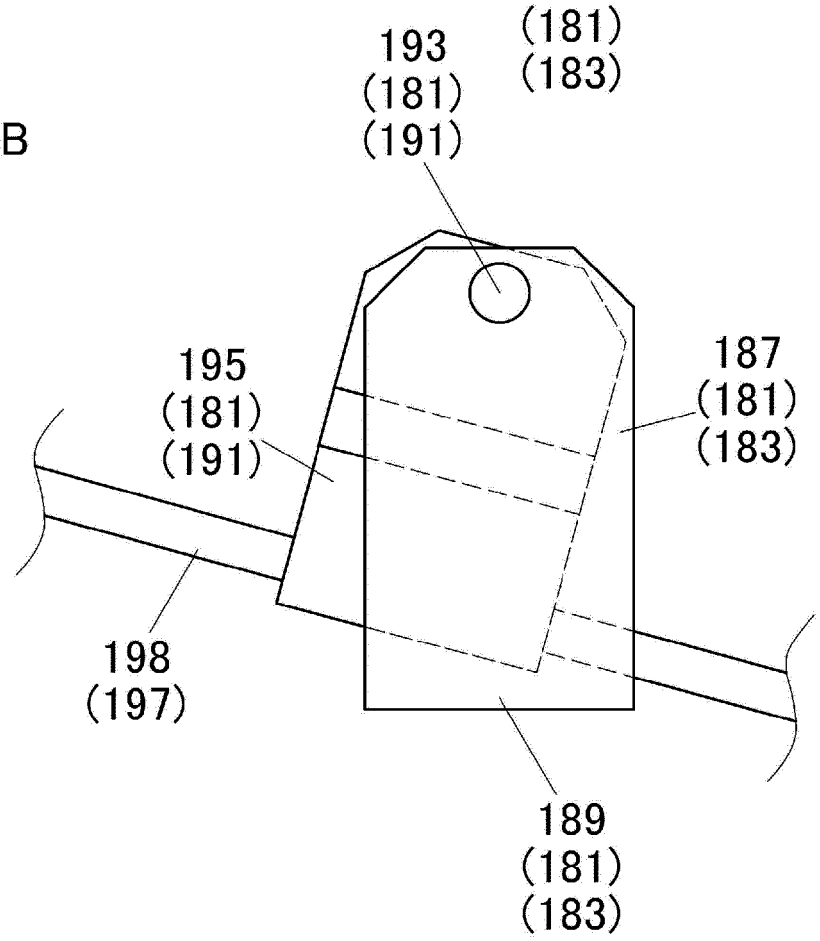
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FIG.8A

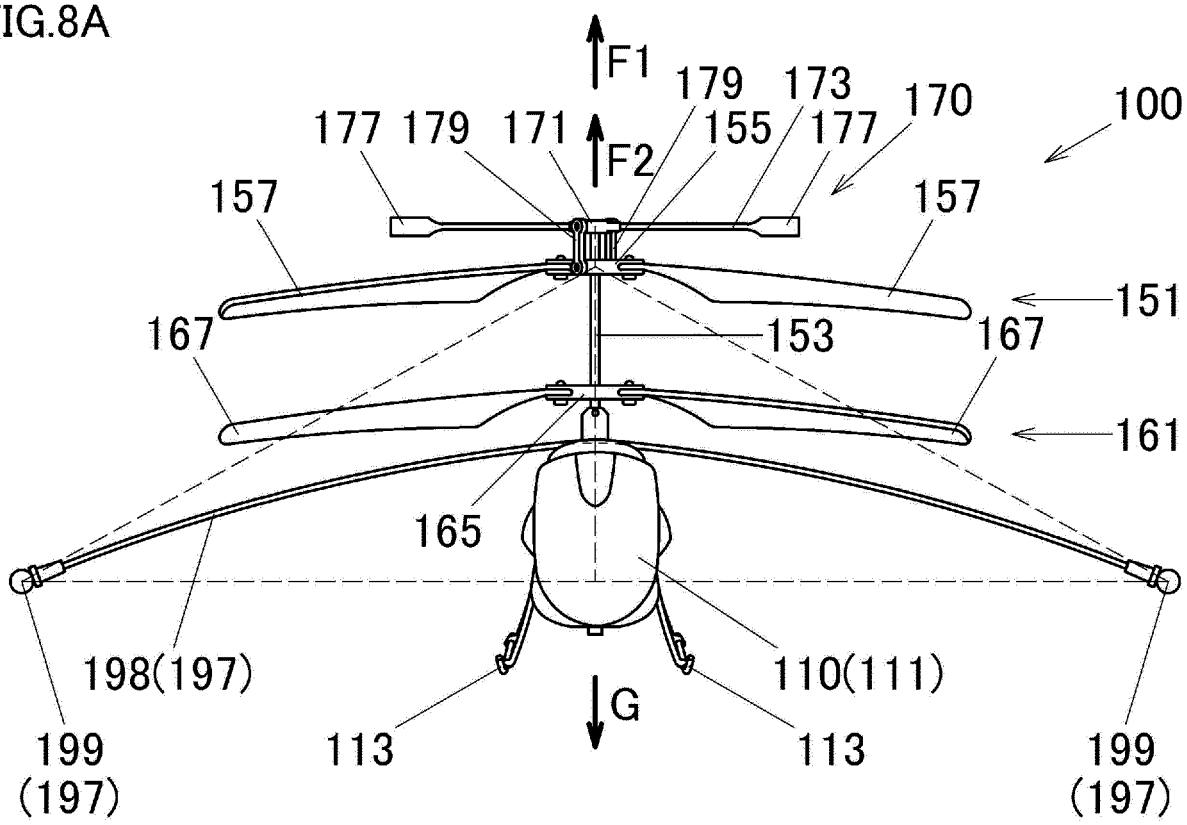
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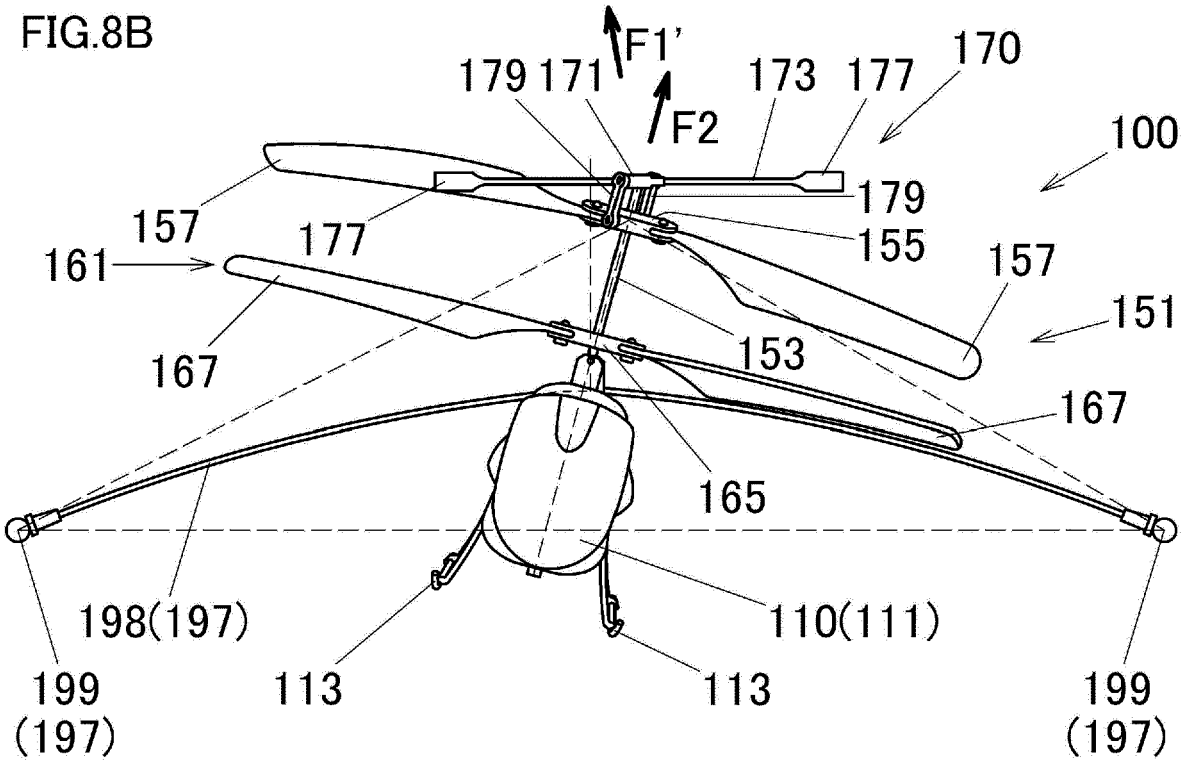
FIG.8B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# EUROPEAN SEARCH REPORT

Application Number
EP 17 15 7098

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| Munich | 10 October 2017 | Bagarry, Damien |

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