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(54) Title: PORTABLE AUXILIARY STABILIZER FOR IMAGE PICKUP AND VIDEO SHOOTING

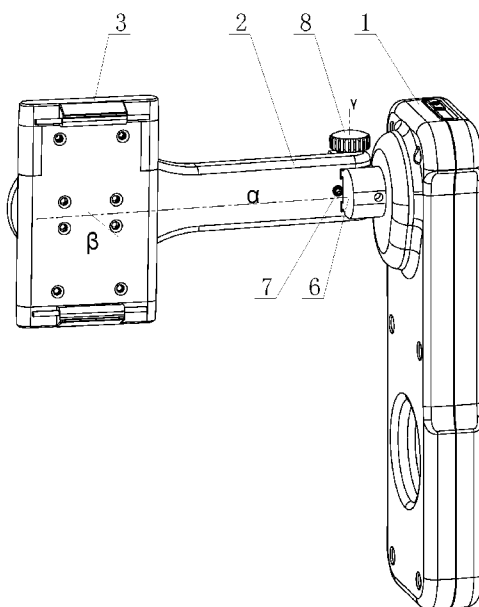


Fig. 1

(57) Abstract: A hand-held auxiliary stabilizer for image pickup and video shooting is provided. One end of a roll mechanical arm (2) is rotatably connected to a roll mechanical arm mounting seat (6) with a center line γ of rotation. The roll mechanical arm mounting seat is rotatably connected to a pitch mechanical arm (1) with a center line α of rotation. A pitch corrected motor (4) is disposed on a rotating shaft of the roll mechanical arm mounting seat. A fixing seat (3) with a center line β of rotation is rotatably mounted beside a side surface of the other end of the roll mechanical arm, and a roll corrected motor (5) is disposed on a rotating shaft of the fixing seat. The center line γ of rotation is perpendicular to a plane in which the center line α of rotation intersects with the center line β of rotation. An accelerometer and a gyroscope are disposed on the fixing seat and connected to the pitch corrected motor and the roll corrected motor by means of control units. The stabilizer is further provided with a pitch-angle regulating switch of the pitch corrected motor which is connected to the pitch corrected motor by means of a control unit. The stabilizer is helpful for a user to find out the balanced center position of gravity of a mobile phone (9) rapidly and conveniently without any professional skills ; the stabilizer is low in system power consumption and less in heat emission ; moreover, a lens of a shooting device is always kept to stably face a subject of shooting with high image quality.



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PORTABLE AUXILIARY STABILIZER FOR IMAGE PICKUP AND VIDEO SHOOTING

Field of the Invention

The present invention relates to the field of adjustment on center of gravity, and in particular to a portable auxiliary stabilizer for image pickup and video shooting.

Background of the Invention

With the continuous development of social economy and science and technology, people are quite used to using mobile phones to record images and video materials in their daily lives and work. In order to adjust the distance and angle of shooting, stabilize a shooting image to achieve a better shooting effect, various hand-held selfie tools come into being.

A selfie stick is a common hand-held selfie tool. A fixing seat is generally disposed at the top end of an extendable stick, and can be turned over in a direction perpendicular to the length direction of the extendable stick. A user fixes a mobile phone, a pad, a camera or the like to the fixing seat, adjusts the pitch angle of shooting by rotating the fixing seat and adjusts the left-and-right angle of shooting by arm swinging, thereby obtaining an appropriate shooting angle.

Hand tremble is common during the use of a selfie stick. The longer the stick is, the stronger the hand trembles, and as the image stabilization function of a mobile phone is still not excellent enough, blurred images often appear. Moreover, if a selfie stick is used for video shooting, a user may feel very tired by holding the selfie stick for a long time, and if the user wants to change the shooting angle during shooting, poor control on the turning amplitude of the arm and too frequent changing of the shooting angle may cause such problems as sudden image switching and subjects being out of the frame; on the contrary, too slow changing of the shooting angle may result in a laggard video and cause an increased burden on the arm. If the user shoots a video while moving, these problems of image dithering, unnatural changing of the shooting angle, subjects being out of the frame and the like will become more serious.

An auxiliary stabilizer is developed to overcome the above problems. The auxiliary stabilizer is designed as a device for allowing a lens of a shooting device, such as a mobile phone, to always face a subject of shooting stably no matter how the arm of a

user moves during in-situ or mobile shooting. The existing auxiliary stabilizers are generally used in very professional fields, and involve some problems, such as extremely inconvenient methods for adjusting center of gravity before shooting and extremely high professional requirements on operators. Although some auxiliary stabilizer can barely operate without center-of-gravity adjustment, they have such disadvantages of great increase of system power consumption, obvious heat emission in the use of the products and short effective use time of power supply batteries after one-time charge. Moreover, the existing auxiliary stabilizers are huge in size and not compact enough in structure, and thus are not convenient to carry, and these defects limit the convenience of use of the products.

Summary of the Invention

The technical problem to be solved by the present invention is to provide a portable auxiliary stabilizer for image pickup and video shooting. The stabilizer has the functions of balancing the center of gravity of a mobile phone during mobile shooting and allowing a lens to always face a subject of shooting, and is helpful for a user to find out the center of gravity rapidly and conveniently without any professional skills; the stabilizer can be used for a long time after one-time charge, and is low in system power consumption and free from obvious heat emission even in long-time use; in addition, the stabilizer is compact in structure, and can be folded when not used for convenient carrying in a pocket.

The present invention is implemented by using the following technical solutions.

A portable auxiliary stabilizer for image pickup and video shooting is characterized as follows:

one end of a roll mechanical arm with a center line γ of rotation is rotatably connected to a roll mechanical arm mounting seat which is rotatably connected to a pitch mechanical arm with a center line α of rotation; a pitch corrected motor is disposed on a rotating shaft of the roll mechanical arm mounting seat;

when the roll mechanical arm is pulled to rotate around the center line γ of rotation, the roll mechanical arm can be kept at any pulled position to change the included angle between the roll mechanical arm and the center line α of rotation; the roll mechanical arm mounting seat and the roll mechanical arm are capable of rotating around the center line α of rotation as a whole;

a fixing seat with a center line β of rotation is rotatably mounted beside a side surface of the other end of the roll mechanical arm; a roll corrected motor is disposed on a rotating shaft of the fixing seat; the fixing seat is capable of rotating around the center line β of rotation;

the center line α of rotation intersects with the center line β of rotation, and the center line γ of rotation is perpendicular to a plane in which the center line α of rotation intersects with the center line β of rotation;

an accelerometer and a gyroscope are disposed on the fixing seat and connected to the pitch corrected motor and the roll corrected motor by means of control units;

the auxiliary stabilizer is further provided with a pitch angle regulating switch which is connected to the pitch corrected motor by means of a control unit;

the auxiliary stabilizer has two position states:

when being folded for carrying, the roll mechanical arm is pulled to rotate around the center line γ of rotation, and the roll mechanical arm mounting seat and the roll mechanical arm are pulled to rotate around the center line α of rotation as a whole until the roll mechanical arm is overlapped on the pitch mechanical arm;

when being unfolded for operating, the roll mechanical arm is pulled to rotate around the center line γ of rotation, and the roll mechanical arm mounting seat and the roll mechanical arm are pulled to rotate around the center line α of rotation as a whole until an inverted L-shaped intersection angle is formed between the roll mechanical arm and the pitch mechanical arm.

The stabilizer only requires simple steps for pre-adjusting the center of gravity before shooting. For example, if a mobile phone is used for video shooting, an adjustment method for the stabilizer comprises the following steps:

Firstly, the stabilizer is pulled to be in an unfolded operating state in whole; the pitch mechanical arm is vertically held by a user, while the roll mechanical arm is kept to laterally extend from one side of the pitch mechanical arm and the fixing seat is kept to face the user; the mobile phone is clamped on the fixing seat first. The roll mechanical arm is then pulled to rotate around the center line γ of rotation to make the common center of gravity of the roll mechanical arm, the fixing seat and the mobile phone be just located in or near the center line α of rotation. A method for determining whether the center of gravity is in place is as follows: after the mobile phone is clamped, the roll mechanical arm is rotated manually to keep the screen of the mobile phone in a vertical state, and after the roll mechanical arm is released, the

mobile phone is capable of staying in the vertical state and the roll mechanical arm does not turn over.

The clamped position of the mobile phone on the fixing seat is then adjusted to make the common center of gravity of the mobile phone and the fixing seat be just located in or near the center line β of rotation, which can be determined by the following method: after the clamped position of the mobile phone on the fixing seat is adjusted manually, the mobile phone kept in the vertical state as described above is kept equivalent in height on the left and right or tilted slightly, and after the fixing seat is released, the mobile phone is capable of staying in the state of being vertical and equivalent in height on the left and right or tilted slightly without turning over. Then, the mobile phone is in the balanced center position of gravity, and the adjustment is finished.

During shooting, the mobile phone moves along with the movement of the arm or the body of a user. In order to keep images captured by the mobile phone stable in horizontal and pitching directions during moving and always targeted at the subjects of shooting stably, the stabilizer controls the balance of the mobile phone by means of two corrected motors as described below.

The user opens a power supply switch to enable a battery to supply power to the auxiliary stabilizer. The user holds the pitch mechanical arm, observes a subject of shooting (selfie or photographing other person) via the screen of the mobile phone and rotates the pitch mechanical arm to select an appropriate shooting angle. Additionally, the gyroscope is used to measure a direction and an angular velocity, and the accelerometer is used to measure an angle and an accelerated speed. If an angular velocity and/or an angle of the mobile phone around the center line β of rotation are/is monitored by the accelerometer and the gyroscope, the roll corrected motor is started to generate a reverse torque equivalent in magnitude to keep the original angles of the mobile phone and the fixing seat. If an angular velocity and/or an angle of the mobile phone around the center line α of rotation are/is monitored by the accelerometer and the gyroscope, the pitch corrected motor is started to generate a reverse torque equivalent in magnitude to keep the original angles of the mobile phone, the fixing seat and the roll mechanical arm. If simultaneous angular velocities and/or angles of the mobile phone around the center line α of rotation and the center line β of rotation are monitored by the accelerometer and the gyroscope, the pitch corrected motor and the roll corrected motor are started separately to generate a

reverse torque resultant equivalent in magnitude to keep the original angle of the mobile phone. Due to accurate center position of gravity, the purpose of always keeping the desired angle for the user can be achieved with only a small torque provided by the corrected motors during shooting; in addition, the system power consumption is low, leading to obvious prolonging of the service time of the battery after one-time charge and low heat emitted by the stabilizer.

The center line α of rotation and the center line β of rotation are intended for guaranteeing that the preset angle of the mobile phone can be still kept in the process of multidirectional three-dimensional rotation, and the center line γ of rotation has two purposes: one purpose is to facilitate folded carrying of the stabilizer, and the other purpose is that in consideration of certain differences in the center position of gravity, weight and size among mobile phones, pads and the like of different models, the included angle between the roll mechanical arm and the center line α of rotation is adjusted to adjust the common center of gravity of the roll mechanical arm, the fixing seat and any different shooting device to be just in or near the center line α of rotation with the same stabilizer. The heavier a shooting device is, the further the roll mechanical arm is pulled away from the center line α of rotation; the lighter the mobile phone is, the closer the roll mechanical arm is pulled to the center line α of rotation.

Further, although the provision of the above center line γ of rotation allows the same mechanism to match with more models of devices with good universality, the pulled angle of the roll mechanical arm needs to be readjusted before use every time, which is complicated in operation. In consideration that most users usually use only one shooting device at the same time, the following limiting structure may be provided: a spacing projection an adjustable protruded height is provided on the roll mechanical arm at the same side as the fixing seat and in the proximity of the roll mechanical arm mounting seat, and is capable of coming into contact with/being separated from the roll mechanical arm mounting seat during rotation of the roll mechanical arm around the roll mechanical arm mounting seat. The protruded height of the spacing projection may be adjusted in advance by a user such that the roll mechanical arm reaches the balanced center position of gravity exactly when the spacing projection is in contact with the roll mechanical arm mounting seat; that is, the center of gravity of an integrated unit formed by the roll mechanical arm mounting seat, the roll mechanical arm, the fixing seat and a mobile phone is just located in or near the center line α of

rotation. When the same shooting device is used, the protruded height of the spacing projection may be adjusted before use for the first time without repeated adjustment in later use each time; before shooting, the roll mechanical arm is just directly pulled in place (i.e., pulled until the spacing projection contacts with the roll mechanical arm mounting seat), and then the center-of-gravity adjustment for the center line α of rotation can be achieved. When different shooting devices are changed, the protruded height of the spacing projection needs to be readjusted to be adapted to different center positions of gravity of different shooting devices.

Still further, the spacing projection is a limiting screw which is screwed into a threaded hole correspondingly formed in the roll mechanical arm. The height of the exposed section of the limiting screw may be adjusted by rotating the limiting screw, and the structure is simple, and is convenient in adjustment.

Still further, the roll mechanical arm is mounted on the roll mechanical arm mounting seat off the center line α of rotation; the center line γ of rotation is located in a back side of the fixing seat without intersecting with the center line α of rotation. Such a structure is capable of guaranteeing that the common center of gravity of the roll mechanical arm mounting seat, the roll mechanical arm, the fixing seat and a mobile phone is located in or near the center line α of rotation when the roll mechanical arm is of a straight arm structure, and perpendicular to or close to the pitch mechanical arm; the structure is more compact, more reasonable in stress bearing, and conducive to operating during shooting.

Still further, the center line α of rotation is perpendicular to the length direction of the pitch mechanical arm, while the center line β of rotation is perpendicular to the length direction of the roll mechanical arm, thereby better facilitating mounting and arrangement.

Still further, the fixing seat and the roll mechanical arm are not parallel with an angle of inclination therebetween and with the distance between the side, close to the pitch mechanical arm, of the fixing seat and the roll mechanical arm being greater than the distance between the other side of the fixing seat and the roll mechanical arm. The provision of the angle of inclination is for the purpose of, when a large-size shooting device is used, allowing the shooting device to escape from the roll mechanical arm mounting seat to prevent mutual interference thereof.

Still further, the pitch corrected motor and the roll corrected motor are brush motors; the rotating shaft of the roll mechanical arm mounting seat and the rotating shaft of

the fixing seat are connected to the output shafts of the corresponding brush motors by means of transmission gear assemblies without backlash, respectively, and addendum circles of gears on the rotating shaft of the roll mechanical arm mounting seat and the rotating shaft of the fixing seat are larger than addendum circles of gears on the output shafts of the brush motors in radius; the rotating shaft of the roll mechanical arm mounting seat and the rotating shaft of the fixing seat are both hollow shafts with a control circuit and/or a power circuit passing through the hollow inner cavities thereof. Due to extremely high transmission accuracy requirement on power output of the portable auxiliary stabilizer for image pickup and video shooting to avoid a transmission error from causing repeated rotation of a mobile phone to affect the shooting effect, brushless motors are usually used in the industry, and the power output of each motor is of a direct output pattern. However, a brushless motor is relatively expensive, leading to a high cost of the product; moreover, in order to meet a certain output torque requirement, a motor may have a relatively large size, and consequently, the contour structure of the whole stabilizer is affected and the auxiliary stabilizer for image pickup and video shooting is inconvenient to carry. The brush motors are used in cooperation with the transmission gear assemblies without backlash, thereby allowing for flexible magnification of the output torque multiple while guaranteeing high accuracy of transmission; therefore, a motor which is smaller in size, lower in output and cheaper may be used to achieve the same output effect, thus leading to further reduction of the system power consumption and the production cost.

Still further, each transmission gear assembly without backlash comprises a first gear fixed to the output shaft of each brush motor, and a second gear and a third gear which are coaxially fixed onto the rotating shaft of the roll mechanical arm mounting seat or the rotating shaft of the fixing seat at an interval; the second gear and the third gear are identical in tooth surface shape and gear size; the second gear is a flexible gear of which an outer gear ring and an inner hub are connected by a plurality of spaced-apart flexible spokes; the outer gear ring is elastically torsional around an axis of the rotating shaft of the roll mechanical arm mounting seat or the rotating shaft of the fixing seat under load, and resiles under no load; the third gear is a rigid gear; tooth surfaces of the second gear and the third gear are staggered, and tooth profiles of one side of the third gear are exposed in tooth spaces of the corresponding second gear thereabove; the first gear is engaged with both the second gear and the third gear,

and at the engaged position, tooth profiles on both sides of the same gear tooth of the first gear tightly lean against side walls of tooth spaces on opposite sides of the second gear and the third gear, respectively.

During engaging, each gear tooth of the first gear extends into two tooth spaces, corresponding to each other up and down, of the second gear and the third gear; the tooth profile of one side of the gear tooth tightly leans against one side of the tooth space of the third gear, while the tooth profile of the other side thereof presses the other side wall, opposite to the above side wall of the tooth space of the third gear, of the tooth space of the second gear, and the outer gear ring of the second gear has a slight elastic torsion to keep that the side wall of the tooth space of the second gear tightly leans against the first gear, thereby realizing transmission without backlash. Regardless of forward or reverse rotation, the tooth clearance is always zero, thus guaranteeing high accuracy of transmission. In addition, once one tooth space of the second gear and one tooth profile of the first gear leave the engaged position, the tooth profile of the first gear stops pressing the side wall of the tooth space of the second gear to allow the tooth space to resile; therefore, the gears will not be locked even no lubrication is applied between the gears. Furthermore, the transmission ratio of the gears may be varied flexibly by adjusting the gear ratio of the first gear to two gears, i.e., the second gear and the third gear.

Still further, each transmission gear assembly without backlash comprises an elastic gear fixed to the output shaft of each brush motor, and a rigid gear fixed to the rotating shaft of the roll mechanical arm mounting seat or the rotating shaft of the fixing seat; tooth profiles of the elastic gear are elastically deformable under the action of an external force, and tooth spaces of the rigid gear are hard and rigid tooth spaces with an outer edge size of each tooth profile of the elastic gear being greater than or equal to an inner edge size of each tooth space of the rigid gear; at an engaged position of the two gears, the tooth profile of the same gear tooth of the elastic gear is elastically deformable as pressed by the walls of a corresponding tooth space of the rigid gear and tightly leans against two side walls of the same tooth space of the rigid gear, resulting in zero backlash between each tooth profile of the elastic gear and each tooth space of the rigid gear; the tooth profiles of the elastic gear resile after the elastic gear leaves the engaged position.

During engaging of the transmission gears, the tooth profiles of the elastic gear having a larger outer edge size are pressed to become smaller, the tooth profiles on both sides

tightly lean against the tooth spaces on both sides of the rigid gear. Regardless of forward or reverse rotation, the tooth clearance is always zero, thus guaranteeing high accuracy of transmission. In addition, once the tooth profiles of the elastic gear and the tooth spaces of the rigid gears leave the engaged position, the tooth spaces of the rigid gear stop pressing the tooth profiles of the elastic gear to allow the elastic gear to resile; therefore, the gears will not be locked even no lubrication is applied between the gears. In addition, such a structure has only a low requirement on the machining accuracy of the elastic gear, and only requires that the outer edge size of each tooth profile of the elastic gear is equal to or slightly larger than the inner edge size of each tooth space of the rigid gear; therefore, the production cost is relatively low.

The elastic gear is integrally formed from other similar materials having certain rigidity and certain elasticity, such as an elastic rubber gear, an elastic foam gear, an elastic silicone gear, an elastic resin gear or the like. Alternatively, the elastic gear may also be assembled with such portions for engagement with the rigid gear as the tooth profiles which are made from such elastic materials as elastic rubber, elastic foam or elastic resin, and other portions which are made from a rigid material.

Certainly, the transmission gear assembly without backlash may also be the following third transmission structure without clearance: two driven gears connected by a spring are both engaged with a driving gear, wherein one driven gear is fixed to the output shaft, while the other driven gear is a floating gear piece sleeving the output shaft. Such a structure allows the tooth surfaces of the two driven gears to be slightly staggered from each other by means of the tension of a tension spring; specifically, the left side of one tooth of one gear and the right side of one tooth of the other gear tightly lean against the left and right sides of the corresponding tooth space of the matching gear, respectively; the backlash is eliminated by means of the staggered-tooth structure, and no backlash error will be generated during reversing.

Still further, limiting blocks are disposed on the rotating shaft of the roll mechanical arm mounting seat and the rotating shaft of the fixing seat, respectively, and limiting stop pieces are correspondingly disposed at one side of each limiting block; the roll mechanical arm mounting seat is capable of rotating around the center line α of rotation by $\pm 175^\circ$ within an angle range defined by the limiting block and the limiting stop piece; and the fixing seat is capable of rotating around the center line β of rotation by $\pm 60^\circ$ within an angle range defined by the limiting block and the limiting stop piece. In consideration of a certain angle range limitation to the monitoring

accuracy of a single accelerometer and a single gyroscope, and considering that the torque output within the angle range already can completely satisfy the stability adjustment of a mobile phone by the auxiliary stabilizer for image pickup and video shooting, the angles of rotation of the roll mechanical arm mounting seat and the fixing seat may be limited by the limiting blocks and the limiting stop pieces. Moreover, since the roll mechanical arm mounting seat and the fixing seat can only rotate within a limited angle, wire cables in the shaft cavities of their hollow rotating shafts may also be prevented from being twisted or broken after multiple turns of rotation.

Still further, the roll mechanical arm and the pitch mechanical arm are both straight arms; a hollow lug boss protrudes from a side, back to the fixing seat, of the roll mechanical arm, and the roll corrected motor is located in the hollow lug boss; a positioning recess is formed in the pitch mechanical arm at a corresponding position, and when being folded for carrying, the lug boss can be elastically pressed into the positioning recess. Such a structure takes full advantage of the contour structures of the arms. The elasticity and friction of a material from which the shells of the arms are made allow for as a small contour size as possible and high portability when the stabilizer is in the folded state for carrying. Furthermore, elastic press fitting of the lug boss and the positioning recess allows for integral fixation of the roll mechanical arm and the pitch mechanical arm to prevent accidental opening.

Besides, the stabilizer may also be used in cooperation with an extendable stick to achieve a longer shooting distance, or with an unmanned aerial vehicle and the like for aerial photography, video monitoring and the like.

It needs to be noted that the positional relations such as up, down, left, right, face, back to and the like presented in the claims and description are merely relative positional relations used for the sake of convenient presentation, rather than absolutely limiting these orientations.

The present invention has the following beneficial effects.

1. Before shooting, it is helpful for a user to find out the center of gravity of a mobile phone rapidly and conveniently without any professional skills; easy operation and convenient play provide more fun in shooting; due to accurate center position of gravity, the purpose of balancing the center of gravity can be achieved with only a small torque provided by the corrected motors during shooting; the system power consumption is low, leading to obvious prolonging of the service time of the battery

after one-time charge and low heat emitted by the stabilizer.

2. A lens of a shooting device is always kept to face a subject of shooting stably, no matter how the arm of a user moves, providing a good shooting angle and high image accuracy without image dithering; thus, an ordinary device such as a mobile phone can be used to achieve a professional shooting effect.

3. The brush motor is used instead of the relatively expensive brushless motor, leading to reduction in product cost; the transmission gear assembly without backlash is used to magnify power output, thereby avoiding idle running caused by the backlashes between the gears in either forward or reverse rotation and guaranteeing a highly accurate transmission ratio; besides, the output torque can be increased manyfold, thereby allowing improvement of the load capability of the whole power system.

4. A motor smaller in size and lower in output may be used to achieve the same output effect, leading to the reduction of the size of the product, more compact structure and convenient carrying of the product, as well as reduction of the system power consumption and prolonging of the service life of the power supply battery; the wiring way of passing wires through the hollow shafts is adopted without additional use of special wire passing pipelines, allowing for more compact structure of the whole stabilizer and convenient wiring.

5. The stabilizer is small in size, low in weight, compact in arrangement after being folded, and uses small size elements, thereby really showing portability of the product.

Brief Description of the Drawings

Fig. 1 is a stereoscopic structural schematic diagram of a preferred embodiment of the present stabilizer.

Fig. 2 is a front view of Fig. 1.

Fig. 3 is a vertical view of Fig. 1.

Fig. 4 is a schematic diagram of internal connection at the joint of a roll mechanical arm and a pitch mechanical arm.

Fig. 5 is schematic diagram of internal connection at the joint of a fixing seat and a roll mechanical arm.

Fig. 6 and Fig. 7 are schematic diagrams of position changes of the roll mechanical arm and the pitch mechanical arm while an arm moves, respectively.

Fig. 8 is a schematic diagram of fitting positions of various parts in a state of being folded for carrying.

Fig. 9 is a schematic diagram of position changes of the parts when the state of being folded for carrying is switched by rotation to a state of being unfolded for operating.

Fig. 10 is a figure of a preferred power output structure.

Fig. 11 is a schematic diagram of a transmission gear structure without backlash.

Fig. 12 is an enlarged stereoscopic schematic diagram of matching of tooth profiles with tooth spaces at the engaged position of the gears in Fig. 11.

In Fig. 1 to Fig. 12, reference numerals are explained as follows: 1, pitch mechanical arm, 101, positioning recess, 2, pitch mechanical arm, 201, lug boss, 3, fixing seat, 4, pitch corrected motor, 5, pitch corrected motor, 6, roll mechanical arm mounting seat, 7, spacing projection, 8, hinger, 9, mobile phone, 10, pitch angle regulating switch, 11, first gear, 12, second gear, 121, outer gear ring, 122, inner hub, 123, spoke, 13, third gear, 14, limiting block, and 15, limiting stop piece.

Detailed Description of the Embodiments

The present invention will be further illustrated in conjunction with the accompanying drawings.

As shown in Fig. 1 to Fig. 5, a pitch mechanical arm 1 and a roll mechanical arm 2 disposed at an inverted L-shaped intersection angle are both strip-shaped straight arm structures; shells of the two arms are made of engineering plastics with certain elasticity and rigidity.

A fixing seat 3 is rotatably mounted on the front side of the left end of the roll mechanical arm 2, and has a center line β of rotation which is perpendicular to the length direction of the roll mechanical arm 2. A roll corrected motor 5 is disposed at one end of a rotating shaft of the fixing seat, and has one end slantwise mounted on the fixing seat 3 such that the distance between the end, close to the pitch mechanical arm 1, of a mobile phone 9 clamped on the fixing seat 3 and the roll mechanical arm 2 is greater than the distance between the other end of the mobile phone 9 and the roll mechanical arm 2. In this way, the ends of some large-size mobile phones 9 are located at the outer side of the roll mechanical arm mounting seat 6 to avoid mutual interference, as shown in Fig. 3.

The right end of the roll mechanical arm 2 with a center line γ of rotation is eccentrically and rotatably connected to the roll mechanical arm mounting seat 6 by

means of a hinge 8, and when the roll mechanical arm 2 is pulled to rotate around the center line γ of rotation, the roll mechanical arm 2 can be locked at any rotation position to change the included angle between the roll mechanical arm 2 and the pitch mechanical arm 1. The roll mechanical arm mounting seat 6 is rotatably connected to the upper end of the pitch mechanical arm 1, and has a center line α of rotation which is perpendicular to the length direction of the pitch mechanical arm 1, and a rotating shaft is provided with a pitch corrected motor 4.

The center line α of rotation intersects with the center line β of rotation, and the center line γ of rotation is perpendicular to a plane in which the center line α of rotation intersects with the center line β of rotation without intersecting with the center line α of rotation.

An accelerometer and a gyroscope are disposed on the fixing seat 3 and connected to the pitch corrected motor 4 and the roll corrected motor 5 by means of control units.

A spacing projection 7 with an adjustable protruded height is provided at the front side of the right end of the roll mechanical arm 2 and in the proximity of the roll mechanical arm mounting seat 6, and is capable of coming into contact with/being separated from the roll mechanical arm mounting seat 6 while the roll mechanical arm 2 rotates around the roll mechanical arm mounting seat 6. In the present embodiment, the spacing projection 7 is a limiting screw, and a threaded hole is correspondingly formed in the roll mechanical arm 2.

As shown in Fig. 4 and Fig. 5, the pitch corrected motor 4 and the roll corrected motor 5 are brush motors; the rotating shaft of the roll mechanical arm mounting seat 6 and the rotating shaft of the fixing seat 3 are connected to output shafts of the corresponding brush motors by means of transmission gear assemblies without backlash, respectively, and addendum circles of gears on the rotating shaft of the roll mechanical arm mounting seat 6 and the rotating shaft of the fixing seat 3 are larger than addendum circles of gears on the output shafts of the brush motors in radius; the rotating shaft of the roll mechanical arm mounting seat 6 and the rotating shaft of the fixing seat 3 are both hollow shafts with a control circuit and/or a power circuit passing through hollow inner cavities thereof.

As shown in Fig. 10 to Fig. 12, each transmission gear assembly without backlash comprises a first gear 11 fixed to the output shaft of each brush motor, and a second gear 12 and a third gear 13 which are coaxially fixed to the rotating shaft of the roll mechanical arm mounting seat 6 or the rotating shaft of the fixing seat 3 at an interval;

the second gear 12 and the third gear 13 are identical in tooth surface shape and gear size; the second gear 12 is a flexible gear of which an outer gear ring 121 and an inner hub 122 are connected by a plurality of spaced-apart flexible spokes 123; the outer gear ring 121 is elastically torsional around an axis of the rotating shaft of the roll mechanical arm mounting seat 6 or the rotating shaft of the fixing seat 3 under load, and resiles under no load.

The third gear 13 is a rigid gear; tooth surfaces of the second gear 12 and the third gear 13 are staggered, and tooth profiles of one side of the third gear 13 are exposed in tooth spaces of the corresponding second gear 12 thereabove; the first gear 11 is engaged with both the second gear 12 and the third gear 13, and at the engaged position, tooth profiles on both sides of a same gear tooth of the first gear 11 tightly lean against side walls of tooth spaces on opposite sides of the second gear 12 and the third gear 13, respectively. In addition, limiting blocks 14 are disposed in the gear spokes, and limiting stop pieces 15 are correspondingly disposed at one side of each limiting block 14; the roll mechanical arm mounting seat 6 is capable of rotating around the center line α of rotation by $\pm 175^\circ$ within an angle range defined by the limiting block 14 and the limiting stop piece 15; the fixing seat 3 is capable of rotating around the center line β of rotation by $\pm 60^\circ$ within an angle range defined by the limiting block 14 and the limiting stop piece 15.

As shown in Fig. 8 to Fig. 9, a hollow lug boss 201 projects from the side, back to the fixing seat 3, of the roll mechanical arm 2, and the roll corrected motor 5 is located in the hollow lug boss 201; a positioning recess 101 is formed in the pitch mechanical arm 1 at a corresponding position; when being folded for carrying, the roll mechanical arm 2 is pulled to rotate around the center line γ of rotation and the roll mechanical arm mounting seat 6 and the roll mechanical arm 2 are rotated around the center line α of rotation as a whole until the roll mechanical arm 2 is overlapped on the pitch mechanical arm 1, and then the lug boss 201 is elastically pressed into the positioning recess 101 to integrally lock the roll mechanical arm 2 and the pitch mechanical arm 1, as shown in Fig. 8.

For unfolding for operating, the roll mechanical arm mounting seat 6 and the roll mechanical arm 2 are rotated around the center line α of rotation as a whole, as shown in Fig. 9, and then the roll mechanical arm 2 is pulled around the center line γ of rotation until an inverted L-shaped intersection angle is formed between the roll mechanical arm 2 and the pitch mechanical arm 1, as shown in Fig. 1.

The center-of-gravity pre-adjustment method of the stabilizer before shooting is illustrated below with an example of a mobile phone for video shooting.

Step 1, the pitch mechanical arm 1 is vertically held by a user, while the roll mechanical arm 2 is kept to laterally extend from the left side of the pitch mechanical arm 1 and the fixing seat 3 is kept to face the user; the mobile phone 9 is clamped on the fixing seat 3 first. The dashed box in Fig. 3 is the schematic representation of the lateral clamping position of the mobile phone.

Step 2, when used for the first time, the protruded height of the spacing projection 7 needs to be adjusted in advance. When the roll mechanical arm 2 is pulled to throw the spacing projection 7 into contact with the roll mechanical arm mounting seat 6, an appropriate included angle is formed between the roll mechanical arm 2 and the pitch mechanical arm 1 to guarantee that the common center of gravity of the roll mechanical arm mounting seat 6, the roll mechanical arm 2, the fixing seat 3 and the mobile phone 9 is just located in or near the center line α of rotation when the mobile phone 9 is clamped on the fixing seat 3. The criterion for determining whether the included angle is appropriate are as follows: after the mobile phone 9 is clamped, the roll mechanical arm 2 is rotated manually to keep the screen of the mobile phone 9 in a vertical state, and after the roll mechanical arm 2 is released, the mobile phone 9 is capable of staying in the vertical state and the roll mechanical arm 2 does not turn over. For later use, if the same mobile phone is used, readjustment of the protruded height of the spacing projection 7 is needless, and only the roll mechanical arm 2 is directly pulled in place.

Step 3, the clamped position of the mobile phone 9 on the fixing seat 3 is adjusted to achieve that the common center of gravity of the mobile phone 9 and the fixing seat 3 is just located in or near the center line β of rotation. The criterion for determining whether the clamped position is appropriate is as follows: after the clamped position of the mobile phone 9 on the fixing seat 3 is adjusted manually, the mobile phone 9 kept in the vertical state as described above is kept equivalently high on the left and right ends without tilting laterally, and after the fixing seat 3 is released, the mobile phone 9 is capable of staying in the vertical state and equally high at the left and right ends without turning over.

Then, the common center of gravity of the mobile phone 9 and the fixing seat 3 is just located in or near the center line β of rotation, and the common center of gravity of the roll mechanical arm mounting seat 6, the roll mechanical arm 2, the fixing seat 3

and the mobile phone 9 is just located in or near the center line α of rotation. That is, two common centers of gravity are located at or near the intersection point of the center line α of rotation and the center line β of rotation, and the mobile phone 9 is in the balanced center position of gravity. Thus, the adjustment is finished.

During shooting, the mobile phone 9 moves along with the movement of the arm or the body of a user. In order to keep that the mobile phone 9 is unchanged in angle and always faces the subjects of shooting stably, the stabilizer controls and maintains the unchanged angle by means of two corrected motors as described below.

The user opens a power supply switch to enable a battery to supply power to the auxiliary stabilizer. The user holds the pitch mechanical arm 1, observes a subject of shooting (selfie or photographing other person) via the screen of the mobile phone 9 and rotates the pitch mechanical arm 1 to select an appropriate shooting angle. If an angular velocity and/or an angle of the mobile phone 9 around the center line β of rotation are/is monitored by the accelerometer and the gyroscope, the roll corrected motor is started to generate a reverse torque equivalent in magnitude to keep the original angles of the mobile phone 9 and the fixing seat 3. If an angular velocity and/or an angle of the mobile phone 9 around the center line α of rotation are/is monitored by the accelerometer and the gyroscope, the pitch corrected motor is started to generate a reverse torque equivalent in magnitude to keep the original angles of the mobile phone 9, the fixing seat 3, the roll mechanical arm 2 and the roll mechanical arm mounting seat 6. If simultaneous angular velocities and/or angles of the mobile phone 9 around the center line α of rotation and the center line β of rotation are monitored by the accelerometer and the gyroscope, the pitch corrected motor and the roll corrected motor are started separately to generate a reverse torque resultant equivalent in magnitude to keep the original angle of the mobile phone 9. The mobile phone 9 is always kept in the position facing the subject of shooting without change during rotation of the arm by an angle in any direction, as shown in Fig. 6 and Fig. 7.

During shooting, if a user wants to adjust the pitch angle of shooting, the pitch angle regulating switch 10 on the auxiliary stabilizer may also be adjusted to forcibly adjust the pitch corrected motor 4 and to select an appropriate shooting pitch angle by means of the control unit under the premise of keeping the balanced center of gravity of the mobile phone.

1. A portable auxiliary stabilizer for image pickup and video shooting, wherein one end of a roll mechanical arm (2) with a center line γ of rotation is rotatably connected to a roll mechanical arm mounting seat (6) which is rotatably connected to a pitch mechanical arm (1) with a center line α of rotation; a pitch corrected motor (4) is disposed on a rotating shaft of the roll mechanical arm mounting seat (6); when the roll mechanical arm (2) is pulled to rotate around the center line γ of rotation, the roll mechanical arm (2) can be kept at any pulled position to change the included angle between the roll mechanical arm (2) and the center line α of rotation; the roll mechanical arm mounting seat (6) and the roll mechanical arm (2) are capable of rotating around the center line α of rotation as a whole; a fixing seat (3) with a center line β of rotation is rotatably mounted beside a side surface of the other end of the roll mechanical arm (2); a roll corrected motor (5) is disposed on a rotating shaft of the fixing seat (3); the fixing seat (3) is capable of rotating around the center line β of rotation; the center line α of rotation intersects with the center line β of rotation, and the center line γ of rotation is perpendicular to a plane in which the center line α of rotation intersects with the center line β of rotation; an accelerometer and a gyroscope are disposed on the fixing seat (3) and connected to the pitch corrected motor (4) and the roll corrected motor (5) by means of control units; the auxiliary stabilizer is further provided with a pitch-angle regulating switch (10) which is connected to the pitch corrected motor (4) by means of a control unit; the auxiliary stabilizer has two position states: when being folded for carrying, the roll mechanical arm (2) is pulled around the center line γ of rotation, and the roll mechanical arm mounting seat (6) and the roll mechanical arm (2) are pulled to rotate around the center line α of rotation as a whole until the roll mechanical arm (2) is overlapped on the pitch mechanical arm (1); when being unfolded for operating, the roll mechanical arm (2) is pulled to rotate around the center line γ of rotation, and the roll mechanical arm mounting seat (6) and the roll mechanical arm (2) are pulled to rotate around the center line α of rotation as a whole until an inverted L-shaped intersection angle is formed between the roll mechanical arm (2) and the pitch mechanical arm (1).
2. The portable auxiliary stabilizer for image pickup and video shooting according to

claim 1, wherein

on the roll mechanical arm (2) at the same side as the fixing seat (3), a spacing projection (7) with an adjustable protruded height is provided in the proximity of the roll mechanical arm mounting seat (6); and during rotation of the roll mechanical arm (2) around the roll mechanical arm mounting seat (6), the spacing projection (7) is capable of coming into contact with/being separated from the roll mechanical arm mounting seat (6).

3. The portable auxiliary stabilizer for image pickup and video shooting according to claim 2, wherein the spacing projection (7) is a limiting screw which is screwed into a threaded hole correspondingly formed in the roll mechanical arm (2).

4. The portable auxiliary stabilizer for image pickup and video shooting according to claim 1, wherein the roll mechanical arm (2) is mounted on the roll mechanical arm mounting seat (6) off the center line α of rotation; the center line γ of rotation is located in a back side of the fixing seat (3) without intersecting with the center line α of rotation.

5. The portable auxiliary stabilizer for image pickup and video shooting according to claim 1, wherein the roll mechanical arm (2) is rotatably connected with the roll mechanical arm mounting seat (6) by means of a hinge (8).

6. The portable auxiliary stabilizer for image pickup and video shooting according to claim 1, wherein the fixing seat (3) is not parallel to the roll mechanical arm (2) with the distance between a side, close to the pitch mechanical arm (1), of the fixing seat (3) and the roll mechanical arm (2) being greater than the distance between the other side of the fixing seat (3) and the roll mechanical arm (2).

7. The portable auxiliary stabilizer for image pickup and video shooting according to claim 1, wherein

the pitch corrected motor (4) and the roll corrected motor (5) are brush motors;

the rotating shaft of the roll mechanical arm mounting seat (6) and the rotating shaft of the fixing seat (3) are connected to output shafts of the corresponding brush motors by means of transmission gear assemblies without a backlash, respectively, and addendum circles of gears on the rotating shaft of the roll mechanical arm mounting seat (6) and the rotating shaft of the fixing seat (3) are larger than addendum circles of gears on the output shafts of the brush motors in radius;

the rotating shaft of the roll mechanical arm mounting seat (6) and the rotating shaft of the fixing seat (3) are both hollow shafts, with a control circuit and/or a power

circuit passing through hollow inner cavities thereof.

8. The portable auxiliary stabilizer for image pickup and video shooting according to claim 7, wherein each transmission gear assembly without a backlash comprises a first gear (11) fixed onto the output shaft of each brush motor, and a second gear (12) and a third gear (13) which are coaxially fixed onto the rotating shaft of the roll mechanical arm mounting seat (6) or the rotating shaft of the fixing seat (3) at an interval;

the second gear (12) and the third gear (13) are identical in tooth surface shape and gear size;

the second gear (12) is a flexible gear of which an outer gear ring (121) and an inner hub (122) are connected by a plurality of spaced-apart flexible spokes (123); the outer gear ring (121) is elastically torsional around an axis of the rotating shaft of the roll mechanical arm mounting seat (6) or the rotating shaft of the fixing seat (3) relative to the inner hub (122) under load, and resiles under no load;

the third gear (13) is a rigid gear; tooth surfaces of the second gear (12) and the third gear (13) are staggered, and tooth profiles of one side of the third gear (13) are exposed in the tooth spaces of the corresponding second gear (12) thereabove;

the first gear (11) is engaged with both the second gear (12) and the third gear (13), and at the engaged position, tooth profiles on both sides of the same gear tooth of the first gear (11) tightly lean against the side walls of tooth spaces on opposite sides of the second gear (12) and the third gear (13), respectively.

9. The portable auxiliary stabilizer for image pickup and video shooting according to claim 7, wherein each transmission gear assembly without a backlash comprises an elastic gear fixed to the output shaft of each brush motor, and a rigid gear fixed to the rotating shaft of the roll mechanical arm mounting seat (6) or the rotating shaft of the fixing seat (3);

tooth profiles of the elastic gear are elastically deformable under the action of an external force, and tooth spaces of the rigid gear are hard and rigid tooth spaces with an outer edge size of each tooth profile of the elastic gear being greater than or equal to an inner edge size of each tooth space of the rigid gear;

at an engaged position of the two gears, the tooth profile of a same gear tooth of the elastic gear is elastically deformable as pressed by the walls of a corresponding tooth space of the rigid gear and tightly leans against two side walls of the same tooth space of the rigid gear, resulting in zero backlash between each tooth profile of the elastic

gear and each tooth space of the rigid gear; and the tooth profiles of the elastic gear resile after the elastic gear leaves the engaged position.

10. The portable auxiliary stabilizer for image pickup and video shooting according to claim 7, wherein limiting blocks (14) are disposed on the rotating shaft of the roll mechanical arm mounting seat (6) or the rotating shaft of the fixing seat (3), respectively, and limiting stop pieces (15) are correspondingly disposed at one side of each limiting block (14);

the roll mechanical arm mounting seat (6) is capable of rotating around the center line α of rotation by $\pm 175^\circ$ within an angle range defined by the limiting block (14) and the limiting stop piece (15); and

the fixing seat (3) is capable of rotating around the center line β of rotation by $\pm 60^\circ$ within an angle range defined by the limiting block (14) and the limiting stop piece (15).

11. The portable auxiliary stabilizer for image pickup and video shooting according to claim 1, wherein

the roll mechanical arm (2) and the pitch mechanical arm (1) are both straight arms; a hollow lug boss (201) projects from a side, back to the fixing seat (3), of the roll mechanical arm (2), and the roll corrected motor (5) is located in the hollow lug boss (201); a positioning recess (101) is formed in the pitch mechanical arm (1) at a corresponding position, and when being folded for carrying, the lug boss (201) can be elastically pressed into the positioning recess (101).

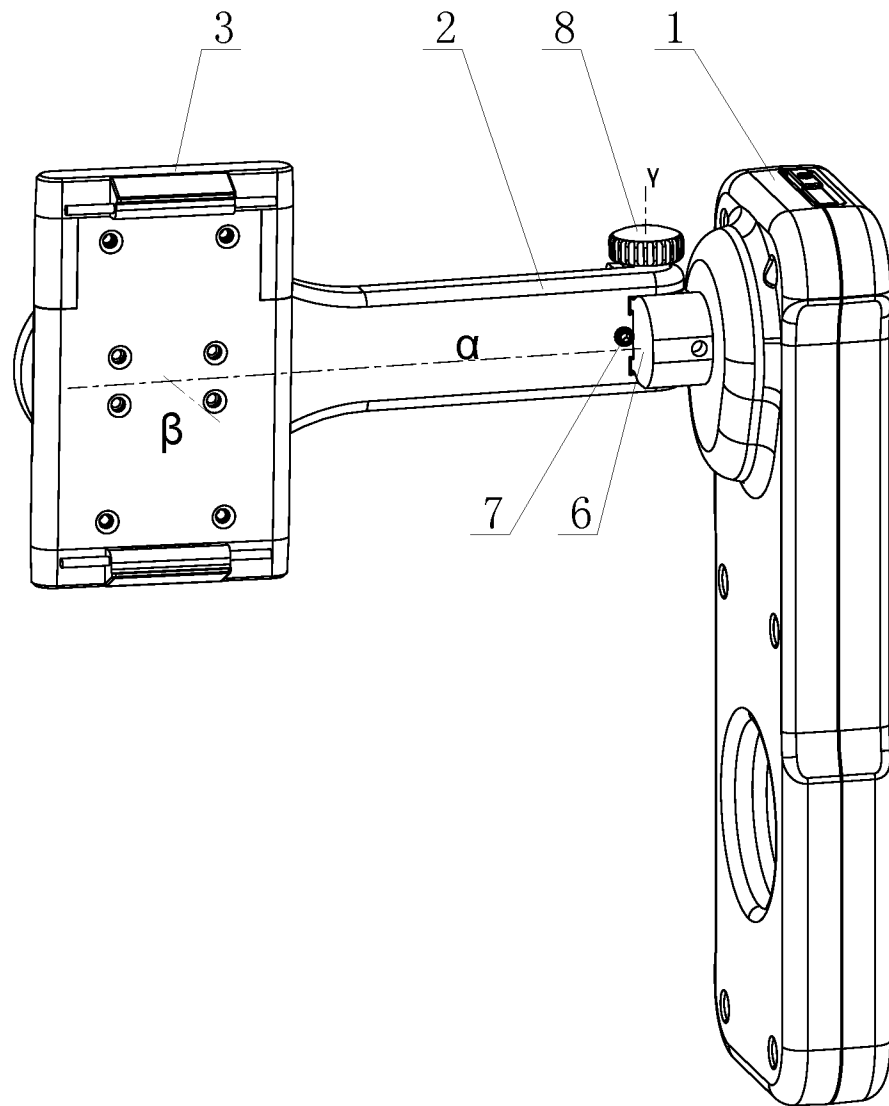


Fig. 1

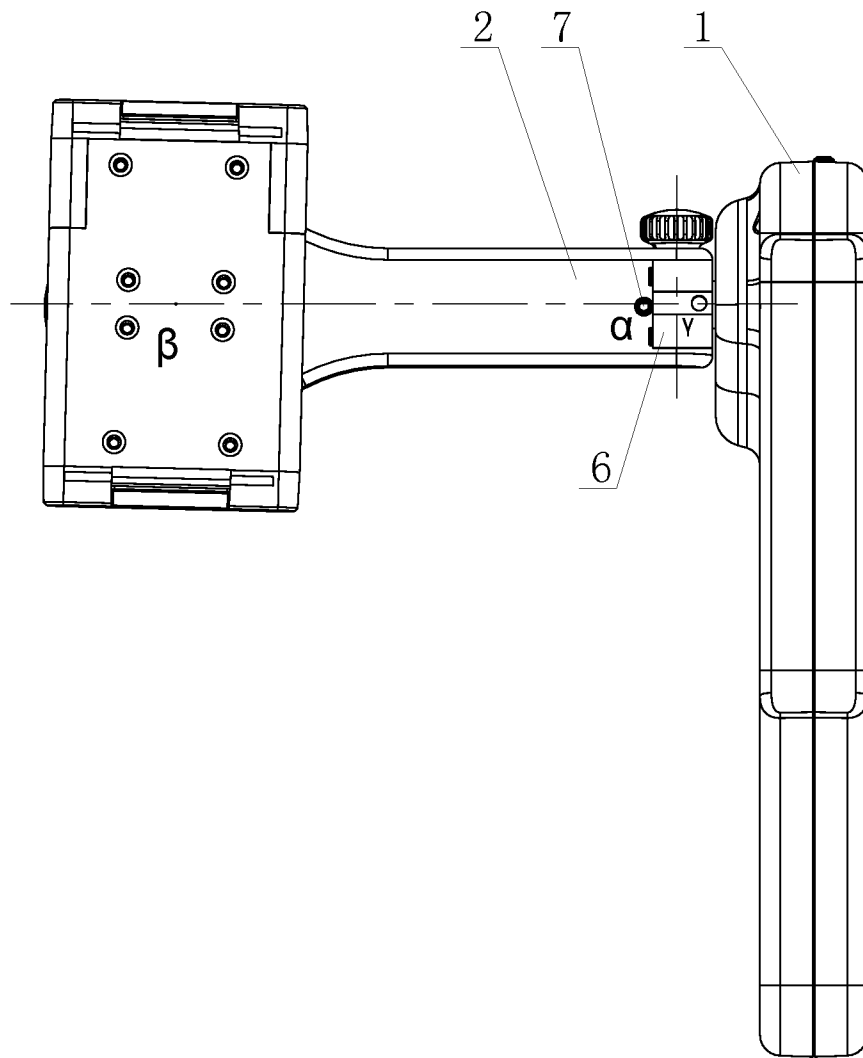


Fig. 2

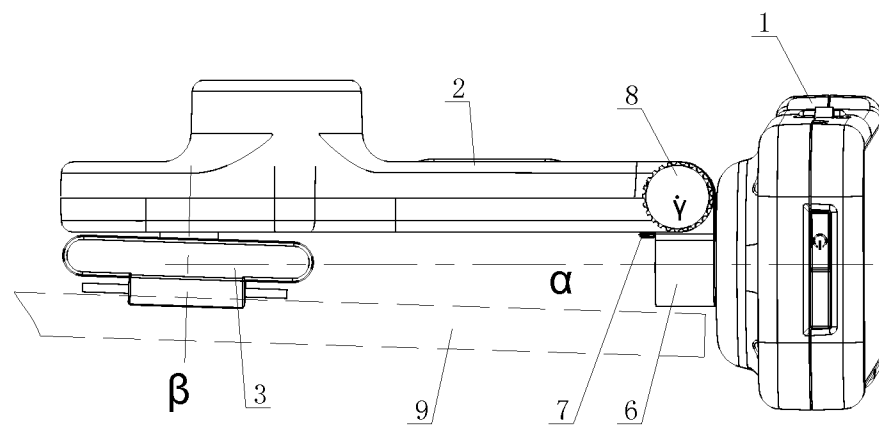


Fig. 3

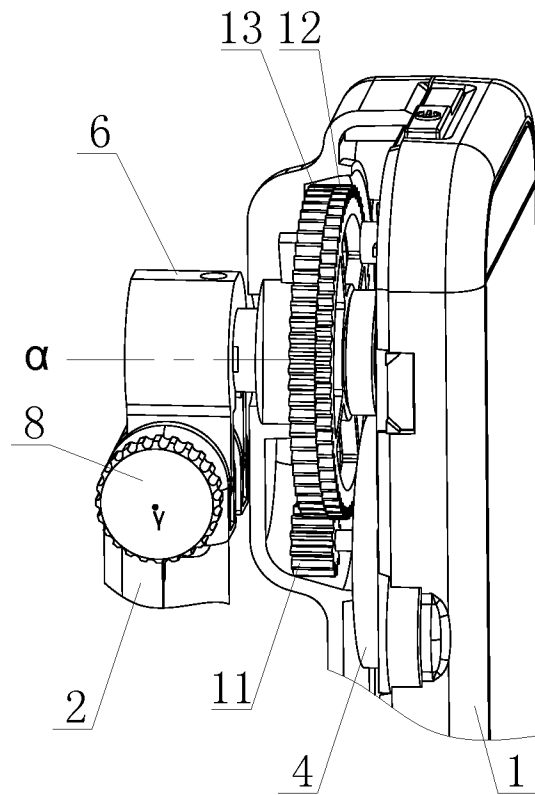


Fig. 4

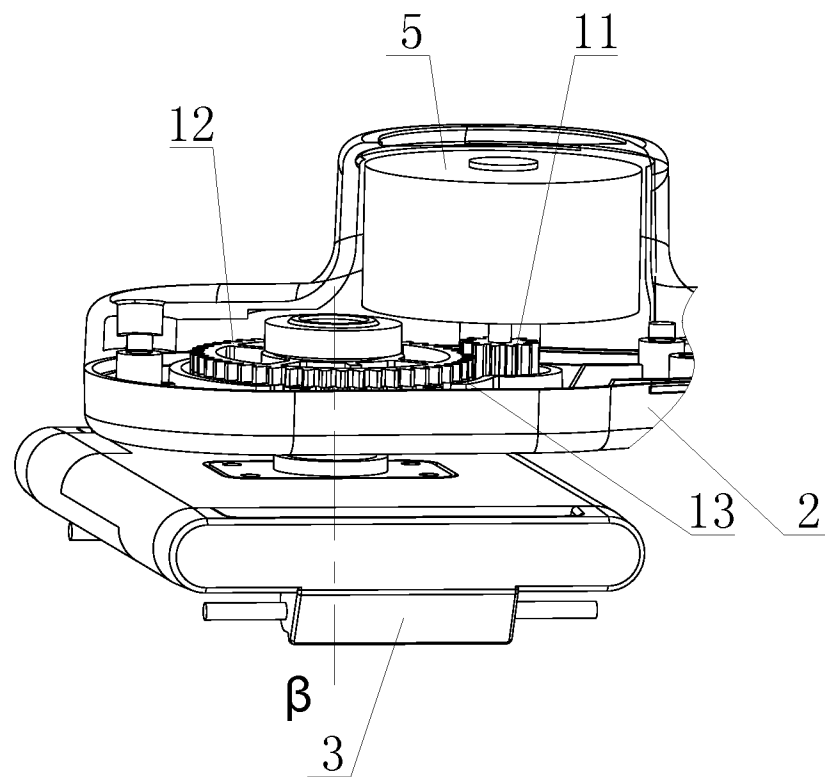


Fig. 5

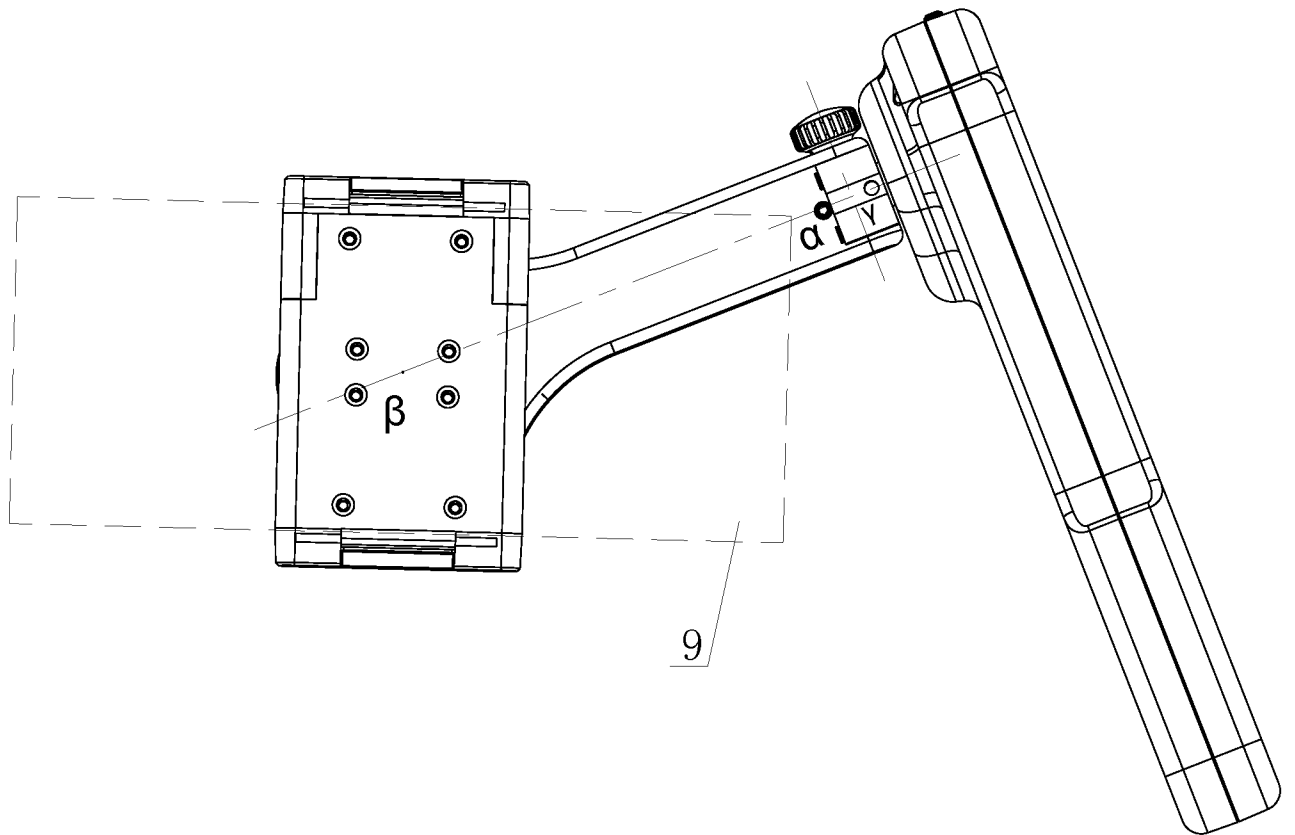


Fig. 6

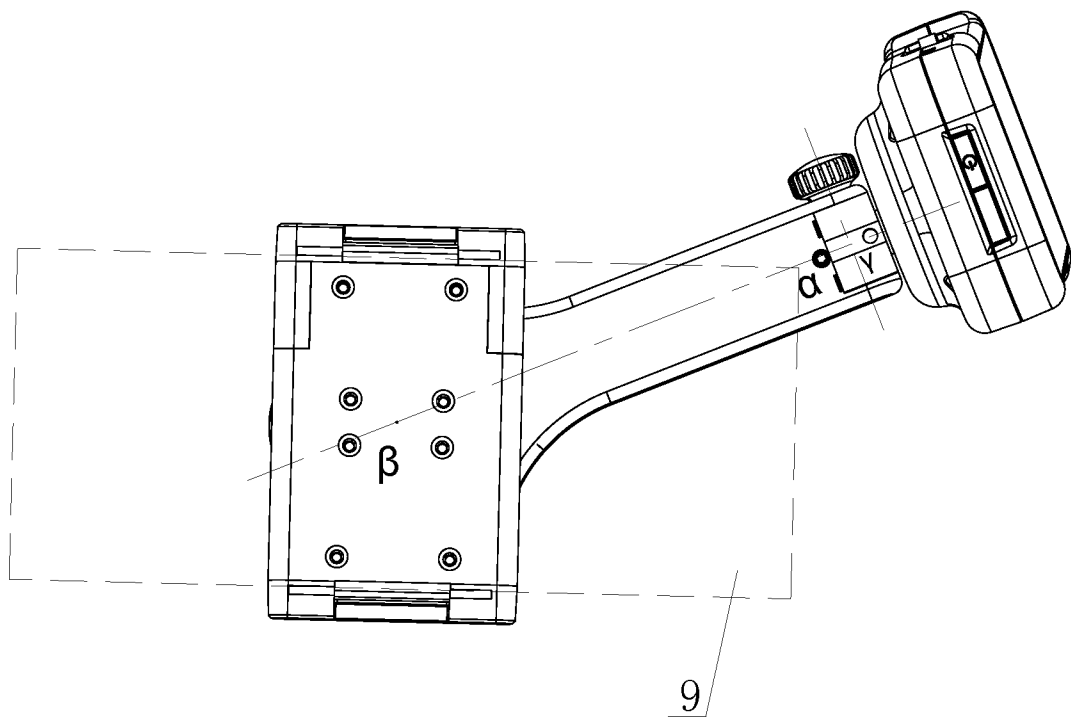


Fig. 7

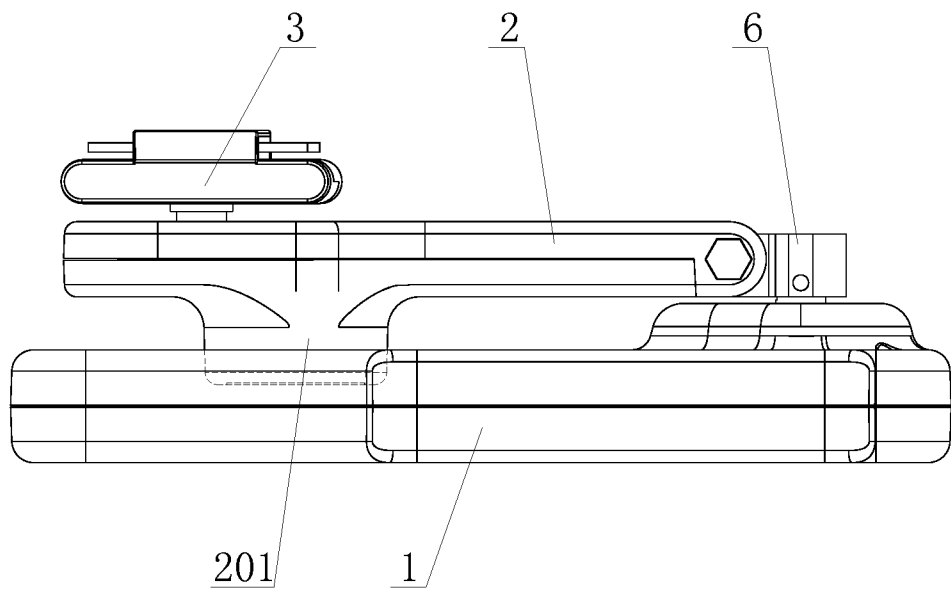


Fig. 8

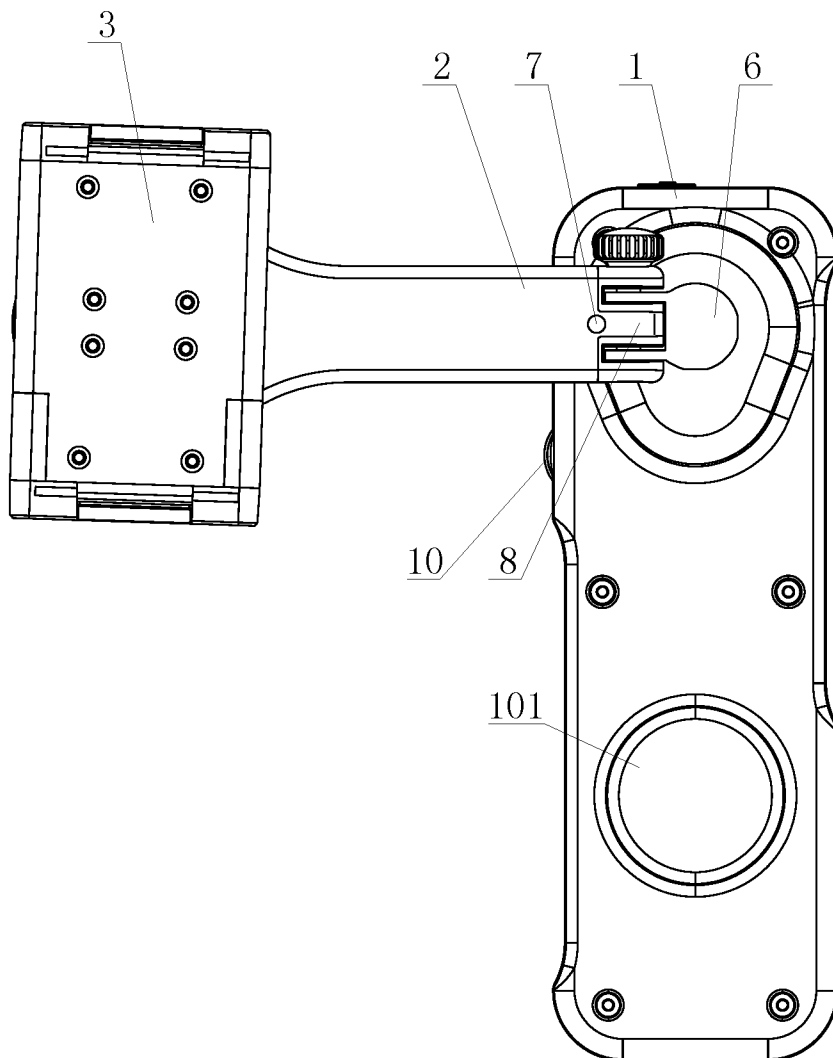


Fig. 9

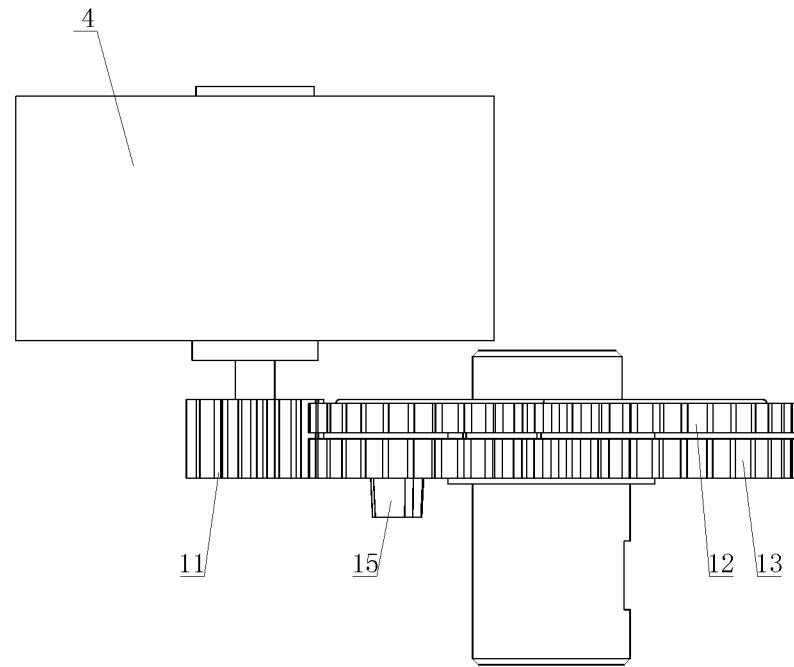


Fig. 10

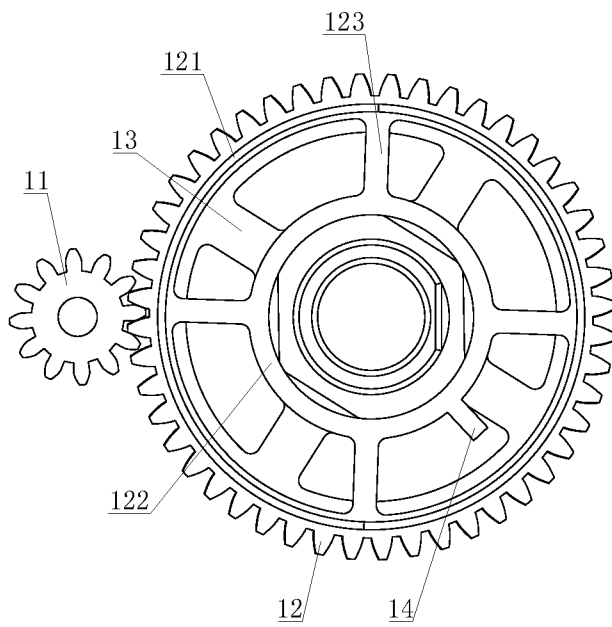


Fig. 11

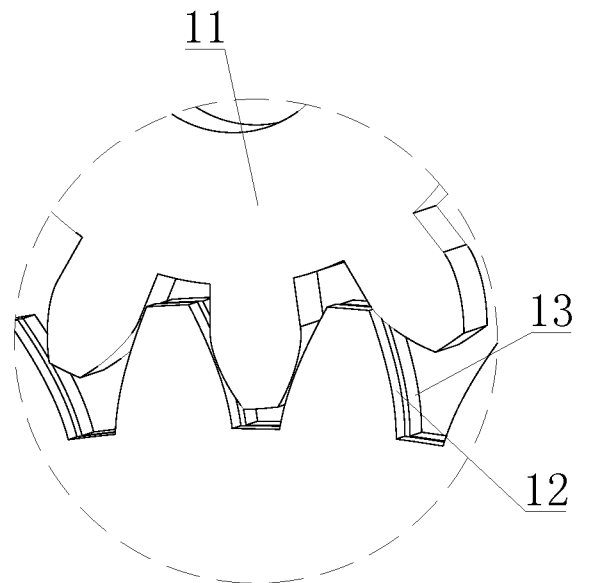


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/107523

A. CLASSIFICATION OF SUBJECT MATTER

G03B 17/56(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G03B17,F16M

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

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

CNABS,CNXTX,CNKI,DWPI,SIPOABS:camera,stabili+,motor,rotat+,fold+,unfold+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 205402194 U (SHANGHAI RUIPAI INTELLIGENT TECH LLC) 27 July 2016 (2016-07-27) claims1-11	1-11
A	CN 103984193 A (GUANGZHOU HONGTIAN AVIAT SCIENCE AND TECHNOLOGY CO LTD) 13 August 2014 (2014-08-13) see description, paragraphs 64-68 and figure 4	1-11
A	CN 202735658 U (ZHONGSHAN DASHAN PHOTOGRAPHIC EQUIP CO) 13 February 2013 (2013-02-13) the whole document	1-11
A	CN 204879379 U (BOSTAR PLASTIC HARDWARE PRODUCT CO LTD) 16 December 2015 (2015-12-16) the whole document	1-11
A	GB 2495908 B (VITEC GROUP PLC) 30 July 2014 (2014-07-30) the whole document	1-11
A	US 2014191094 A1 (IND REVOLUTION INC) 10 July 2014 (2014-07-10) the whole document	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

28 December 2016

Date of mailing of the international search report

17 February 2017

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/107523

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	205402194	U	27 July 2016	None			
CN	103984193	A	13 August 2014	EP	2919064	A1	16 September 2015
				JP	2015177539	A	05 October 2015
				WO	2015135310	A1	17 September 2015
				US	2015261070	A1	17 September 2015
CN	202735658	U	13 February 2013	None			
CN	204879379	U	16 December 2015	None			
GB	2495908	B	30 July 2014	US	8970778	B2	03 March 2015
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				GB	2495837	B	29 July 2015
				US	9094591	B2	28 July 2015
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