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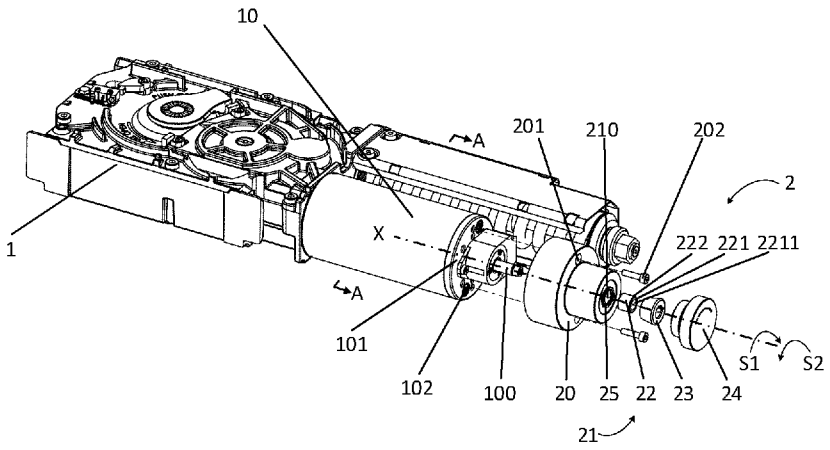


FIG.1

(57) Abstract: The present application relates to a damping device for a door closer, and the door closer includes a motor including a motor shaft and a fixing base. The damping device includes a base block, a damping mechanism and an adjustment mechanism. The base block is fixed to the fixing base and includes a first through hole, and the motor shaft is inserted into the first through hole. The damping mechanism is arranged in the first through hole, and at least a part of the damping mechanism is fixedly connected to the motor shaft. The adjustment mechanism is operatively connected to the damping mechanism and is configured to adjust damping of the damping. When the motor shaft is rotated in a first direction, at least a part of the damping mechanism is capable of being rotated along with the motor shaft in the first direction, and the damping mechanism does not provide damping to the motor shaft. When the motor shaft is rotated in a second direction, at least a part of the damping mechanism is capable of being rotated along with the motor shaft in the second direction, and the damping mechanism provides damping to the motor shaft. The damping device provided in the embodiment of the present application is capable of providing adjustable delayed time for an electric door closing.

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DAMPING DEVICE

TECHNICAL FIELD

[0001] The present application relates to the technical field of a door closer, and in particular to a damping device for the door closer.

BACKGROUND

[0002] An automatic door is widely applied due to its convenience in opening and closing, for example, the automatic door could be applied in a fire door. In some application scenarios, it is necessary to delay closing time of the automatic door, for example, in "Fire Rescue Industry Standard of the People's Republic of China" with the standard No. XF93-2004, a maximum closing time of the fire door (i.e., a maximum time required for self-closing when a speed control valve of a door closer of the fire door is closed completely and a door leaf is opened at an angle of 70°) is required to be no less than 20s. Generally, a hydraulic valve is commonly used to achieve the maximum closing time described above. However, on the one hand, the hydraulic valve is not suitable for a door closer of an electric door, on the other hand, the hydraulic valve has disadvantages of complex structure, easy leakage, short service life, or the like.

SUMMARY

[0003] Based on this, it is necessary to address the above problems to provide a damping device suitable for a door closer of an electric door. The damping device is capable of delaying closing time of the electric door, and has advantages of simple structure, adjustable delayed time of the door closing, long service life, or the like.

[0004] In order to achieve the above object, a damping device for a door closer according

to the present application is provided, the door closer includes a motor, and the motor includes a motor shaft and a fixing base. The damping device includes a base block, a damping mechanism and an adjustment mechanism. The base block is fixed to the fixing base and includes a first through hole, and the motor shaft is inserted into the first through hole. The damping mechanism is arranged in the first through hole, and at least a part of the damping mechanism is fixedly connected to the motor shaft. The adjustment mechanism is operatively connected to the damping mechanism and is configured to adjust a damping of the damping mechanism. When the motor shaft is rotated in a first direction, at least a part of the damping mechanism is capable of being rotated along with the motor shaft in the first direction, and the damping mechanism does not provide the damping to the motor shaft; when the motor shaft is rotated in a second direction, at least a part of the damping mechanism is capable of being rotated along with the motor shaft in the second direction, and the damping mechanism provides the damping to the motor shaft.

[0005] The damping device provided in the embodiment of the present application is capable of providing an adjustable delayed time for the electric door closing, and satisfying requirements for the delayed time of a closure of the automatic door in various application scenarios. In particular, it can satisfy the requirements for a maximum closing time of a fire door in "Fire Rescue Industry Standard of the People's Republic of China" with the standard No. XF93-2004. Further, the damping device provided in the embodiment of the present application has advantages of simple structure, long service life, or the like.

[0006] In an embodiment, the first through hole includes a first portion and a second portion. The first portion has a first diameter, and the first diameter is greater than a diameter of the motor shaft. The second portion is adjoined to the first portion, a minimum diameter of the second portion is greater than the first diameter, and a stepped surface is formed between the second portion and the first portion. In a radial direction of the motor shaft, the first portion and the second portion are arranged in sequence in a direction away from the fixing base of the motor.

[0007] In an embodiment, the damping mechanism includes a one way clutch bearing, the one way clutch bearing includes an inner bearing member and an outer bearing member, the inner bearing member has a second through hole, and the motor shaft is inserted into and fixedly connected to the second through hole. When the motor shaft is rotated in the first direction, the

inner bearing member is rotated along with the motor shaft in the first direction, the inner bearing member is incapable of driving the outer bearing member to be rotated in the first direction, and the damping mechanism does not provide damping to the motor shaft. When the motor shaft is rotated in the second direction, the inner bearing member is rotated in the second direction along with the motor shaft, the inner bearing member drives the outer bearing member to be rotated in the second direction, and the damping mechanism provides damping to the motor shaft via the outer bearing member.

[0008] In an embodiment, the second portion of the first through hole includes a conical section, a diameter of the conical section, in the radial direction of the motor shaft, increases gradually in a direction away from the stepped surface. The damping device includes a first elastic member and a spacer bush. The first elastic member is arranged in the second portion of the first through hole and is arranged around the motor shaft, and an end of the first elastic member abuts against the stepped surface of the first through hole. The spacer bush has a conical shape matched with the conical section of the second portion, an outer diameter of the spacer bush, in the radial direction of the motor shaft, increases gradually in the direction away from the stepped surface, an outer surface of the spacer bush in a radial direction abuts against an inner wall of the conical section of the second portion of the first through hole, an end of the spacer bush toward the stepped surface abuts against another end of the first elastic member, the spacer bush further has a third through hole, and the one way clutch bearing being is arranged in the third through hole. The hole wall of the third through hole of the spacer bush abuts against the outer bearing member, when the outer bearing member is rotated along with the inner bearing member and the motor shaft, a friction force between the spacer bush and the outer bearing member prevents the rotation of the outer bearing member, and therefore damping against the rotation of the motor shaft is provided to the motor shaft.

[0009] In an embodiment, the adjustment mechanism abuts against an end of the spacer bush away from the stepped surface and is capable of moving toward or away from the stepped surface. When the adjustment mechanism moves toward the stepped surface, the adjustment mechanism pushes the spacer bush to move toward the stepped surface and is inserted into a portion of the conical section of the second portion with a lesser diameter, so that the inner wall of the conical section of the second portion presses the spacer bush, a diameter of the third through hole of the spacer bush decreases, and the pressing of the hole wall of the third through

hole of the spacer bush against the outer bearing member increases. If the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the outer bearing member and the spacer bush increases because the pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member increases, and therefore the damping provided to the motor shaft increases. When the adjustment mechanism moves away from the stepped surface, the adjustment mechanism gradually releases a push on the spacer bush, under the action of the first elastic member, the spacer bush moves in the direction away from the stepped surface and is inserted into a portion of the conical section of the second portion with a greater diameter, the pressing of the inner wall of the conical section of the second portion against the spacer bush decreases, so that the diameter of the third through hole of the spacer bush increases, and the pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member decreases. If the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the outer bearing member and the spacer bush decreases because the pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member decreases, and therefore the damping provided to the motor shaft decreases.

[0010] In an embodiment, the adjustment mechanism is an adjustment knob, the adjustment knob includes a control portion and a connecting portion, the connecting portion is arranged on a side of the control portion toward the damping mechanism, and an outer wall of the connecting portion is provided with a first thread. The first through hole of the base block further includes a third portion, the first portion, the second portion and the third portion are arranged in sequence in the direction away from the fixing base of the motor in the radial direction of the motor shaft, and at least a part of the inner wall of the third portion is provided with a second thread which is capable of being engaged with the first thread. The adjustment knob is in threaded connection to the third portion of the first through hole via the connecting portion, and when the connecting portion moves to at least a part of its threaded connection stroke in a direction toward the stepped surface, an end of the connecting portion toward the stepped surface abuts against the damping mechanism.

[0011] In an embodiment, the damping mechanism includes a connecting member and a damper. The connecting member has a fourth through hole, the one way clutch bearing is

arranged in and the outer bearing member is fixedly connected to the fourth through hole. The damper includes an output shaft and an adjustment end, the output shaft is inserted and fixedly connected in the fourth through hole, the adjustment end operatively is connected to the adjustment mechanism, and the adjustment mechanism adjusts the damping output from the output shaft via the adjustment end. The outer bearing member and the output shaft of the damper become a whole via the connecting member. When the outer bearing member is rotated along with the inner bearing member and the motor shaft, the damping output from the output shaft of the damper prevents the rotation of the outer bearing member, and therefore a damping against the rotation of the motor shaft is provided to the motor shaft.

[0012] In an embodiment, the adjustment mechanism is an adjustment knob, the adjustment knob is fixedly connected to the adjustment end of the damper, and by rotating the adjustment knob, the adjustment end is driven to be rotated to adjust the damping output from the output shaft.

[0013] In an embodiment, the damping mechanism includes a friction plate and a connecting flange. The friction plate is arranged in the second portion of the first through hole and abuts against the stepped surface, and the friction plate having a fifth through hole. The connecting flange includes a first fixing portion, a friction portion, a second fixing portion, and a sixth through hole which are arranged coaxially. The outer bearing member of the one way clutch bearing is fixedly connected in the sixth through hole, the first fixing portion is extended trough the fifth through hole, and a side of the friction portion toward the stepped surface abuts against the friction plate. When the outer bearing member is rotated along with the inner bearing member and the motor shaft, a friction force between the friction plate and the friction portion of the connecting flange prevents a rotation of the outer bearing member, and therefore a damping against the rotation of the motor shaft is provided to the motor shaft.

[0014] In an embodiment, the adjustment mechanism is capable of pushing a side of the friction portion away from the stepped surface, and the adjustment mechanism is capable of moving toward or away from the stepped surface. When the adjustment mechanism moves toward the stepped surface, the adjustment mechanism pushes the connecting flange so that pressing of the friction portion of the connecting flange against the friction plate increase. If the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the friction

plate and the friction portion of the connecting flange increases because the pressing of the friction portion of the connecting flange on the friction plate increases, and therefore the damping provided to the motor shaft increases. When the adjustment mechanism moves away from the stepped surface, the adjustment mechanism gradually releases a push on the connecting flange so that the pressing of the friction portion of the connecting flange against the friction plate decrease. If the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the friction plate and the friction portion of the connecting flange decreases because the pressing of the friction portion of the connecting flange against the friction plate decreases, and therefore the damping provided to the motor shaft decreases.

[0015] In an embodiment, the damping device further includes an anti-lock mechanism. The anti-lock mechanism is arranged between the damping mechanism and the adjustment mechanism. An end of the anti-lock mechanism abuts againstthe side of the friction portion away from the stepped surface, another end of the anti-lock mechanism abuts against the adjustment mechanism, the adjustment mechanism is capable of abutting against the side of the friction portion away from the stepped surface via the anti-lock mechanism, and the anti-lock mechanism is configured to prevent the motor shaft from stalling due to excessive friction force between the friction plate and the friction portion of the connecting flange when a maximum pushing force is applied by the adjustment mechanism. In the present embodiment, the damping device is capable of preventing the closing action of the door sheet from being terminated due to excessive damping.

[0016] In an embodiment, the anti-lock mechanism includes a thrust bearing and a second elastic member. An end of the thrust bearing abuts against the side of the friction portion away from the stepped surface. An end of the second elastic member abuts against another end of the thrust bearing, and another end of the second elastic member abuts against the adjustment mechanism.

[0017] In an embodiment, the adjustment mechanism is an adjustment knob, the adjustment knob includes a control portion and a connecting portion, the connecting portion is arranged on a side of the control portion toward the damping mechanism, and an outer wall of the connecting portion is provided with a first thread. At least one part of the inner wall of the second portion of the first through hole of the base block is provided with a second thread

which is capable of being engaged with the first thread. The adjustment knob is in threaded connection to the second portion of the first through hole via the connecting portion, and when the connecting portion moves in a direction toward the stepped surface, the connecting portion abuts against the damping mechanism via the anti-lock mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other objects, features and advantages of the present disclosure will become more apparent from a more detailed description of the preferred embodiments of the present application shown in the accompanying drawings. The same reference numerals refer to the same parts throughout the drawings, the drawings are not intentionally scaled to actual size, and focus on illustrating the subject matter of the present application.

[0019] Other features, objects and advantages of the present application will become more apparent upon reading the detailed description of non-limiting embodiments taken with reference to the following drawings:

[0020] FIG. 1 is a partially exploded view of a door closer equipped with a damping device according to an embodiment of the present application;

[0021] FIG. 2 is a partial sectional view of the door opener shown in FIG. 1 along a direction A-A;

[0022] FIG. 3 is a partially exploded view of a door closer equipped with a damping device according to another embodiment of the present application;

[0023] FIG. 4 is a partial sectional view of the door opener shown in FIG. 3 along a direction B-B;

[0024] FIG. 5 is a partially exploded view of a door closer equipped with a damping device according to a further embodiment of the present application; and

[0025] FIG. 6 is a partial sectional view of the door opener shown in FIG. 5 along a direction C-C.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] In order to facilitate understanding of the present disclosure, the present application is described more fully below with reference to the related drawings. Preferred embodiments of the present application are shown in the accompanying drawings. However, the present invention may be implemented in many different forms and is not limited to the embodiments described herein. Rather, these embodiments are provided to enable a more thorough and complete understanding of the present application.

[0027] It should be noted that when an element is referred to as being "connected" to another element, it may be directly connected to and integrated with the other element, or an intervening element may also be present. The terms "mounting", "an end", "another end" and similar expressions used herein are for illustrative purposes only.

[0028] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the technical field to which the present application belongs. The terms used herein in the specification of the present application are for the purpose of describing specific embodiments only, and are not intended to limit the present disclosure. The term "and/or" used herein includes any and all combinations of one or more of the associated listed items.

[0029] Referring to FIGS. 1 and 2, in the embodiment shown in FIGS. 1 and 2, a damping device 2 connected to a door closer 1 is provided. The door closer 1 includes a motor 10, the motor 10 includes a motor shaft 100 and a fixing base 101, and the motor 10 is configured to drive a door sheet (not shown) connected to the door closer 1 to open and close. Optionally, the door closer 1 is, for example, a door closer of an electric door. The structure and function of the door closer 1 are well known to those skilled in the art and are not described herein.

[0030] In the present embodiment, the damping device 2 includes a base block 20, a damping mechanism 21 and an adjustment mechanism 24. The motor shaft 100 is inserted into the base block 20 and is fixedly connected to at least a part of the damping mechanism 21, and the adjustment mechanism 24 is operatively connected to the damping mechanism 21. When the door sheet is opened, the motor shaft 100 is rotated, for example, in a first direction S1, at least a part of the damping mechanism 21 is capable of being rotated along with the motor shaft 100 in the first direction S1, and the damping mechanism 21 does not provide a damping to the

motor shaft 100. When the door sheet is closed, the motor shaft 100 is rotated, for example, in a second direction S2, at least a part of the damping mechanism 21 is capable of being rotated along with the motor shaft 100 in the second direction S2, the damping mechanism 21 provides the damping to the motor shaft 100, and therefore closing time of the door sheet is delayed. Optionally, the first direction S1 and the second direction S2 can be arranged reversely, i.e., when the door sheet is opened, the motor shaft 100 is rotated, for example, in the second direction S2, at least a part of the damping mechanism 21 is capable of being rotated along with the motor shaft 100 in the second direction S2, and the damping mechanism 21 does not provide the damping to the motor shaft 100. When the door sheet is closed, the motor shaft 100 is, for example, rotated in the first direction S1, at least a part of the damping mechanism 21 is capable of being rotated along with the motor shaft 100 in the first direction S1, the damping mechanism 21 provides the damping to the motor shaft 100, and therefore the closing time of the door sheet is delayed. It should be understood by those skilled in the art that the damping device 2 according to an embodiment of the present application provides the damping to the motor shaft 100 at least when the door sheet is closed, so as to delay the door sheet closing. Via the adjustment mechanism 24, the damping provided by the damping mechanism 21 to the motor shaft 100 is capable of being adjusted, and therefore the delayed time of the door sheet closing is adjusted.

[0031] Referring to FIG. 1, the base block 20 is fixedly connected to a fixing base 101. Specifically, in the present embodiment, the base block 20 is provided with at least two first bolt holes 201, which are arranged in a radial direction of the base block 20. The fixing base 101 is provided with second bolt holes 102 in the same number as the first bolt holes 201, and the two second bolt holes are arranged in the radial direction of the fixing base 101. Each of the first bolt holes 201 and each of the second bolt holes 102 are capable of being aligned with each other in an axial direction when the base block 20 is assembled to the fixing base 101. By inserting bolts 202 into the first bolt holes 201 and the second bolt holes 102 which are aligned with each other in the axial direction, the fixed connection of the base block 20 with the fixing base 101 is achieved. It should be realized by those skilled in the art that while the two radially arranged first bolt holes 201 and the two radially arranged second bolt holes 102 are shown in FIGS. 1 and 2, they are exemplary only, and the number and arrangement of the first bolt holes 201 and the second bolt holes 102 can be arbitrarily selected according to actual requirements,

which is not limited herein. Optionally, fixed connection between the base block 20 and the fixing base 101 can also be achieved by other suitable connection means, for example, by threaded connection, by snap-on connection, or the like.

[0032] Referring to FIGS. 1 and 2, the base block 20 includes a first through hole 210 into which a motor shaft 100 is coaxially inserted. In the present embodiment, the first through hole 210 includes a first portion 211 and a second portion 212. The first portion 211 has a first diameter that is greater than a diameter of the motor shaft 100 to allow the motor shaft 100 to be inserted into the first through hole 210. The second portion 212 is adjoined to the first portion 211, and a minimum diameter of the second portion 212 is greater than the first diameter, and therefore a stepped surface 2120 is formed between the second portion 212 and the first portion 211. In an axial direction X of the motor shaft 100, the first portion 211 and the second portion 212 are arranged in sequence in a direction away from the fixing base 101 of the motor 10.

[0033] Still referring to FIGS. 1 and 2, the damping mechanism 21 is arranged in the first through hole 210, and at least a part of the damping mechanism 21 is fixedly connected to the motor shaft 100. In the present embodiment, the damping mechanism 21 includes a one way clutch bearing 22, the one way clutch bearing 22 includes an inner bearing member 221 and an outer bearing member 222, the inner bearing member 221 has a second through hole 2211, and the motor shaft 100 is inserted into and fixedly connected to the second through hole 2211. The structure and function of the one way clutch bearing 22 are well known to those skilled in the art and are not described herein. When the door sheet is opened, the motor shaft 100 is rotated, for example, in the first direction S1 and the inner bearing member 221 is rotated along with the motor shaft 100 in the first direction S1 because the motor shaft 100 is inserted into and fixedly connected to the second through hole 2211 of the inner bearing member 221. At this time, based on the inherent characteristics of the one way clutch bearing 22, the inner bearing member 221 is incapable of driving the outer bearing member 222 to be rotated in the first direction, and therefore the damping mechanism 21 does not provide the damping to the motor shaft 100. When the door sheet is closed, the motor shaft 100 is rotated, for example, in the second direction S2, the inner bearing member 221 is rotated along with the motor shaft 100 in the second direction S2. At this time, based on the inherent characteristics of the one way clutch bearing 22, the inner bearing member 221 drives the outer bearing member 222 to be rotated in the second direction S2 and the damping mechanism 21 provides the damping to the motor

shaft 100 via the outer bearing member 222, and therefore a delayed closing of the door is achieved. Optionally, similar to the above, the first direction S1 and the second direction S2 can also be arranged reversely.

[0034] Specifically, the second portion 212 of the first through hole 210 includes a conical section, and a diameter of the conical section, in the axial direction X of the motor shaft 100, increases gradually in a direction away from the stepped surface. The damping mechanism 21 further includes a first elastic member 25 and a spacer bush 23. Preferably, the first elastic member 25 is a wave spring. Optionally, the first elastic member 25 can be other suitable elastic member, such as a pressure spring, a rubber spring, a sheet spring, or the like, and the first elastic member 25 can be reasonably selected according to actual use requirements, which is not limited in the present application. The first elastic member 25 is arranged in the second portion 212 of the first through hole 210 and is arranged around the motor shaft 100, and an end of the first elastic member 25 abuts against the stepped surface 2120 of the first through hole 210. In the present embodiment, the spacer bush 23 has a shape of a truncated cone, an outer contour of the cone of the spacer bush 23 is matched with the conical section of the second portion 212, an outer diameter of the spacer bush 23, in the axial direction X of the motor shaft 100, increases gradually in the direction away from the stepped surface 2120, an outer surface of the spacer bush 23 in the radial direction abuts against an inner wall of the conical section of the second portion 212 of the first through hole 210, and an end of the spacer bush 23 toward the stepped surface 2120 abuts against another end of the first elastic member 25. The spacer bush 23 further has a third through hole 231 and is coaxially sleeved on the outer bearing member 222 of the one way clutch bearing 22, and therefore the one way clutch bearing 22 is accommodated in the third through hole 231 of the spacer bush 23. Because a hole wall of the third through hole 231 of the spacer bush 23 abuts against the outer bearing member 222, i.e., the hole wall of the third through hole 231 applies a pressing force on the outer bearing member 222, a friction force, which can prevent the rotation of the outer bearing member 222, is generated between the spacer bush 23 and the outer bearing member 222 when the outer bearing member 222 is rotated along with the inner bearing member 221 and the motor shaft 100, and therefore the damping against the rotation of the motor shaft 100 is provided to the motor shaft 100. Specifically, when the door sheet is opened, the motor shaft 100 is rotated, for example, in the first direction S1, and the inner bearing member 221 is rotated along with the motor shaft

100 in the first direction S1. At this time, based on the inherent characteristics of the one way clutch bearing 22, the inner bearing member 221 is incapable of driving the outer bearing member 222 to be rotated in the first direction S1, i.e., the outer bearing member 222 does not cause any obstruction to the rotation of the motor shaft 100, and therefore does not provide the damping against the rotation of the motor shaft 100 to the motor shaft 100. When the door sheet is closed, the motor shaft 100 is rotated, for example, in the second direction S2, and the inner bearing member 221 is rotated along with the motor shaft 100 in the second direction S2. At this time, based on the inherent characteristics of the one way clutch bearing 22, the inner bearing member 221 drives the outer bearing member 222 to be rotated in the second direction S2, relative movement between the outer bearing member 222 and the hole wall of the third through hole 231 of the spacer bush 23 is generated, the friction force between the outer bearing member 222 and the hole wall of the third through hole 231 of the spacer bush 23, which prevents the rotation of the outer bearing member 222 and then prevents the rotation of the motor shaft 100, is generated, and therefore the damping against the rotation of the motor shaft 100 is provided to the motor shaft 100, and delayed closing of the door sheet is achieved.

[0035] Still referring to FIGS. 1 and 2, the adjustment mechanism 24 abuts against an end of the spacer bush 23 away from the stepped surface 2120 and is capable of moving toward or away from the stepped surface 2120. When the adjustment mechanism 24 moves toward the stepped surface 2120, the adjustment mechanism 24 pushes the spacer bush 23, so that the spacer bush 23 moves toward the stepped surface 2120 and is inserted into a portion of the conical section of the second portion 212 with a lesser diameter, and therefore the inner wall of the conical section of the second portion 212 presses an outer wall of the spacer bush 23. The spacer bush 23 is deformed by the pressing of the inner wall of the conical section of the second portion 212, i.e., a diameter of the third through hole 231 of the spacer bush 23 decreases, and therefore the pressing of the hole wall of the third through hole 231 of the spacer bush 23 against the outer bearing member 222 increases. At this time, if the door sheet is closed, the motor shaft 100 is rotated, for example, in the second direction S2, and the inner bearing member 221 drives the outer bearing member 222 to be rotated in the second direction S2, and because the pressing of the hole wall of the third through hole 231 of the spacer bush 23 against the outer bearing member 222 increases, the friction force between the outer bearing member 222 and the spacer bush 23 increases, the damping against the rotation of the motor shaft

provided to the motor shaft 100 increases, and therefore the delayed time of the door sheet closing increases. When the adjustment mechanism 24 moves away from the stepped surface 2120, the adjustment mechanism 24 gradually releases the push on the spacer bush 23. Under action of the first elastic member 25, the spacer bush 23 moves in the direction away from the stepped surface 2120 and is inserted into a portion of the conical section of the second portion 212 with a greater diameter, and therefore the pressing of the inner wall of the conical section of the second portion 212 against the spacer bush 23 decreases, and the spacer bush 23 gradually returns to an original shape under the action of its elastic restoring force, so that the diameter of the third through hole 231 of the spacer bush 23 increases, and the pressing of the hole wall of the third through hole 231 of the spacer bush 23 on the outer bearing member 222 decreases. At this time, if the door sheet is closed, the motor shaft 100 is rotated, for example, in the second direction S2, and the inner bearing member 221 drives the outer bearing member 222 to be rotated in the second direction S2. Because the pressing of the hole wall of the third through hole 231 of the spacer bush 23 against the outer bearing member 222 increases, the friction force between the outer bearing member 222 and the spacer bush 23 decreases, and the damping against the rotation of the motor shaft provided to the motor shaft 100 decreases, and therefore the delayed time of the door sheet closing decreases. The adjustment mechanism 24 adjusts a pushing force applied on the spacer bush 23 by moving toward or away from the stepped surface 2120 to change the friction force between the outer bearing member 222 and the spacer bush 23, and therefore a function of adjusting the delayed time of the door sheet closing is achieved.

[0036] Specifically, in the present embodiment, the adjustment mechanism 24 is, for example, an adjustment knob which is a roughly stepped cylinder. The adjustment mechanism 24 includes a control portion 242 and a connecting portion 241. The first through hole 210 of the base block 20 further includes a third portion 213, and at least a part of an inner wall of the third portion 213 is provided with a second thread. In the axial direction X of the motor shaft 100, the first portion 211, the second portion 212 and the third second 213 are arranged in sequence in a direction away from the fixing base 101 of the motor 10. The control portion 242 is roughly cylindrical, and a user can operate the control portion 242 directly, for example, by screwing the control portion 242, to operate the adjustment mechanism 24. The connecting portion 241 is a generally cylindrical boss extended from an axial end of the control portion

242, and at least a part of an outer wall of the boss is provided with a first thread. The connecting portion 241 is coaxially inserted into the third portion 213 of the first through hole 210, and is connected to the second thread of the third portion 213 of the first through hole 210 via the first thread. Optionally, the connecting portion 241 may be connected to the third portion 213 of the first through hole 210 by other suitable means, for example, by a connecting member, by snap-on connection, or the like, as long as a requirement of the adjustment mechanism 24 moving toward the step surface 2120 or away from the step surface 2120 is satisfied. In the present embodiment, the adjustment mechanism 24 is in threaded connection to the third portion 213 of the first through hole 210 via the connecting portion 241. When in use, the user can make the adjustment mechanism 24 move toward or away from the stepped surface 2120 by simply screwing the control portion 242, to adjust the pushing force applied on the spacer bush 23 and to change the friction force between the outer bearing member 222 and the spacer bush 23,so that the function of adjusting the delayed time of the door sheet closing is achieved. In the present embodiment, when the connecting portion 241 moves in the direction toward the stepped surface 2120 to at least a part of its threaded connection stroke, the end of the connecting portion 241 toward the stepped surface 2120 abuts against the damping mechanism 21.

[0037] A specific process of adjusting the delayed time of the door sheet closing in the present embodiment is described in detail below with reference to FIGS. 1 and 2. When the adjustment mechanism 24 is just screwed to the base block 20, the end of the connecting portion 241 toward the stepped surface 2120 is not in contact with the end of the spacer bush 23 away from the stepped surface 2120. At this time, under the action of the first elastic member 25, the spacer bush 23 is not in contact with or is just in contact with the inner wall of the third portion 213 of the first through hole 210, the third through hole 231 of the spacer bush 23 has an initial diameter, the damping which can be provided to the motor shaft 100 is minimum and the delayed time of the door sheet closing is shortest. When the control portion 242 is screwed to make the adjustment mechanism 24 move to at least a part (for example, one-third or one-half, or the like) of its threaded connection stroke, an end of the connecting portion 241 toward the stepped surface 2120 starts to abuts against the end of the spacer bush 23 away from the stepped surface. Continuously screwing the control portion 242 to make the adjustment mechanism 24 move toward the stepped surface 2120, the pushing force of the end of the connecting portion

241 toward the stepped surface 2120 on the end of the spacer bush 23 away from the stepped surface 2120 increases gradually, the pressing force of the inner wall of the third portion of the first through hole 210 on the spacer bush 23 increases gradually, the diameter of the third through hole 231 of the spacer bush 23 decreases gradually, the pressing force of the third through hole 231 of the spacer bush 23 on the outer bearing member 222 increases gradually, and therefore the damping provided to the motor shaft 100 increases gradually, and the delayed time of the door sheet closing increases gradually. When the adjustment mechanism 24 completes its threaded connection stroke, the adjustment mechanism 24 is screwed to a limiting position. At this time, the pushing force of the end of the connecting portion 241 toward the stepped surface 2120 on the end of the spacer bush 23 away from the stepped surface 2120 is maximized, the pressing force of the inner wall of the third portion of the first through hole 210 against the spacer bush 23 is maximized, the diameter of the third through hole 231 of the spacer bush 23 is minimized, the pressing force of the third through hole 231 of the spacer bush 23 against the outer bearing member 222 is maximized, and therefore the damping provided to the motor shaft 100 is maximized, and the delayed time of the door sheet closing is maximized. The process can be reversed by screwing the control portion 242 in an opposite direction to gradually decrease the delayed time of the door sheet closing.

[0038] FIGS. 3 and 4 show another embodiment of the present application. The damping device 2 provided in the present embodiment has a similar structure to the damping device 2 provided in the embodiment shown in FIGS. 1 and 2, and the differences between them are described below. The damping mechanism 2 according to the present embodiment is not provided with the first elastic member 25 and the spacer bush 23. The damping device 2 is connected to the door closer 1. The door closer 1 includes the motor 10, the motor 10 includes the motor shaft 100 and the fixing base 101, and the motor 10 is provided for driving the door sheet (not shown) connected to the door closer 1 to open and close.

[0039] Specifically, in the present embodiment, the damping device 2 includes a base block 20, a damping mechanism 21 and an adjustment mechanism 24. The damping mechanism 21 includes the one way clutch bearing 22, the connecting member 26 and a damper 27. The one way clutch bearing 22 is sleeved on the motor shaft 100 via the second through hole 2211, the motor shaft 100 is inserted into and fixedly connected to the second through hole 2211 of the one way clutch bearing 22, and therefore the motor shaft 100 is fixedly connected to the inner

bearing member 221 of the one way clutch bearing 22.

[0040] The connecting member 26 is, for example, a cylinder having a fourth through hole 261, and is arranged in the first portion 211 of the first through hole 210 of the base block 20. It should be understood by those skilled in the art that the connecting member 26 in a shape of the cylinder is exemplary only, and the connecting member 26 can also be in other suitable shapes, such as a stepped cylinder, a polyhedron, or the like, as long as it is capable of being accommodated in the first portion 211 of the first through hole 210. The one way clutch bearing 22 is arranged in the fourth through hole 261, and the outer bearing member 222 is fixedly connected to the fourth through hole 261. Preferably, the connecting member 26 is provided with a first connecting hole 262, and the outer bearing member 222 is fixedly connected to the fourth through hole 261 via a set screw (not shown) which is inserted into the first connecting hole 262. It should be understood by those skilled in the art that the outer bearing member 222 can be fixedly connected to the fourth through hole 261 by other suitable means, for example, by a threaded connection, by a rivet connection, by a keying connection, or the like, which is not limited in the present application.

[0041] The damper 27 includes an output shaft 271, an adjustment end 272 and a main body 273, and adjustment end 272 is configured to adjust the damping that the output shaft 271 can provide. The function and structure of the damper 27 are well known to those skilled in the art and are not described herein. The main body 273 of the damper 27 is fixedly arranged in the second portion 212 of the first through hole 210 of the base block 20, and an end of the main body 273 toward the stepped surface 2120 abuts against the stepped surface 2120. Preferably, the base block 20 is provided with a third connecting hole 204, the main body 273 is fixedly connected to the second portion 212 of the first through hole 210 of the base block 20 via the set screw 203 (referring to FIG. 4) inserted into the third connecting hole 204. It should be understood by those skilled in the art that the main body 273 can also be fixedly connected to the second portion 212 of the first through hole 210 by other suitable means, for example, by threaded connection, by rivet connection, by snap-on connection, or the like, which is not limited in the present application. The output shaft 271 is inserted into and fixedly connected to the fourth through hole 261. Preferably, the connecting member 26 is provided with a second connecting hole 263, and the outer bearing member 271 is fixedly connected to the fourth through hole 261 via the set screw (not shown) inserted into the second connecting hole 263.

It should be understood by those skilled in the art that the output shaft 271 can be fixedly connected to the fourth through hole 261 by other suitable means, for example, by threaded connection, by rivet connection, by snap-on connection, or the like, which is not limited in the present application. The adjustment end 272 is operatively connected to the adjustment mechanism 24. In the present embodiment, the adjusting end 272 is rotatable, and damping provided by the output shaft 271 can be adjusted via the rotating adjusting end 272. Optionally, the adjustment mechanism 24 is, for example, a cylindrical adjustment knob having a first inner hole, the first inner hole of the adjustment knob is sleeved on an end of the base block 20 away from the fixing base 101, and the adjustment knob is fixedly connected to the adjustment end 272, and by rotating the adjustment knob, the adjustment end 272 is driven to be rotated to adjust the damping that can be output by the output shaft 271.

[0042] In the present embodiment, the outer bearing member 222 and the output shaft 271 of the damper 27 become a whole via the connecting member 26. When the door sheet is opened, the motor shaft 100 is rotated, for example, in the first direction S1, and the inner bearing member 221 is rotated along with the motor shaft 100 in the first direction S1. At this time, based on the inherent characteristics of the one way clutch bearing 22, the inner bearing member 221 is incapable of driving the outer bearing member 222 to be rotated in the first direction, and the output shaft 271 of the damper 27 which becomes a whole with the outer bearing member 222 does not output the damping, and therefore does not provide the damping against the rotation of the motor shaft 100 to the motor shaft 100. When the door sheet is closed, the motor shaft 100 is rotated, for example, in the second direction S2, the inner bearing member 221 is rotated along with the motor shaft 100 in the second direction S2. At this time, based on the inherent characteristics of the one way clutch bearing 22, the inner bearing member 221 drives the outer bearing member 222 to be rotated in the second direction S2, the output shaft 271 of the damper 27 which becomes a whole with the outer bearing member 222 outputs the damping, and the damping is transferred to the motor shaft 100 to prevent the rotation of the motor shaft 100 via the outer bearing member 222 and the inner bearing member 221, and therefore delayed closing of the door is achieved. By rotating the adjustment mechanism 24, the adjustment end 272 is driven to be rotated to adjust the damping output from the output shaft 271, so as to adjust the delayed time of the door sheet closing.

[0043] FIGS. 5 and 6 show a further embodiment of the present application. The damping

device 2 provided in the present embodiment has a similar structure to the damping device 2 provided in the embodiments shown in FIGS. 1 and 2, and the differences between them are described below. The damping mechanism 2 according to the present embodiment is not provided with the first elastic member 25 and the spacer bush 23. The damping device 2 is connected to the door closer 1. The door closer 1 includes the motor 10, the motor 10 includes the motor shaft 100 and the fixing base 101, and the motor 10 is provided for driving a door sheet (not shown) connected to the door closer 1 to open and close.

[0044] Specifically, in the present embodiment, the damping device 2 includes the base block 20, the damping mechanism 21 and the adjustment mechanism 24. The damping mechanism 21 includes the one way clutch bearing 22, a friction plate 28, and a connecting flange 29. The one way clutch bearing 22 is sleeved on the motor shaft 100 via the second through hole 2211, and the motor shaft 100 is inserted into and fixedly connected to the second through hole 2211 of the one way clutch bearing 22, and therefore the motor shaft 100 is fixedly connected to the inner bearing member 221 of the one way clutch bearing 22.

[0045] The friction plate 28 is arranged in the second portion 212 of the first through hole 210 of the base block 20 and abuts against the stepped surface 2120. Optionally, the friction plate can be made of any suitable material, such as a metal material, a rubber material, a nylon material, a plastic material, or the like. Preferably, the friction plate is made of the plastic material. The friction plate 28 has an annular structure and has a fifth through hole 281.

[0046] The connecting flange 29 is, for example, a stepped cylinder, and includes a first fixing portion 291, a friction portion 292, a second fixing portion 293, and a sixth through hole 294 which are arranged coaxially. In the axial direction X of the motor shaft 100, the first fixing portion 291, the friction portion 292, and the second fixing portion 293 are arranged in sequence in the direction away from the fixing base 101 of the motor 10. The outer bearing member 222 of the one way clutch bearing 22 is fixedly connected to the sixth through hole 294, and therefore the outer bearing member 222 becomes a whole with the connecting flange 29. Preferably, the first fixing portion 291 is provided with a fourth connecting hole 2912, and the outer bearing member 222 is fixedly connected to the sixth through hole 294 of the connecting flange 29 via the set screw 2911 (referring to FIG. 5) inserted in the fourth connecting hole 2912. It should be understood by those skilled in the art that the outer bearing member 222 can be fixedly connected to the sixth through hole 294 of the connecting flange 29 by other suitable

means, for example, by a threaded connection, by a rivet connection, by a keying connection, or the like, which is not limited in the present application. The first fixing portion 291 is extended through the fifth through hole 281 of the friction plate 28, and a side of the friction portion 292 toward the stepped surface 2120 abuts against the friction plate 28. When the outer bearing member 222 is rotated along with the inner bearing member 221 and the motor shaft 100, a friction force between the friction plate 28 and the friction portion 292 of the connecting flange 29 prevents the rotation of the outer bearing member 222, and therefore the damping against the rotation of the motor shaft 100 is provided to the motor shaft 100.

[0047] In the present embodiment, the damping device 2 further includes an anti-lock mechanism 30. The anti-lock mechanism 30 is arranged between the damping mechanism 21 and the adjustment mechanism 24, an end of the anti-lock mechanism 30 abuts against a side of the friction portion 292 away from the stepped surface 2120, and another end of the anti-lock mechanism 30 abuts against the adjustment mechanism 24. The adjustment mechanism 24 pushes the friction portion 292 away from the stepped surface 2120 via the anti-lock mechanism 30. The anti-lock mechanism 30 is configured to limit the maximum damping provided by the damping structure 21 to the motor shaft 100, to prevent the motor shaft 100 from stalling due to an excessive damping.

[0048] Specifically, the anti-lock mechanism 30 includes a thrust bearing 31 and a second elastic member 32. The structure and function of the thrust bearing are well known to those skilled in the art. The thrust bearing 31 of the present application can be select any suitable thrust bearing selected according to actual needs, which is not limited in the present application. The thrust bearing 31 has a seventh through hole 311, and the thrust bearing 31 is sleeved on the second fixing portion 293 of the connecting flange 29 via the seventh through hole 311. An end of the thrust bearing 31 abuts against the side of the friction portion 292 away from the stepped surface 2120. An end of the second elastic member 32 abuts against another end of the thrust bearing 31, and another end of the second elastic member 32 abuts against the adjustment mechanism 24. In the present embodiment, the second elastic member 32 is the wave spring. Optionally, the second elastic member 32 can be another suitable elastic member, such as a pressure spring, a rubber spring, a sheet spring, or the like. The second elastic member 32 can be reasonably selected according to actual use requirements, which is not limited in the present application.

[0049] In the present embodiment, the adjustment mechanism 24 is, for example, the adjustment knob which is a roughly stepped cylinder. The adjustment mechanism 24 includes the control portion 242 and the connecting portion 241. At least a part of the inner wall of the second portion 212 of the base block 20 is provided with a third thread. The control portion 242 is roughly cylindrical, and the user can operate the control portion 242 directly, for example, by screwing the control portion 242, to operate the adjustment mechanism 24. The connecting portion 241 is a roughly cylindrical boss extended from the axial end of the control portion 242, at least a part of the outer wall of the connecting portion 241 is provided with a fourth thread, and the connecting portion 241 has a second inner hole 2411. The connecting portion 241 is coaxially inserted into the second portion 212 of the first through hole 210, and is connected to the third thread of the second portion 212 of the first through hole 210 via the fourth thread, Optionally, the connecting portion 241 can be connected to the second portion 212 of the first through hole 210 by other suitable means, for example, by a connecting member, by snap-on connection, or the like, as long as the requirement of the adjustment mechanism 24 moving toward the step surface 2120 or away from the step surface 2120 is satisfied. In the present embodiment, the adjustment knob is in threaded connection to the second portion 212 of the first through hole 210 via the connecting portion 241. When in use, the user can make the adjustment mechanism 24 move toward or away from the stepped surface 2120 by simply screwing the control portion 242.

[0050] In the present embodiment, the anti-lock mechanism 30 is at least partially accommodated in the second inner hole 2411 of the connecting portion 241, and the connecting portion 241 abuts against the damping mechanism 21 via the anti-lock mechanism 30 when the connecting portion 241 moves to at least a part (for example, one-third or one-half, or the like) of its threaded connection stroke in the direction toward the stepped surface 2120. Specifically, an end of the second elastic member 32 abuts against a bottom of the second inner hole 2411, and another end of the second elastic member 32 abuts against one end of the thrust bearing 31. Another end of the thrust bearing 31 abuts against the side of the friction portion 292 of the connecting flange 29 away from the stepped surface 2120. The thrust bearing 31 is partially accommodated in the second bore 2411. When the adjustment mechanism 24 moves toward the stepped surface 2120, the bottom of the second inner hole 2411 presses the second elastic member 32, and therefore the pressing force is transferred to the friction plate 28 via the second

elastic member 32, the thrust bearing 31, and the connecting flange 29.

[0051] A specific process of adjusting the delayed time of the door sheet closing and a functioning principle of anti-lock mechanism 30 in the present embodiment are described in detail below with reference to FIGS. 5 and 6. When the adjustment mechanism 24 is just screwed to the base portion 20, the bottom of the second inner hole 2411 of the connecting portion 241 does not abut against the second elastic member 32. At this time, the second elastic member 32 is in a substantially relaxed state, the friction portion 292 of the connecting flange 29 does not press or only slightly presses the friction plate 28, the damping provided to the motor shaft 100 is minimum, and the delayed time of the door sheet closing is shortest. When the control portion 242 is screwed to make the adjustment mechanism 24 move to a part (e.g., one-third or one-half, or the like) of its threaded connection stroke, a bottom of the second inner hole 2411 of the connecting portion 241 starts to abuts against the second elastic member 32, the second elastic member 32 starts to receive the pressing force, and the pressing force is transferred to the friction plate 28 via the second elastic member 32, the thrust bearing 31, and the connection flange 29. Continuously screwing the control portion 242 to make the adjustment mechanism 24 move toward the stepped surface 2120, the pressing force of the friction portion 29 of the connecting flange 29 on the friction plate increases gradually. Therefore, the damping provided to the motor shaft 100 increases gradually, and the delayed time of the door sheet closing increases gradually. When a sliding friction force (i.e., a friction force that needs to be overcome for the rotation of the outer bearing member 222) between the friction portion 29 of the connecting flange 29 and the friction plate 28 reaches a first threshold value (which is less than a torque force output by the rotation of the motor shaft), the first threshold value is also the maximum value of a static friction force between the friction plate 28 and the stepped surface 2120, the friction plate 28, the connecting flange 29 and a part of the thrust bearing 31 close to the connecting flange 29 are rotated along with the outer bearing member 222, and at this time, the damping provided by the damping device 21 to the motor shaft 100 reaches the maximum value, i.e., the first threshold value. Even if the adjustment mechanism 24 continues to be made move toward the stepped surface 2120 to increase the pressing force of the connecting flange 29 on the friction plate 28, the damping provided to the motor shaft 100 by the damping device 21 does not continue to increase. Therefore, the anti-lock mechanism 30 prevents the damping provided by the damping device 21 to the motor shaft

100 from being greater than the torque force output by the rotation of the motor shaft, thus preventing that the closing action of the door sheet is terminated due to excessive damping causing the motor shaft 100 to stall.

[0052] The damping device 2 provided in the embodiment of the present application is capable of providing adjustable delayed time for the electric door closing, and satisfying requirements for the delayed time of the automatic door closing in various application scenarios. In particular, it can satisfy the requirements for the maximum closing time of afire door in "Fire Rescue Industry Standard of the People's Republic of China" with the standard No. XF93-2004. Further, the damping device 2 provided in the embodiment of the present application is capable of preventing that the closing action of the door sheet is terminated due to excessive damping. Further, the damping device 2 provided in the embodiment of the present application has advantages of a simple structure, a long service life, or the like.

[0053] The technical features of the above-mentioned embodiments can be arbitrarily combined. For the sake of concise description, all possible combinations of the technical features of the above-mentioned embodiments are not described, however, it should be considered as the scope of this specification, as long as there is no contradiction in the combination of these technical features.

[0054] The above-mentioned embodiments express only several implementations of the present application, and the descriptions are more specific and detailed, but they should not be interpreted as a limitation of the scope of the utility model patent. It should be pointed out that for a person of ordinary technical personnel in the art, under the premise of not being separated from the practical new ideas, a number of deformations and improvements can be made, which all belong to the scope of protection of the utility model. Therefore, the scope of protection of the utility model patent shall be subject to the attached claims.

CLAIMS

1. A damping device for a door closer, the door closer comprising a motor, and the motor comprising a motor shaft and a fixing base, wherein

the damping device comprises:

a base block fixed to the fixing base, the base block comprising a first through hole, and the motor shaft being inserted into the first through hole;

a damping mechanism arranged in the first through hole, and at least a part of the damping mechanism being fixedly connected to the motor shaft; and

an adjustment mechanism operatively connected to the damping mechanism and configured to adjust a damping of the damping mechanism,

wherein when the motor shaft is rotated in a first direction, at least a part of the damping mechanism is capable of being rotated along with the motor shaft in the first direction, and the damping mechanism does not provide the damping to the motor shaft,

wherein when the motor shaft is rotated in a second direction, at least a part of the damping mechanism is capable of being rotated along with the motor shaft in the second direction, and the damping mechanism provides the damping to the motor shaft.

2. The damping device according to claim 1, wherein

the first through hole comprises:

a first portion having a first diameter, and the first diameter being greater than a diameter of the motor shaft; and

a second portion adjoined to the first portion, a minimum diameter of the second portion being greater than the first diameter, and a stepped surface being formed between the second portion and the first portion,

wherein, in a radial direction of the motor shaft, the first portion and the second portion are arranged in sequence in a direction away from the fixing base of the motor.

3. The damping device according to claim 2, wherein

the damping mechanism comprises a one way clutch bearing, the one way clutch bearing comprises an inner bearing member and an outer bearing member, the inner bearing member has a second through hole, and the motor shaft is inserted into and fixedly connected to the second through hole,

wherein when the motor shaft is rotated in the first direction, the inner bearing member is

rotated along with the motor shaft in the first direction, the inner bearing member is incapable of driving the outer bearing member to be rotated in the first direction, and the damping mechanism does not provide damping to the motor shaft;

wherein when the motor shaft is rotated in the second direction, the inner bearing member is rotated in the second direction along with the motor shaft, the inner bearing member drives the outer bearing member to be rotated in the second direction, and the damping mechanism provides damping to the motor shaft via the outer bearing member.

4. The damping device according to claim 3, wherein

the second portion of the first through hole comprises a conical section, a diameter of the conical section, in the radial direction of the motor shaft, increases gradually in a direction away from the stepped surface,

and the damping device comprises:

a first elastic member arranged in the second portion of the first through hole and arranged around the motor shaft, and an end of the first elastic member abutting against the stepped surface of the first through hole; and

a spacer bush having a conical shape matched with the conical section of the second portion, an outer diameter of the spacer bush, in the radial direction of the motor shaft, increasing gradually in the direction away from the stepped surface, an outer surface of the spacer bush in a radial direction abutting against an inner wall of the conical section of the second portion of the first through hole, an end of the spacer bush toward the stepped surface abutting against another end of the first elastic member, the spacer bush further having a third through hole, and the one way clutch bearing being arranged in the third through hole,

wherein, a hole wall of the third through hole of the spacer bush abuts against the outer bearing member, when the outer bearing member is rotated along with the inner bearing member and the motor shaft, a friction force between the spacer bush and the outer bearing member prevents a rotation of the outer bearing member, and therefore damping against the rotation of the motor shaft is provided to the motor shaft.

5. The damping device according to claim 4, wherein

the adjustment mechanism abuts against an end of the spacer bush away from the stepped surface and is capable of moving toward or away from the stepped surface,

wherein, when the adjustment mechanism moves toward the stepped surface, the adjustment mechanism pushes the spacer bush to move toward the stepped surface and is

inserted into a portion of the conical section of the second portion with a lesser diameter, so that the inner wall of the conical section of the second portion presses the spacer bush, a diameter of the third through hole of the spacer bush decreases, and pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member increases, wherein if the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the outer bearing member and the spacer bush increases because the pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member increases, and therefore the damping provided to the motor shaft increases;

wherein, when the adjustment mechanism moves away from the stepped surface, the adjustment mechanism gradually releases a push on the spacer bush, under the action of the first elastic member, the spacer bush moves in the direction away from the stepped surface and is inserted into a portion of the conical section of the second portion with a greater diameter, the pressing of the inner wall of the conical section of the second portion against the spacer bush decreases so that the diameter of the third through hole of the spacer bush increases, and the pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member decreases, wherein if the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the outer bearing member and the spacer bush decreases because the pressing of the hole wall of the third through hole of the spacer bush against the outer bearing member decreases, and therefore the damping provided to the motor shaft decreases.

6. The damping device according to one of claims 2-5, wherein

The adjustment mechanism is an adjustment knob, the adjustment knob comprises a control portion and a connecting portion, the connecting portion is arranged on a side of the control portion toward the damping mechanism, and an outer wall of the connecting portion is provided with a first thread,

wherein the first through hole of the base block further comprises a third portion, the first portion, the second portion and the third portion are arranged in sequence in the direction away from the fixing base of the motor in the radial direction of the motor shaft, and at least a part of the inner wall of the third portion is provided with a second thread which is capable of being engaged with the first thread,

wherein the adjustment knob is in threaded connection to the third portion of the first

through hole via the connecting portion, and when the connecting portion moves to at least a part of its threaded connection stroke in a direction toward the stepped surface, one end of the connecting portion toward the stepped surface abuts against the damping mechanism.

7. The damping device according to claim 3, wherein

the damping device comprises:

a connecting member having a fourth through hole, the one way clutch bearing being arranged in and the outer bearing member is fixedly connected to the fourth through hole; and

a damper comprising an output shaft and an adjustment end, the output shaft being inserted and fixedly connected in the fourth through hole, the adjustment end being operatively connected to the adjustment mechanism, and the adjustment mechanism adjusting the damping output from the output shaft via the adjustment end,

wherein, the outer bearing member and the output shaft of the damper become a whole via the connecting member, when the outer bearing member is rotated along with the inner bearing member and the motor shaft, damping output from the output shaft of the damper prevents rotation of the outer bearing member, and therefore damping against the rotation of the motor shaft is provided to the motor shaft.

8. The damping device according to claim 7, wherein

the adjustment mechanism is an adjustment knob, the adjustment knob is fixedly connected to the adjustment end of the damper, and by rotating the adjustment knob, the adjustment end is driven to be rotated to adjust damping output from the output shaft.

9. The damping device according to claim 3, wherein

the damping device comprises:

a friction plate arranged in the second portion of the first through hole and abutting against the stepped surface, and the friction plate having a fifth through hole;

a connecting flange comprising a first fixing portion, a friction portion, a second fixing portion, and a sixth through hole arranged coaxially, the outer bearing member of the one way clutch bearing being fixedly connected in the sixth through hole, the first fixing portion being extended through the fifth through hole, and one side of the friction portion toward the stepped surface abutting against the friction plate,

wherein, when the outer bearing member is rotated along with the inner bearing member and the motor shaft, a friction force between the friction plate and the friction portion of the connecting flange prevents a rotation of the outer bearing member, and therefore damping

against the rotation of the motor shaft is provided to the motor shaft.

10. The damping device according to claim 9, wherein

the adjustment mechanism is capable of pushing a side of the friction portion away from the stepped surface, and the adjustment mechanism is capable of moving toward or away from the stepped surface,

wherein, when the adjustment mechanism moves toward the stepped surface, the adjustment mechanism pushes the connecting flange so that pressing of the friction portion of the connecting flange against the friction plate increase, if the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the friction plate and the friction portion of the connecting flange increases because the pressing of the friction portion of the connecting flange against the friction plate increases, and therefore the damping provided to the motor shaft increases;

wherein, when the adjustment mechanism moves away from the stepped surface, the adjustment mechanism gradually releases a push on the connecting flange so that the pressing of the friction portion of the connecting flange against the friction plate decrease, if the motor shaft is rotated in the second direction, the inner bearing member drives the outer bearing member to be rotated in the second direction, the friction force between the friction plate and the friction portion of the connecting flange decreases because the pressing of the friction portion of the connecting flange against the friction plate decreases, and therefore the damping provided to the motor shaft decreases.

11. The damping device according to claim 10, wherein the damping device further comprises:

an anti-lock mechanism arranged between the damping mechanism and the adjustment mechanism, wherein an end of the anti-lock mechanism abuts against the side of the friction portion away from the stepped surface, another end of the anti-lock mechanism abuts against the adjustment mechanism, the adjustment mechanism is capable of abutting against the side of the friction portion away from the stepped surface via the anti-lock mechanism, and the anti-lock mechanism is configured to prevent the motor shaft from stalling due to excessive friction force between the friction plate and the friction portion of the connecting flange when a maximum pushing force is applied by the adjustment mechanism.

12. The damping device according to claim 11, wherein the anti-lock mechanism

comprises:

a thrust bearing, and an end of the thrust bearing abutting against the side of the friction portion away from the stepped surface; and

a second elastic member, an end of the second elastic member abutting against another end of the thrust bearing, and another end of the second elastic member abutting against the adjustment mechanism.

13. The damping device according to claim 11 or 12, wherein

the adjustment mechanism is an adjustment knob, the adjustment knob comprises a control portion and a connecting portion, the connecting portion is arranged on a side of the control portion toward the damping mechanism, an outer wall of the connecting portion is provided with a first thread,

at least one portion of the inner wall of the second portion of the first through hole of the base block is provided with a second thread which is capable of being engaged with the first thread,

wherein, the adjustment knob is in threaded connection to the second portion of the first through hole via the connecting portion, and when the connecting portion moves in a direction toward the stepped surface, the connecting portion abuts against the damping mechanism via the anti-lock mechanism.

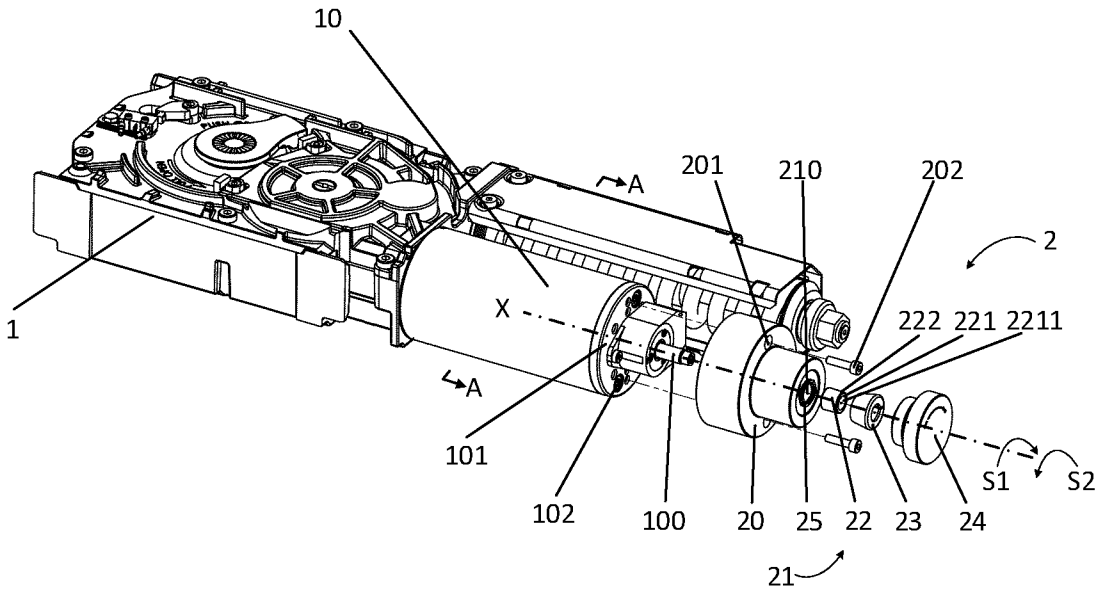

10
A
201
210
202
2
1
X
222
221
2211
A
101
102
100
20
25
22
23
24
S1
S2
21

FIG.1

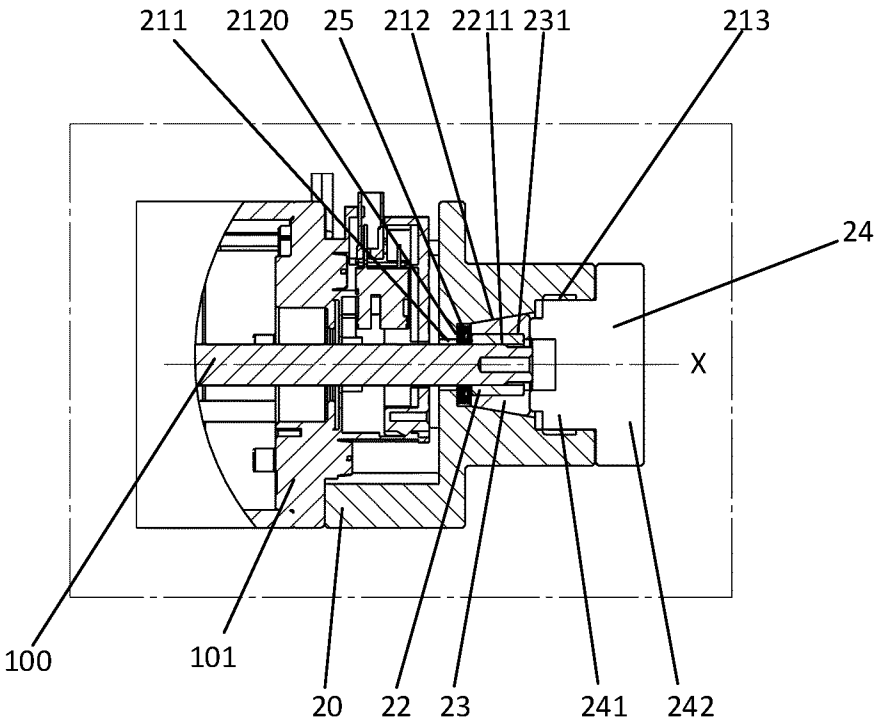

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212
2211
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213
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X
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101
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22
23
241
242

FIG.2

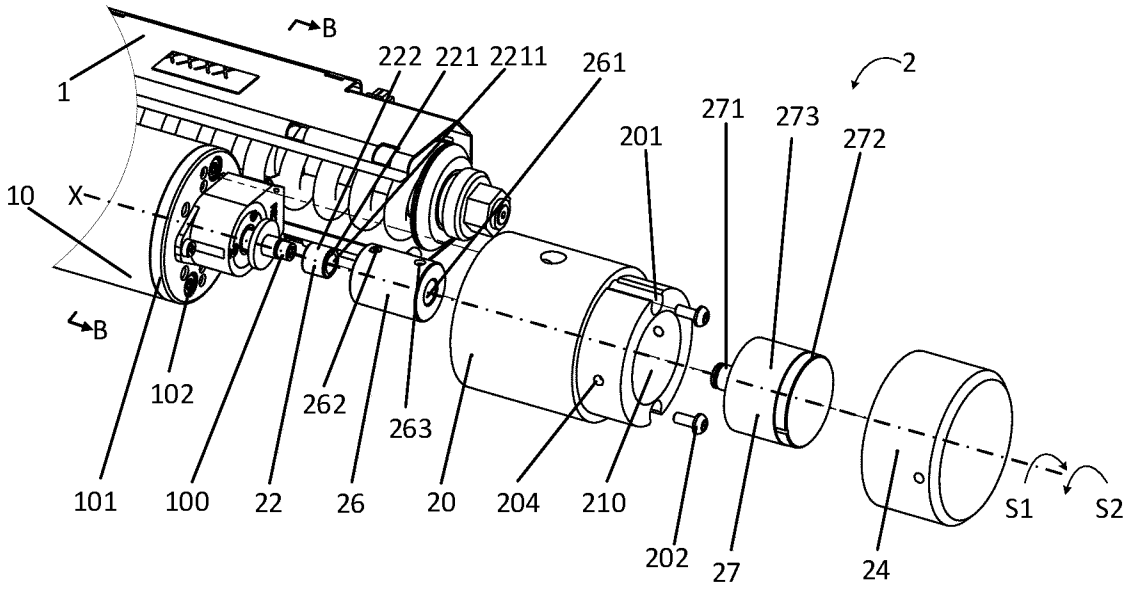

B
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1
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273
272
201
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26
20
204
210
202
27
24
S1
S2

FIG.3

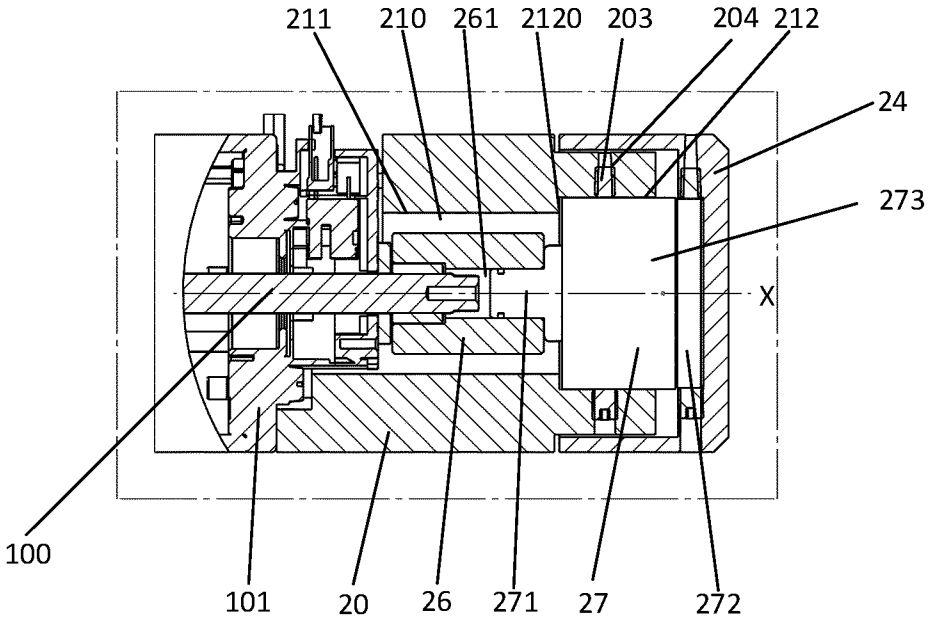

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203
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212
24
273
X
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101
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26
271
27
272

FIG.4

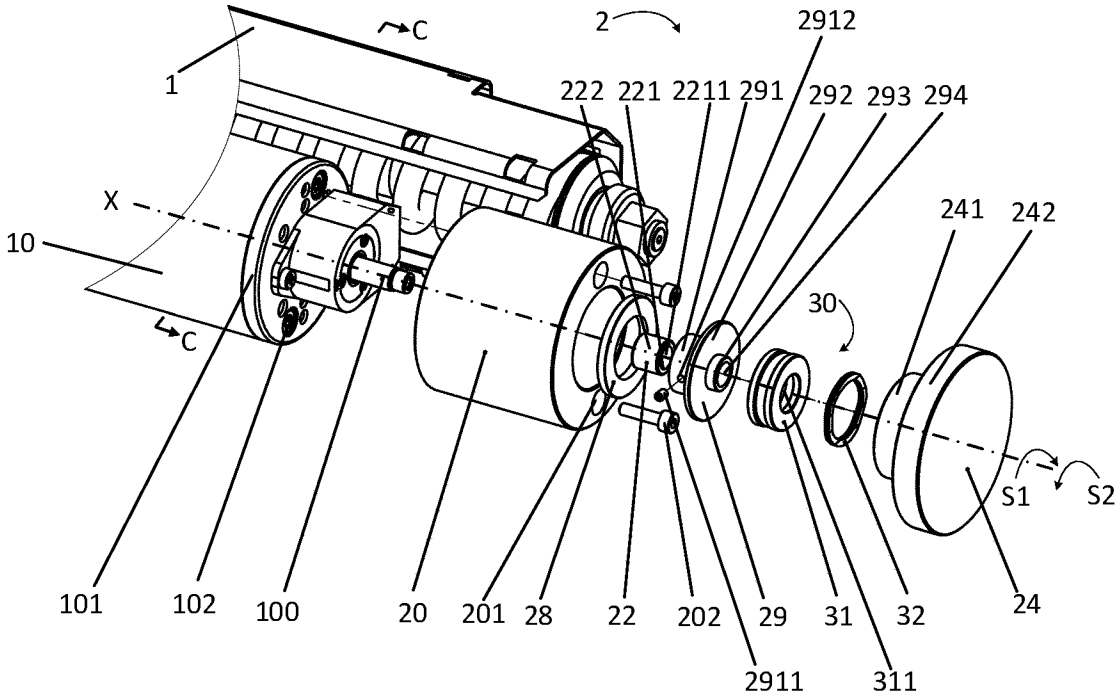

C
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1
222
221
2211
291
292
293
294
X
241
242
10
30
C
S1
S2
101
102
100
20
201
28
22
202
29
31
32
24
2911
311

FIG.5

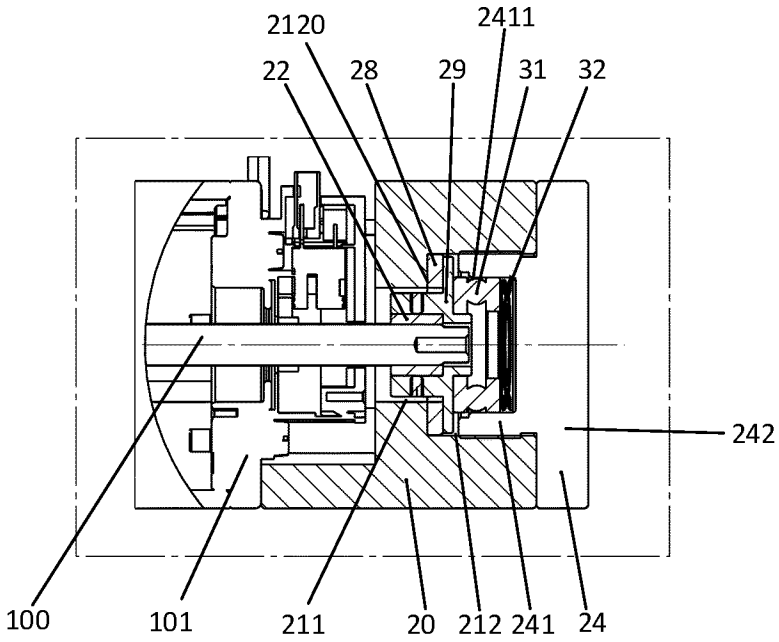

2120
2411
22
28
29
31
32
242
100
101
211
20
212
241
24

FIG.6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2023/085894

A. CLASSIFICATION OF SUBJECT MATTER
INV. E05F3/16 E05F5/00 E05F15/603 F16D7/02 F16D41/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E05F F16D

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 818 619 B1 (GEZE GMBH [DE]) 9 August 2017 (2017-08-09)	1-3
A	paragraphs [0013] - [0030]; claims 1,3; figures 1-9	4-13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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"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

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"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	Date of mailing of the international search report
28 February 2024	12/03/2024

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Rémondot, Xavier

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2023/085894

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2818619 B1	09-08-2017	DE 102013212650 B3	07-08-2014
		DK 2818619 T3	20-11-2017
		EP 2818619 A1	31-12-2014
		ES 2646047 T3	11-12-2017
		NO 3031222 T3	10-03-2018
		PL 2818619 T3	31-01-2018