

## **DRAG ADJUSTING MECHANISM FOR DUAL-BEARING REEL**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

[001] This application claims priority under 35 U.S.C. § 119 to Japanese Patent Application No. 2008-178485 filed on July 8, 2008. The entire disclosure of Japanese Patent Application No. 2008-178485 is hereby incorporated herein by reference.

### **BACKGROUND OF THE INVENTION**

[002] Field of the Invention

[003] The present invention relates to a drag adjusting mechanism. More particularly, the present invention relates to a drag adjusting mechanism for a dual bearing reel contrived to adjust a drag force of a drag mechanism serving to brake a rotation of a spool rotatably attached to a reel unit of the dual-bearing reel in a line reel-out direction.

[004] Background Information

[005] A dual-bearing reel has a drag mechanism serving to brake a rotation of a spool in a line reel-out direction and prevent breakage of a fishing line caused by abrupt, strong pulling. A lever drag type dual-bearing reel is known in which a drag mechanism is arranged surrounding a spool shaft. In order to adjust a drag force, a lever drag type drag mechanism employs a drag adjusting mechanism that includes a drag adjusting lever rotatably mounted onto a spool shaft.

[006] A drag adjusting mechanism of a conventional lever drag dual-bearing reel has a drag adjusting lever and a cam mechanism contrived to convert rotation of the drag adjusting lever into an axial movement of a spool shaft. The cam mechanism has, for example, a cam receiving pin provided in the drag adjusting lever and a cam member having a cam surface configured to engage with the cam receiving pin. The cam member is supported on a reel unit such that it cannot rotate but can move freely in an axial direction. The cam member is contrived to act against the spool shaft so as to push a spool toward the drag mechanism, thereby pressing the spool against the drag mechanism. The cam surface of the cam member is formed along a circumferential direction of the cam member and configured such that its height along an axial direction of the spool shaft varies gradually.

[007] With this kind of drag adjusting mechanism, when the drag adjusting lever is rotated, the cam mechanism causes the spool shaft to move in an axial direction and the

spool moves in the same direction so as to press against the drag mechanism, thereby enabling the drag force to be adjusted.

[008] With a lever drag type drag adjusting mechanism, the drag force can be adjusted from a drag released state in which the spool rotates freely to a maximum drag state by operating the drag adjusting lever. Consequently, if the drag adjusting lever is accidentally operated such that the drag adjusting mechanism enters the drag released state during fishing, then it will be possible for the spool to rotate abruptly in a line reel-out direction and cause the fishing line to become tangled on the spool due to backlash. Therefore, a conventional drag adjusting mechanism has a protruding portion configured such that it can contact an operating portion of the drag adjusting lever retractably provided on the reel unit in a position just in front of a drag release position (e.g., Japanese Laid-Open Patent Publication No. 2006-61012). With such a drag adjusting mechanism, when the drag adjusting lever contacts the protruding portion, the drag adjusting lever is prevented from rotating to the drag release position. A user can then move the drag adjusting lever to the drag release position by pressing the protruding portion and moving the drag adjusting lever past the protruding portion.

[009] Recently, attempts are being made to reduce the size of lever drag type dual-bearing reels. When a protruding portion is used to restrict the rotation of the drag adjusting lever, it is necessary to provide a space for the protruding portion. Consequently, it is difficult to reduce the size of a dual-bearing reel that uses such a protruding portion. In order to reduce the size of a dual-bearing reel, it is feasible to use a technology in which a protrusion is provided on a cam surface of a cam mechanism and the protrusion serves to make it difficult for the drag adjusting lever to rotate to the drag release position (e.g., U.S. Patent No. 6,402,073 B1 to Dancuk, Jr.).

[010] In a conventional dual-bearing reel configured to restrict rotation of the drag adjusting lever with the cam surface, a protruding portion contrived to apply a minimal drag force is formed on the cam surface at a position just in front of the drag release position. The protruding portion has an apex, a first slanted surface that extends from the apex toward the drag release position, and a second slanted surface that extends from the apex in the opposite direction as the drag release position. The angle of the first slanted surface is larger than the angle of the second slanted surface.

## SUMMARY OF THE INVENTION

[011] It has been discovered that the protruding portion formed on a conventional cam surface is configured such that the angle of the first slanted surface (on the drag release position side) is larger than the angle of the second slanted surface. Consequently, a force acting on the drag adjusting lever increases abruptly when the drag adjusting lever is rotated from the drag release position. As a result, operation of the drag adjusting lever from the drag release position to a point where the drag adjusting lever passes the protruding portion is difficult.

[012] Accordingly, aspects of the present invention have been created to solve the above-mentioned problems occurring in conventional practice, and to provide a drag adjusting mechanism for a dual-bearing reel that is contrived to make it more difficult to rotate a drag adjusting lever to a drag release position and easier to rotate the drag adjusting lever from the drag release position.

[013] According to one aspect of the present invention, a drag adjusting mechanism for a dual-bearing reel is contrived to adjust a drag force of a drag mechanism serving to brake a rotation of a spool of the dual-bearing reel in a line reel-out direction by moving in an axial direction of a spool shaft. The drag adjusting mechanism comprises drag adjusting lever, a cam mechanism, and a rotation restricting portion. The drag adjusting lever is arranged to be rotated about the spool shaft between a drag release position and a maximum drag position and contrived such that rotation thereof can adjust a drag force of the drag mechanism. The cam mechanism has a cam surface having a height along an axial direction of the spool shaft that varies such that when the drag adjusting lever is rotated between the drag release position and the maximum drag position, the rotation is converted into a movement of the drag mechanism along an axial direction of the spool shaft. The rotation restricting portion is provided on the cam surface and has a protrusion configured to restrict rotation of the drag adjusting lever when the drag adjusting lever is being rotated toward the drag release position and has reached a position just in front of the drag release position. The protrusion has an apex, a first slanted surface that extends from the apex toward a first position serving as a drag release position, and a second slanted surface that extends from the apex in the opposite direction as the drag release position. An angle of the first slanted surface is smaller than an angle of the second

slanted surface. With this drag adjusting mechanism, when the drag adjusting lever is rotated from the drag release position toward the maximum drag position, the cam surface of the cam mechanism acts to convert the rotation of the drag adjusting lever into an axial movement of the spool shaft. Until the drag adjusting lever passes the apex of the protrusion, the first slanted surface (which has a smaller angle than the second slanted surface) is used and, thus, the amount by which spool shaft moves with respect to a given rotation amount of the drag adjusting lever is small. Consequently, the amount by which the drag force changes are small and the drag adjusting lever is easy to rotate until the protrusion is passed.

[014] Conversely, when the drag adjusting lever is rotated toward the drag release position so as to pass by the protrusion, the second slanted surface is used until the drag adjusting lever reaches the apex of the protrusion. Since the angle of the second slant surface is larger than the angle of the first slant surface, the amount by which the spool moves with respect to a given rotation amount of the drag adjusting lever is larger. Consequently, the change in the drag force is larger and the drag adjusting lever becomes more difficult to rotate, making it more difficult to return the drag adjusting lever to the drag release position. In this aspect of the invention, the angle of the first slanted surface of the protrusion, which is located on the drag release position side of the apex, is smaller than the angle of the second slanted surface. Consequently, when the drag adjusting lever is rotated from the maximum drag position to the rotation restricting portion, the drag force increases before the protrusion is passed and rotation of the drag adjusting lever to the drag release position becomes more difficult before the drag release position is reached. Meanwhile, when the drag adjusting lever is rotated from the drag release position toward the rotation restricting portion, the change in the drag force is smaller and the rotation operation is easier to perform because the slope of the first slanted surface is more gradual.

[015] According to another aspect of the present invention, the drag adjusting mechanism for a dual-bearing reel is a drag mechanism, wherein the protrusion is configured such that a first height thereof at the apex in an axial direction of the spool shaft is smaller than one half of a second height at a second position corresponding to a maximum drag position. With this aspect, a small drag force can be exerted against the spool during restriction of rotation of the drag adjusting lever because the apex is located

in a position where a movement amount of the spool shaft is equal to or smaller than one half of a maximum movement amount.

[016] According to further aspect of the present invention, the drag adjusting mechanism for a dual-bearing reel is a drag mechanism, wherein the cam surface includes a first flat surface formed at the first position and arranged substantially perpendicular to the spool shaft; a second flat surface formed at the second position and arranged parallel to the first flat surface and further outward in an axial direction than the first flat surface; and a third slanted surface arranged to join the first flat surface and the second flat surface together, the protrusion being arranged between the first flat surface and the third slanted surface. With this aspect, since the protrusion is formed between a third slanted surface and a first flat surface corresponding to a drag release position, rotation of the drag adjusting lever can be restricted reliably just in front of the drag release position.

[017] According to yet another aspect of the present invention, the drag adjusting mechanism for a dual-bearing reel is a drag mechanism, wherein the first slanted surface is a linearly slanted surface; the second slanted surface is a curved slanted surface curved in a circular arc-like fashion such that angle of a line tangent to the second slanted surface at the apex is larger than the angle of the first slanted surface. With this aspect, since the drag adjusting lever rides up the circular-arc-like curved second slanted surface when it is rotated toward the drag release position, an operating force gradually increases such that a user can recognize with certainty that the drag adjusting lever is approaching the drag release position.

[018] According to still another aspect of the present invention, the drag adjusting mechanism for a dual-bearing reel is a drag mechanism, wherein the drag adjusting lever is arranged on the same side of the spool as the drag mechanism; the cam mechanism has a cam member provided with a cam surface and mounted to a reel unit such that it can move freely along an axial direction of the spool shaft but cannot rotate, an adjusting knob arranged to contact the cam member on side of the cam member facing outward along an axial direction of the spool shaft and configured to screw onto the spool shaft; a cam receiving portion provided on the drag adjusting lever such that it can contact the cam surface and serving to move the cam member in a first axial direction away from the drag adjusting lever when the drag adjusting lever is rotated in a first direction, and a force

applying portion configured and arranged to act through the adjusting knob so as to move the cam member in a second axial direction that is opposite said first axial direction when the drag adjusting lever is rotated in a second direction; and the rotation restricting portion is contrived to temporarily restrict rotation of the drag adjusting lever when the drag adjusting lever is rotated to a position where the cam receiving portion is just in front of the drag release position.

[019] With this aspect, the side of the reel can be reduced more easily because the drag mechanism and the drag adjusting lever are on the same side. Additionally, since the cam receiving portion is provided in the rotating drag adjusting lever and the cam surface is provided on a detachable cam member, the manner in which the drag force varies can be easily changed in accordance with the type of fishing being done by changing (replacing) the cam member. Furthermore, the cam member is easier to manufacture.

[020] These and other features, aspects and advantages of the present invention will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, disclose embodiments of the present invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[021] Referring now to the attached drawings which form a part of this original disclosure:

[022] Figure 1 is a perspective view of dual-bearing reel in which an embodiment of the invention is employed;

[023] Figure 2 is a side view of the handle side of the same dual-bearing reel;

[024] Figure 3 is a cross sectional view of the same dual-bearing reel;

[025] Figure 4 is an exploded perspective view of a drag adjusting mechanism;

[026] Figure 5 is an enlarged cross sectional view showing constituent features of parts on the handle side;

[027] Figure 6 is an exploded perspective view showing constituent features of a rotation transmission system that includes a drag mechanism;

[028] Figure 7 is a cross sectional view focusing on specific portions surrounding a spool;

[029] Figure 8 is a frontal view of a cam member;

[030] Figure 9 is a cross sectional view of the cam member;

[031] Figure 10 is a development view depicting a circular arc-shaped cam surface in a linear fashion; and

[032] Figure 11 is an exploded perspective view of the spool sound generating mechanism.

#### DETAILED DESCRIPTION OF AN EXAMPLE EMBODIMENT

[033] Selected embodiments of the present invention will now be explained with reference to the drawings. It will be apparent to those skilled in the art from this disclosure that the following descriptions of the embodiments of the present invention are provided for illustration only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

[034] Referring initially to Figures 1 to 3, a dual-bearing reel is illustrated in accordance with a first example embodiment of the present invention. As shown in Figures 1 to 3, a dual-bearing reel is a small lever drag reel configured to wind a fishing line about an axis oriented crosswise with respect to a longitudinal direction of a fishing rod. The dual-bearing reel comprises a reel unit 1, a drag adjusting mechanism 7 including a drag adjusting lever 2 rotatably arranged on a side portion of the reel unit 1, a handle 3 rotatably supported on the reel unit 1 in a position below the drag adjusting lever 2, and a spool 4 arranged inside the reel unit 1. The dual bearing reel further comprises a spool shaft 5 arranged and configured to rotatably support the spool 4 and a drag mechanism 6 contrived to brake rotation of the spool 4 in a line reel-out direction.

[035] Constituent Features of the Reel Unit

[036] The reel unit 1 is a metal member made of, for example, an aluminum alloy. The reel unit 1 has a frame 10 and a first side plate 13a and a second side plate 13b arranged and configured to cover both sides of the frame 10. In this embodiment, the second side plate 13b is formed as a one-piece integral unit with the frame 10, but it is acceptable for the second side plate 13b to be a separate entity fastened to the frame 10. The frame 10 has a first cylindrical portion 11a on a handle 3 side thereof, a second cylindrical portion 11b that is smaller in diameter than the first cylindrical portion 11a and arranged to be spaced apart from the first cylindrical portion 11a along an axial direction of the spool shaft, and a plurality of connecting portions 12a to 12c arranged and

configured to connect the cylindrical portions 11a and 11b together at frontward, rearward, and lower portions thereof. The external diameter of the first cylindrical portion 11a is, for example, from 110% to 140% of the external diameter of the second cylindrical portion 11b. In this embodiment, the external diameter of the first cylindrical portion 11a is from 110% to 120% of the external diameter of the second cylindrical portion 11b. The connecting portions 12a to 12c are formed as an integral unit with the first and second cylindrical portions 11a and 11b and, as shown in Figures 1 and 3, a metal rod mounting leg 8a is fixed to the lower connecting portion 12c. The rod mounting leg 8a extends in a longitudinal direction of a fishing rod RD and is employed in order to mount the reel to the rod RD. A rod clamp 8b is arranged opposite the rod mounting leg 8a such that the fishing rod RD is sandwiched in-between.

[037] As shown in Figures 1 to 3, the first side plate 13a includes a cylindrical portion 14 that attaches to a side of the first cylindrical portion 11a and a bulged portion 15 configured to protrude outward along an axial direction of the cylindrical portion 14 (to the right in Figure 2). As shown in Figures 1 and 3, the second side plate 13b is substantially circular in a side view and is integrally formed on a side of the second cylindrical portion 11b. The cylindrical portion 14 and the second side plate 13b are both substantially circular in a side view and each has approximately the same diameter as the first cylindrical portion 11a and the second cylindrical portion 11b, respectively. The external diameter of the first side plate 13a is larger than the external diameter of the second side plate 13b. The external diameter of the cylindrical portion 14 is, for example, from 110% to 140% of the external diameter of the second cylindrical portion 11b. In this embodiment, the external diameter of the first cylindrical portion 14 is from 110% to 120% of the external diameter of the second cylindrical portion 11b.

[038] The bulged portion 15 is formed as an integral unit with the cylindrical portion 14 and is formed to protrude outward in an axial direction (rightward in Figure 2) so as to contain a space that communicates with the cylindrical portion 14. The bulged portion 15 is a generally water droplet-shaped member having a smaller arc section above and a larger arc section below. The larger arc section protrudes downward beyond the cylindrical portion 14. The drag adjusting lever 2 and the handle 3 are mounted to the bulged portion 15 so as to be exposed to the outside.

[039] As shown in Figures 4 and 5, the portion of the bulged portion 15 where the drag adjusting lever 2 is mounted is formed into a boss 34 for rotatably supporting the drag adjusting lever 2 and supporting the spool shaft 5. The boss 34 protrudes outward in a step-like fashion beyond other portions. The boss portion 34 has a large diameter protruding portion 34a and a small diameter protruding portion 34b that protrudes from the large diameter protruding portion 34a. A bearing 20d (explained later, see Figure 5) is housed inside the large diameter protruding portion 34a. A guide member 17 for supporting a cam member 50 (explained later, see Figure 5) such that the cam member 50 cannot rotate but can move in an axial direction and is fixed inside the boss 34, i.e., more specifically, inside the small diameter protruding portion 34b.

[040] The guide member 17 is crimp-fastened to the inside of the small diameter protruding portion 34b such that it passes through the first side plate 13a. The spool shaft 5 of the first side plate 13a passes through the smaller diameter protruding portion 34b. An outer peripheral surface of the guide member 17 is formed into a hexagonal guide section 17a, and an internal surface is formed into a through hole 17b configured such that the spool shaft 5 can pass there-through. A stopper 35 serving to establish a maximum drag position of the drag adjusting lever 2 is fixed to the bulged portion 15 in a position forward of the boss 34. The stopper 35 is arranged to touch against a lever portion 47b (explained later) of the drag adjusting lever 2 so as to restrict rotation of the drag adjusting lever 2 in a clockwise direction (clockwise from the perspective shown in Figure 2).

[041] Constituent Features of the Rotation Transmission System

[042] A outwardly protruding cylinder 16 for mounting the handle 3 is formed on the bulged portion 15 in a position below the drag adjusting lever 2. As shown in Figures 3 and 5, a cylindrical handle shaft 31 is arranged inside the protruding cylinder 16 so as to be parallel to the spool shaft 5 (which is a shaft about which the spool 4 rotates). The handle shaft 31 is rotatably supported in the protruding cylinder 16 with two bearings 32 and 33 arranged at both ends of the protruding cylinder 16 and is arranged such that one end thereof (left end in Figure 5) protrudes axially inward beyond the bearing 32. A main gear 60 is rotatably attached to the end portion of the handle shaft 31 that protrudes beyond the bearing 32.

[043] As shown in Figures 1 to 3, the handle 3 is fixed to the other end portion (distal end) of the handle shaft 31. The handle 3 has a handle arm 40 that is fixed to the distal end of the handle shaft 31 and a handle knob 41 that is rotatably supported on a distal end of the handle arm 40. The handle arm 40 is fastened to the distal end of the handle shaft 31 with a screw member 42 such that it can rotate as an integral unit with the handle shaft 31. In order to make it easier to grip and apply force to, the external shape of the handle knob 41 is formed to be rounded and generally T-shaped.

[044] As shown in Figure 5, the main gear 60 is prevented from rotating by a rotation preventing member 63 such that it rotates integrally with the handle shaft 31. The rotation preventing member 63 is connected to the handle shaft 31 such that it can rotate integrally there-with and is fastened the handle shaft 31 with a fastening bolt 65 screwed into to the proximal end of the handle shaft 31. The rotation preventing member 63 has a ring portion 63a connected to the handle shaft 31 such that it can rotate integrally there-with and a pair of interlocking portions 63b configured to interlock with the main gear 60. The interlocking portions 63b are bent in an L-shaped fashion from the outer circumference of the ring portion 63a and arranged on diametrically opposite sides of the ring portion 63a. The main gear 60 is provided with a pair interlocking holes 60a configured and arranged to interlock with the interlocking portions 63b. The main gear 60 meshes with a pinion gear 61.

[045] The pinion gear 61 is mounted onto the outside of the spool shaft 5 such that it can rotate about the spool shaft 5. The pinion gear 61 is rotatably supported with respect to the reel unit 1 by a bearing 20d that is installed inside the large diameter protruding portion 34a of the boss 34 of the first side plate 13a. As shown in Figure 6, gear teeth 61a configured to mesh with the main gear 60 and a disk support portion 61b formed to be generally rectangular are provided on an external circumferential surface of the pinion gear 61. Machining scars left by a gear cutting tool when the gear teeth 61a were made remain on the disk support portion 61b. An internal circumferential surface of the pinion gear 61 forms a through hole 61c configured for the spool shaft 5 to pass through. An internal circumferential portion of a brake disk 22 (described later) of the drag mechanism 6 is connected to the disk support portion 61b of the pinion gear 61 such that it can rotate integrally therewith. As a result, rotation of the handle 3 is transmitted to the friction disk

21 through the main gear 60, the pinion gear 61, and the brake disk 22. The friction disk 21 transfers the rotation to the spool 4 and the spool 4 rotates. A spring support plate 69 of a second one-way clutch 64 (explained later) is also mounted to the disk support portion 61b such that it can rotate integrally therewith.

[046]      Constituent Features of the Spool Shaft and Surrounding Parts

[047]      As shown in Figure 3, the spool shaft 5 is a shaft member supported on the reel unit 1 such that it can move in an axial direction but cannot rotate relative to the reel unit 1. An end of the spool shaft 5 depicted as the left end in Figure 3 is supported in a boss 13c formed in a center portion of the second side plate 13b. The boss 13c protrudes in an inward direction and the left end of the spool shaft 5 is supported therein such that it can move in an axial direction but cannot rotate relative to the boss 13c. A rotation preventing pin 5a for preventing the spool shaft 5 from rotating is arranged to pass through the spool 5 at a position closer to the left end of the spool shaft 5. The rotation preventing pin 5a engages with a rotation preventing groove 13d formed in the boss 13c.

[048]      Bearings 20a and 20b for rotatably mounting the spool 4 and a bearing 20c for rotatably supporting the brake disk 22 are attached to the outside circumference of the spool shaft 5.

[049]      Constituent Features of the One-way Clutches

[050]      As shown in Figure 5, a roller type first one-way clutch 62 is arranged between the bearings 32 and 33. The first one-way clutch 62 only allows forward rotation of the handle shaft 31 in the line winding direction and prohibits reverse rotation in the line reel-out direction. A pawl type second one-way clutch 64 is arranged on the outer circumference of the spool shaft 5. The second one-way clutch 64 prevents reverse rotation of the handle shaft 31 by acting on the pinion gear 61.

[051]      The first and second one-way clutches 62 and 64 are used chiefly for operating the drag mechanism 6. As shown in Figure 6, the second one-way clutch 64 has a ratchet wheel 66 connected to the brake disk such that it can rotate integrally therewith, a ratchet pawl 67 configured to engage with the ratchet wheel 66, an spring member 68 arranged to apply a spring force to the ratchet pawl 67, and a spring support plate 69 for mounting the spring member 68.

[052] The ratchet wheel 66 is a plate-like member, an external circumferential surface of which is formed to have generally saw-like ratchet teeth 66a configured to mesh with the ratchet pawl 67, and a radially inward portion of which is provided with an engaging protrusion 66b configured to engage with the brake disk 22. The engaging protrusion 66b is connected to an end face of a core member 25 (explained later) of the brake disk 22 such that it can rotate integrally therewith.

[053] The ratchet pawl 67 is rotatably supported on a pivot shaft 90 that is screwed into an inside surface of the first side plate 13a. At a proximal end thereof the ratchet pawl 67 has a pivot support portion 67b provided with a support hole 67a configured to be supported on the pivot shaft 90, and at a distal end thereof the ratchet pawl 67 has a pawl portion 67c configured to mesh with the ratchet teeth 66a of the ratchet wheel 66. An engaging slot 67d configured to engage with the spring member 68 is formed in a middle portion of the ratchet pawl 67. Due to the spring action of the spring member 68, the ratchet pawl 67 pivots between a contact position in which it contacts the ratchet wheel 66 and prohibits rotation of the ratchet wheel 66 and a separated position in which it is separated from the ratchet wheel 66 so as to reduce the sound of the ratchet wheel 66 rotating in the line winding direction. The separated position of the ratchet pawl 67 is restricted to a position only slightly separated from the ratchet wheel 66 by a restricting part (not shown) provided on an inside surface of the first side plate 13a.

[054] The spring member 68 serves both to separate the ratchet pawl 67 from the ratchet wheel 66 when the spool 4 rotates in the line winding direction so as to quiet the sound of the second one-way clutch 64 and to force the ratchet pawl 67 toward the ratchet wheel 66 when the spool 4 rotates in the line reel-out direction. The spring member 68 is made of a metal wire material having a spring quality and is arranged such that it spring loads the ratchet pawl 67 in a different direction depending on the direction in which the spool 4 rotates. The spring member 68 has a C-shaped mounting portion 68a configured to engage frictionally with a mounting groove 69a of the spring support plate 69, an arm portion 68b that extends in a radial direction from the mounting portion 68a, and a curved portion 68c that is bent from the arm portion 68b and configured to curve in a U-shaped manner and engage with the engaging slot 67d. When the spool 4 rotates in the line winding direction and the brake disk 22 rotates in the same direction, the spring member

68 applies a spring force against the ratchet pawl 67 in a direction of separating from the ratchet wheel 66. Conversely, when the spool 4 rotates in the line reel-out direction and the brake disk 22 rotates in the same direction, the spring member 68 applies a spring force against the ratchet pawl 67 in a direction of moving closer to the ratchet wheel 66. As a result, rotation of the brake disk 22 in the line reel-out direction is prevented.

[055] The spring support plate 69 is a circular disk shaped member having a mounting groove 69a configured to frictionally engage with the mounting portion 68a of the spring member 68 formed in an external circumferential surface thereof. In a radially inward portion of the spring support plate 69 there is formed a rectangular connecting hole 69b configured to connect to the disk support portion 61b of the pinion gear 61 such that the spring support plate 69 can rotate integrally with the pinion gear 61.

[056] Constituent Features of the Spool

[057] As shown in Figure 7, the spool 4 comprises a spool unit 9 and a fishing line stop pin 23 that is fixed to the spool body 9. The spool unit 9 has a cylindrical line winding body portion 9a that is configured for a fishing line to be wound onto an outside circumferential surface thereof and arranged such that a gap exists between an internal circumferential surface thereof and an external circumferential surface of the spool shaft 5. The spool unit 9 also has a first flange portion 9b and a second flange portion 9c that are larger in diameter than the line winding body portion 9a and arranged on both sides of the line winding body portion 9a. The spool unit 9 also has a counterbored portion 9f formed in the outside circumferential surface of the line winding body portion 9a and a pin fixing portion 9h formed in the counterbored portion 9f.

[058] The spool unit 9 is rotatably supported on the spool shaft 5 with bearings 20a and 20b. The drag mechanism 6 is provided on the handle 3 side of the spool 4. A spool sound generating mechanism 18 contrived to generate a sound when the spool 4 rotates is provided on the second side plate 13b side of the spool 4.

[059] As shown in the partial view G of Figure 7, the counterbored portion 9f is a circular recess formed in the external circumferential surface of the line winding body portion 9a at a middle position with respect to an axial direction. A bottom surface 9g of the counterbored portion 9f is flat and the pin fixing portion 9h – which has a through hole 9i – is formed in a center of the bottom surface 9g. The through hole 9i is formed to pass

from the bottom surface 9g to the internal circumferential surface of the line winding body portion 9a along a radial direction of the line winding body portion 9a.

[060] The fishing line stop pin 23 serves to hold an end of the fishing line and is secured by being press fitted into the through hole 9i (which is positioned midway along the axial direction of the line winding body portion 9a). The fishing line stop pin 23 has a first shaft portion 23a configured to be press fitted into the through hole 9i, a second shaft portion 23b having a larger diameter than the first shaft portion 23a and configured such that a fishing line can be held on an external circumferential surface thereof by, for example, tying the fishing line, and a head portion 23c having a larger diameter than the second shaft portion 23b.

[061] Thus, the fishing line stop pin 23 is made to have a first shaft portion 23a and a second shaft portion 23b that is larger in diameter than the first shaft portion 23a. The first shaft portion 23a is configured to be press fitted into the through hole, and the counterbored portion 9f is configured to have a flat bottom surface 9g. Consequently, the press fitting of the fishing line stop pin 23 into the through hole 9i can be ended when the step-like portion between the first shaft portion 23a and the second shaft portion 23b contacts the bottom surface 9g, and the amount by which the fishing line stop pin 23 is pressed in can be held to a prescribed amount. Moreover, since the step-like portion contacts the flat bottom surface 9g, it is more difficult for a gap to exist between the step-like portion and the bottom surface 9g and more difficult for the fishing line to become pinched between the step-like portion and the bottom surface 9g.

[062] The first flange portion 9b is larger in diameter than the second flange portion 9c, and the axial length of an external circumferential surface 9d is longer than the axial length of an external circumferential surface 9e of the second flange portion 9c. A storage space 36 configured such that the drag mechanism 6 can be stored therein is formed in an outside face of the first flange portion 9b.

[063] The first flange portion 9b is inserted into the first cylindrical portion 11a, and the second flange portion 9c is inserted into the second cylindrical portion 11b. The first cylindrical portion 11a has a circular first opening 19a configured such that the first flange portion 9b can be inserted therein. The first cylindrical portion 11a has a first facing portion 19c that is provided at the edge of the first opening 19a, faces toward the external

circumferential surface of the first flange portion 9b at the edge of the opening such that it forms only a small gap (e.g., 0.2 to 0.7 mm) therewith, and is shorter in length than the external circumferential surface of the first flange portion 9b. The first cylindrical portion 11a also has a first escape portion 19e arranged farther outward along the axial direction of the spool shaft than the first facing portion 19c and having a larger diameter than the first facing portion 19c. Additionally, the first cylindrical portion 11a has a third escape portion 19g arranged on an inward side of the first facing portion 19c along an axial direction of the spool shaft and having a larger diameter than the first facing portion 19c. In this explanation, “inward along the axial direction of the spool shaft” means axially toward a middle portion of the spool unit 9 (i.e., the portion where the fishing line stop pin 23 is installed), and “outward along the axial direction of the spool shaft” means in an axial direction oriented away from the middle portion of the spool unit 9.

[064] The second cylindrical portion 11b has a circular second opening 19b configured such that the smaller diameter second flange portion 9c of the spool unit 9 can be inserted therein. Thus, the second opening 19b has a smaller diameter than the first opening 19a. As shown in Figure 7, the second cylindrical portion 11b has a second facing portion 19d that is provided at the edge of the second opening 19b, faces toward the external circumferential surface of the second flange portion 9c at the edge of the opening such that it forms only a small gap (e.g., 0.2 to 0.7 mm) therewith, and is shorter in length than the external circumferential surface of the second flange portion 9c. The second cylindrical portion 11b also has a second escape portion 19f arranged farther to the outside along the axial direction of the spool shaft than the second facing portion 19d and having a larger diameter than the second facing portion 19d. Additionally, the second cylindrical portion 11b has a fourth escape portion 19h arranged on an inward side of the second facing portion 19d along the axial direction of the spool shaft and having a larger diameter than the second facing portion 19d.

[065] In this way, since the length of the portion where the first opening 19a and the first flange portion 9b (which is normally longer than the second flange portion 9c) face each other is short, a liquid entering the gap there-between will flow more readily toward the first escape portion 19e where the gap is wider. As a result, a liquid entering the gap

between the first opening 19a and the first flange portion 9b will be less likely to inhibit the ability of the spool 4 to rotate freely.

[066] Additionally, a first water drain hole 13e is provided in a portion of the first cylindrical portion 11a where the first escape portion 19e is formed and a second water drain hole 13f is provided in a portion of the second cylindrical portion 11b where the second escape portion 19f is formed. The water drain holes are formed in portions corresponding to the lower connecting portion 12c. The first and second water drain holes 13e and 13f serve to discharge any liquid that enters the reel through the gap between the first flange portion 9b and the first opening 19a or the gap between the second flange portion 9c and the second opening 19b.

[067] Constituent Features of the Drag Adjusting Mechanism

[068] As shown in Figures 3 to 5, the drag adjusting mechanism 7 serves as a moving mechanism for moving the drag mechanism 6 in order to change and adjust a drag force applied against rotation of the spool 4 (which is mounted to the spool shaft 5) in the line reel-out direction. In Figures 3 and 5, the portion below the center axis X of the spool shaft 5 indicates an axial position of the spool shaft 5 when the drag adjusting mechanism 7 is set for maximum drag, and the portion above indicates an axial position of the same when the drag adjusting mechanism 7 is in a released state.

[069] The drag adjusting mechanism 7 comprises a cam mechanism 43 contrived to convert rotation of the drag adjusting lever 2 into a movement of the drag mechanism 6 along an axial direction of the spool shaft, a rotation restricting portion 44 (see Figure 10) provided in the cam mechanism 43 and contrived to restrict rotation of the drag adjusting lever 2, and a lever sound generating mechanism 45 contrived to generate a sound when the drag adjusting lever 2 is rotated.

[070] Constituent Features of the Drag Adjusting Lever

[071] The drag adjusting lever 2 is arranged such that the drag force increases when the drag adjusting lever 2 is rotated clockwise (clockwise from the perspective of Figure 2) and decreases when the drag adjusting lever 2 is rotated counterclockwise. A position slightly clockwise of the position depicted with a solid-line sketch is a strike position, the position depicted with a double-dot chain line is a drag release position, and the position depicted with a broken line sketch is a maximum drag position. The strike position is a

position that can be adjusted to a drag force at which the hook will pierce the fish's mouth securely but the fishing line will not break when a fish suddenly bites and pulls strongly. Typically it is set to approximately one-third of the breakage strength of the fishing line.

[072] The drag adjusting lever 2 is rotatably attached to the external circumferential surfaces of the large diameter protruding portion 34a and the small diameter protruding portion 34b of the boss 34 of the first side plate 13a. The drag adjusting lever 2 has a lever unit 47 made of, for example, an aluminum alloy and an insert member 48 configured to be press fitted into the lever unit 47 and made of, for example, a zinc alloy. The lever unit 47 has a proximal end portion 47a arranged to surround the boss 34 and a lever portion 47b that extends radially outward from the proximal end portion 47a. A cut-out portion 47c is diagonally formed in an internal circumferential surface of the proximal end portion 47a at a portion bordering with the lever portion 47b, and the lever sound generating mechanism 45 is installed therein. The insert member 48 is press fitted into an internal circumferential surface of the proximal end portion 47a such that it is fixed therein.

[073] The insert member 48 is a stepped cylindrical member rotatably supported on the large diameter protruding portion 34a and the small diameter protruding portion 34b. Two cam receiving pins 52a constituting a cam receiving section 52 of the cam mechanism 4, for example, are erectly provided on an external circumferential surface of a small diameter cylindrical portion 48a of the insert member 48 so as to extend along a radial direction. As shown in Figure 4, a radial bush 46a for rotatably supporting the insert member 48 is arranged between the small diameter cylindrical portion 48a of the insert member 48 and the small diameter protruding portion 34b of the boss 34. A thrust ring 46b is installed so as to be axially supported between the insert member 48 and a wall surface 34c of the boss 34.

[074] Constituent Features of Lever Sound Generating Mechanism

[075] The lever sound generating mechanism 45 serves to accomplish positioning of the drag adjusting lever 2 in addition to generating a sound when the drag adjusting lever 2 is operated. As shown in Figures 4 and 5, the lever sound generating mechanism 45 includes a cylindrical sound generating member 70 mounted on the external circumferential surface of the large diameter protruding portion 34a of the boss 34 and a

striker mechanism 71 contrived to repeatedly strike against the sound generating member 70.

[076] The sound generating member 70 is a ring shaped member made of, for example, polyacetal or another synthetic resin that is comparatively hard and has an excellent sliding property. The sound generating member 70 has a cone-shaped surface 70a that tapers to a smaller diameter as one moves in an outward direction along an axial direction of the spool shaft 5, and an undulated portion 70b formed along a circumferential direction of the cone-shaped surface 70a. The undulated portion 70b comprises circular arc-shaped recesses formed in the cone-shaped surface 70a. The sound generating member 70 is installed on the large diameter protruding portion 34a such that it cannot rotate, its movement in an axially inward direction is restricted, and its movement in an axially outward direction is unrestricted. Movement of the sound generating member 70 in the axially inward direction is restricted by an outside wall surface 15a of a portion of the bulged portion 15 where the boss 34 is formed. A rotation preventing hole 15b is formed in the outside wall surface 15a, and a rotation preventing protrusion 70c configured to engage with the rotation preventing hole 15b is formed on the sound generating member 70. As a result, movement of the sound generating member 70 in the axially inward direction is restructured and the sound generating member 70 is prevented from rotating. However, movement of the sound generating member 70 in the axially outward direction is not restricted.

[077] The lever sound generating mechanism 45 also has an installation portion 72 provided with an installation hole 72a formed in the cut-out portion 47c of the drag adjusting lever 2 along an axis substantially perpendicular to the cone-shaped surface 70a. The striker mechanism 71 has a sounding pin 73 installed in the installation hole 72a such that it can move back and forth toward and away from the cone-shaped surface 70a and a coil-type spring member 74 installed in the installation hole 72a such that it spring loads the sounding pin 73 toward the undulated portion 70b. The sounding pin 73 is made of, for example synthetic resin material and configured such that distal end thereof is spherical and a proximal end thereof is smaller in diameter than the distal end. The spring member 74 is arranged on the outside circumference of a proximal end portion of the sounding pin 73.

[078] Thus, in this embodiment, a sound generating member 70 is made to have a tapered cone-shaped surface 70a whose diameter decreases along an axially outward direction, an undulated portion 70b is formed on the cone-shaped surface 70a, and a sounding pin 73 of a striker mechanism 71 is arranged and configured to contact the undulated portion 70b in an elastic fashion. Since the striker mechanism 71 spring loads the sound generating member 70 in an axially inward direction, the sound generating member 70 is retained in place by the striker mechanism 71. As a result, the sound generating member 70 can be mounted to the boss 34 without providing a separate retaining structure.

[079] Also, since the installation hole 72a is formed along an axis substantially perpendicular to the cone-shaped surface 70a, the sounding pin 73 spring loaded by the spring member can be 74 can serve to spring load the sound generating member 70 axially inward while allowing the sound generating member 70 to move freely in the axially outward direction. Thus, since sounding pin 73 spring loaded by the spring member 74 can spring load the sound generating member 70 axially inward, the striker member can serve to retain the sound generating member 70 in position. As a result, a clear clicking sound is generated and the sound generating member 70 can be retained more securely with the sounding pin 73.

[080] Since the installation hole 72a is formed diagonally, even if it is formed in a position close to an inward side surface of the drag adjusting lever 2, the distance between the installation hole 72a and the inward side surface will gradually increase. As a result, the installation hole 72a is less likely to cause a portion where the wall thickness is thin to exist in the drag adjusting lever 2 and the decrease in strength at the portion where the installation hole 72a is made can be suppressed.

[081] Once the sounding pin 73 is installed in the installation hole 72a, it is difficult to remove. However, since the sounding pin 73 is made of a synthetic resin that does not readily corrode, the lever sound generating mechanism 45 is maintenance free because the sounding pin 73 will not corrode and become jammed in the installation hole 72a.

[082] Constituent Features of the Cam Mechanism

[083] The cam mechanism 43 comprises a cam member 50, a drag adjusting knob 51, a cam receiving portion 52, and a first force applying member 53. The cam member has a

cam surface 49. The drag adjusting knob 51 is for setting an adjustment range of the drag adjusting lever 2. The cam receiving portion 52 is arranged such that it can contact the cam surface 49 and serves to move the cam member 50 in a first axial direction (rightward in Figure 5) when the drag adjusting lever 2 is rotated clockwise from the perspective of Figure 2. The first force applying member 53 is a coil spring serving to generate a spring force that acts through the drag adjusting knob 51 so as to move the cam member 50 in a second axial direction such that it contacts the cam receiving portion 52 when the drag adjusting lever 2 is rotated counterclockwise from the perspective of Figure 2. The drag adjusting mechanism 7 has a second force applying member 54 that serves to spring load the spool 4 in a direction of separating from the spool shaft 5 (rightward in Figure 3) and comprises, for example, four Belleville springs.

[084]      Constituent Features of the Cam Member

[085]      The cam member 50 is a cylindrical member made of, for example, a stainless metal alloy. As shown in Figures 8 and 9, the cam member 50 has an outer cylindrical portion 50a, an inner cylindrical portion 50b, and a disk portion 50c that joins the outer cylindrical portion 50a and the inner cylindrical portion 50b together. The cam surface 49 is formed on an edge of the outer cylindrical portion 50a. An annular groove 50d configured for an O-ring 56 to be installed therein is formed in the outer cylindrical portion 50a. An internal surface of the inner cylindrical portion 50b is made into hexagonal hole 50e configured to engage with the hexagonal guide section 17a of the guide member 17. Sounding recesses 50f forming part of a knob sound generating mechanism 55 (explained later) are formed in an outward surface of the disk portion 50c.

[086]      As shown in Figures 8 and 10, the cam surface 49 is a slanted surface formed along an edge face of the cam member 50 in an overall circular arc-like shape and configured such that its protruding height gradually decreases. Two cam surfaces 49 having the same shape are formed at 180° intervals. A rotation restricting portion 44 configured to restrict rotation of the drag adjusting lever 2 is formed on both sides of a restriction position C located at an intermediate portion of the cam surface 49. The restriction position C is located, for example, 25° to 30° away from a reference position A of the cam surface 49.

[087] The rotation restricting portion 44 has a protrusion 44a configured to protrude toward the cam receiving pin 52a. The protrusion 44a has an apex 44b positioned at the restriction position C, a first slanted surface 44c that declines from the apex 44b to a first position B equivalent to a drag release position, and a second slanted surface 44d that declines from the apex 44b in a direction opposite the first position B. An angle  $\alpha$  of the first slanted surface 44c is smaller than an angle  $\beta$  of the second slanted surface 44d. The angle  $\alpha$  is preferably larger than  $10^\circ$  and smaller than or equal to  $18^\circ$ , e.g.,  $14^\circ$  in this embodiment. The second slanted surface 44d is formed with a circular arc whose radius of curvature is substantially equal to a radius of curvature of a cam receiving pin 52a, indicated in Figure 10 with a double-dot chain line. The angle  $\beta$  of a tangential line intersecting at the apex 44b is preferably larger than  $18^\circ$  and smaller than or equal to  $25^\circ$ , e.g.,  $20^\circ$  in this embodiment. A first height H1 of the apex 44b in an axial direction of the spool shaft is smaller than one half of a second height H2 of the protrusion 44a at a second position E corresponding to a maximum drag position. In this embodiment, for example, the first height H1 of the apex 44b is from 0.6 to 0.8 mm and the second height H2 of the second position E is from 1.7 to 2.0 mm. In this embodiment, the second position E is  $150^\circ$  from the reference position A.

[088] The first slanted surface 44c and the second slanted surface 44d on both sides of the apex 44b of the protrusion 44a are configured such that the angle  $\alpha$  of the first slanted surface 44c (which is on the drag release position side) is smaller than the angle  $\beta$  of the second slanted surface 44d. Consequently, when the drag adjusting lever 2 is rotated from the maximum drag position side to the rotation restricting portion 44, before the protrusion 44 is passed, the drag force increases and it becomes more difficult to rotate the drag adjusting lever 2 toward the drag release position. Conversely, when the drag adjusting lever 2 is rotated from the drag release position toward the rotation restricting portion 44, the change in the drag force is smaller and the rotation operation is easier to perform because the slope of the first slanted surface 44c is more gradual.

[089] Additionally, since the first height H1 of the apex 44b in an axial direction of the spool shaft is smaller than one half of the second height H2 of the protrusion 44a at the second position E (which corresponds to a maximum drag position), the apex 44b is located in a position corresponding to a movement amount of the spool shaft 5 that is less

than one half of a maximum movement amount and, consequently, a small drag force can be made to act on the spool 4 when rotation is restricted.

[090] The cam surface 49 includes a first flat surface 49a, a second flat surface 49b, and a third slanted surface 49c. The first flat surface 49a is formed from the first position B to the reference position A and arranged to be substantially perpendicular to the spool shaft. The second flat surface 49b is formed from the second position E to a fourth position F, arranged to be parallel to the first flat surface 49a, and configured to protrude more in an axial direction than the first flat surface 49a. The third slanted surface 49c joins the first flat surface 49a and the second flat surface 49b together. The protrusion 44a is formed between the first flat surface 49a and the third slanted surface 49c.

[091] In this embodiment, the third slanted surface 49c comprises a fourth slanted surface 49d and a fifth slanted surface 49e having different angles and bordering each other at a third position D located  $100^\circ$  from the reference position A. The angle  $\gamma$  of the fourth slanted surface 49d is larger than  $3^\circ$  and equal to or smaller than  $4^\circ$ , and the angle  $\delta$  of the fifth slanted surface 49e is larger than  $2^\circ$  and equal to or smaller than  $3^\circ$  (which is smaller than that of the fourth slanted surface 49d). A recessed portion 49f that is slightly recessed (e.g., 0.05 to 0.2 mm) in a circular arc shape is formed at the third position D and serves to inform a user of the strike position. The recessed portion 49f and the cam receiving pin 52a are formed to have approximately the same radius of curvature. When the strike position is passed, the angle decreases and, thus, the rate of increase of the drag force decreases.

[092] The angular distance from the reference position A to the fourth position F is, for example,  $170^\circ$ . A restricting wall 49g arranged parallel to the spool shaft is formed at the fourth position F. A restricting wall 49g serves to restrict the drag release position such that the drag adjusting lever 2 does not rotate beyond that position. However, if the aforementioned stopper 35 was not there, then the drag adjusting lever could be rotated beyond the restricting wall 49g at the maximum drag position. Thus, the stopper 35 serves to prevent the drag adjusting lever 2 from rotating beyond the maximum drag position. The restricting wall 49g is also configured to have a circular arc-shaped surface having the same radius of curvature as the cam receiving pins 52a.

[093] Other Constituent Features of Cam Mechanism

[094] As shown in Figures 4 and 5, the drag adjusting knob 51 is configured to screw onto an externally threaded portion 5c formed on an end portion of the spool shaft 5. The drag force of the strike position and an adjustment range of the drag force can be adjusted by adjusting the amount by which the drag adjusting knob 51 is screwed in or out. A knob sound generating mechanism 55 contrived to generate a sound when the drag adjusting knob 51 is operated is provided inside the drag adjusting knob 51. The knob sound adjusting mechanism 55 comprises a sounding recess 50f formed in the cam member 50, a sounding pin 55a installed in a storage hole 51a such that it can move toward and away from the sounding recess 50f, and a spring member 55b serving to spring load the sounding pin 55a toward the sounding recess 50f. The storage hole 51a is formed in the drag adjusting knob 51 to be generally parallel to the spool shaft 5.

[095] As described previously, the cam receiving portion 52 has two cam receiving pins 52a erectly provided on an insert member 48 of the drag adjusting lever 2. The cam receiving pins 52a are rod-like members made of, for example, a stainless metal alloy and are secured to an outside circumferential surface of the small diameter cylindrical portion 48a of the insert portion 48 by press fitting, an adhesive, or other suitable fixing means. The cam receiving pins 52a serve to move the cam member 50 while contacting the cam surface 49.

[096] The first force applying member 53 is arranged on an outside circumference of the spool shaft 5 between the bearing 20b and the bearing 20c. The first force applying member 53 spring loads the spool 4 in a direction of separating from the drag mechanism 6 and causes the cam member 50 to contact the cam receiving portion 52. The second force applying member 54 is arranged on an outside circumference of the spool shaft 5 in a position axially outward (leftward in Figure 3) from the bearing 20a. The second force applying member 54 spring loads the spool 4 axially inward (rightward in Figure 3) with respect to the spool shaft 5. The second force applying member 54 is arranged between the bearing 20a and a retaining ring 5b attached to the spool shaft 5. The first force applying member 53 applies a weaker force than the second force applying member 54. Consequently, when the spool shaft 5 moves axially rightward during a drag adjustment, the first force applying member 53 compresses first and the second force applying member

54 compresses next. The second force applying member 54 is provided in order to make the drag force change smoothly.

[097]      Constituent Features of the Drag Mechanism

[098]      The drag mechanism 6 is configured to move along an axial direction of the spool shaft 5 of the spool 4 and brake rotation of the spool 4 in the line reel-out direction. As shown in Figures 5 and 6, the drag mechanism 6 is housed inside a circular storage space 36 formed in the first flange portion 9b side of the spool 4. The drag mechanism 6 comprises a friction disk 21 arranged such that it can rotate integrally with the spool unit 9, a brake disk 22 arranged facing opposite the friction disk 21, and a cover member 26 serving to cover the storage space 36 from the axially outward direction of the spool shaft 5.

[099]      The friction disk 21 is arranged inside the storage space 36 such that it contacts an outward facing surface of the first flange portion 9b. The friction disk 21 is a circular disk-shaped member having at least one (e.g., four) engaging recess 21a formed in an external circumferential surface thereof and recessed in a radially inward direction. The friction disk 21 is connected to the spool unit 9 by the cover member 26 such that it can rotate integrally with the spool unit 9. The friction disk 21 is made of a heat resistant synthetic resin material, such as a fiber reinforced resin material made by impregnating, for example, a woven cloth made of carbon fibers with a phenol resin or other heat resistant resin.

[0100]      The cover member 26 is a bottomed cylindrical member having a cylindrical portion 26a and a bottom portion 26b and made of a metal material, e.g., an aluminum alloy. The cover member 26 is fastened to an end face of the first flange portion 9b with a plurality of screw members 28 (see Figure 5). The cover member 26 has a through hole 26c provided in a center of the bottom portion 26b through which the core member 25 of the brake disk 22 can pass. The cylindrical portion 26a has an external circumferential surface 26d configured to fit snugly inside an internal circumferential surface of the first flange portion 9b, i.e., of the storage space 36. The length of the cylindrical portion 26a in an axial direction of the spool shaft 5 is set such that when the cover member 26 is fastened to the first flange portion 9b, the distal end of the cylindrical portion 26 can contact a side surface of the friction disk 21. A circular protruding portion 26f is arranged to protrude

from the external circumferential surface 26d of the cylindrical portion 26a and configured such that it can mate closely with an end face of the first flange portion 9b. The protruding portion 26f is arranged to face toward the end face of the first flange portion 9b and has screw through holes 26g that are configured for the screw members 28 (Figure 7) to be installed through and arranged along a circumferential direction with spaces in-between. Threaded holes 9j (Figure 7) configured for the screw members 28 to screw into are formed in the end face of the first flange portion 9b.

[0101] The cover member 26 has at least one engaging protrusion 26e configured to engage with the engaging recess 21a provided on a distal end surface of the cylindrical portion 26a. The engaging protrusions 26e (e.g., four) are formed on the distal end of the cylindrical portion 26a and protrude axially toward an outward facing surface of the first flange portion 9b. The engaging protrusions 26e are circular arc-shaped and arranged to be spaced apart along a circumferential direction. The axially protruding length of the engaging protrusions 26e is set such that a slight gap exists between the outward facing surface of the first flange portion 9b and the distal end portions of the engaging protrusions 26e.

[0102] The brake disk 22 is connected to the second one-way clutch 64 and is prohibited from rotating in the line reel-out direction. As shown in Figures 5 and 6, the brake disk 22 has donut-shaped sliding disk 24 arranged such that it can contact the friction disk 21 and a core member 25 that is mounted to the spool shaft 5 such that it cannot move axially but can rotate freely with respect to the spool shaft 5. The sliding disk 24 is made of stainless steel or another heat resistant, corrosion resistant metal material. The sliding disk 24 has a slightly smaller diameter than the friction disk 21 and is retained in place on the core member 25 by a retaining member 27. A rectangular engaging hole 24a is provided in a center portion of the sliding disk 24. The engaging hole 24a is configured to engage with the core member 25 such that the sliding disk can rotate integrally therewith.

[0103] The core member 25 is a generally cylindrical member made of, for example, an aluminum alloy. The core member 25 is rotatably supported on the spool shaft 5 with the aforementioned bearing 20c. An internal surface of a pinion gear 61 side of the core member 25 is formed into a rectangular engaging hole 25a (Figure 5) configured to engage

with the disk support portion 61b of the pinion gear 61 such that the core member 25 can rotate integrally with the pinion gear 61. A coupling groove 25b is formed in an end face of the core member 25 facing toward the pinion gear 61 along the direction of a diameter thereof. The coupling groove 25b is configured to couple to the ratchet wheel 66 of the second one-way clutch 64 such that the ratchet wheel 66 can rotate integrally with the core member 25. More specifically, the engaging protrusions 66b of the ratchet wheel 66 engage with the coupling groove 25b such that the ratchet wheel 66 rotates integrally with the pinion gear 61 and the core member 25.

[0104] A generally rectangular rotation preventing portion 25c for coupling to the sliding disk 24 in an integrally rotatable manner is formed on an external circumferential surface of the core member 25 on the opposite side as the pinion gear 61. The rotation preventing portion 25c engages with an engaging hole 24a (explained later) of the sliding disk 24 such that the core member 25 and the sliding disk 24 rotate as an integral unit. An annular groove 25d for installing the retaining member 27 is formed in the rotation preventing portion 25c. Also, an annular mounting groove 25e for mounting a seal member 29 to seal an inside of the cover member 26 is formed in an external circumferential surface between the rotation preventing portion 25c and the coupling groove 25b. Since an internal surface of the core member 25 engages with the pinion gear 61, the pinion gear 61 is restrained from moving axially outward (rightward in Figure 5) by the reel unit 1 through the bearing 20d.

[0105] The seal member 29 has a lip 29a on an outer periphery thereof. The lip 29a is configured such that it does not contact the cover member 26 when the reel is in the drag released state shown in the portion of Figure 5 drawn above the spool center axis X, and such that it contacts the cover member 26 and seals the inside thereof when the reel is in the maximum drag state shown in the portion of Figure 5 drawn below the spool center axis X. As a result, the resistance to rotation of the spool 4 can be decreased when the reel is in the drag released state and the spool is rotating freely.

[0106] When the drag mechanism 6 is assembled, the spool 4 is attached to the spool shaft 5 and then, for example, the brake disk 22 and the friction disk 21 are installed into the cover member 26. When this is done, the engaging protrusions 26e of the cover member 26 are made to engage with the engaging recesses 21a of the friction disk 21. Next,

the spool shaft 5 is inserted and the protruding portion 26f of the cover member 26 is made to mate closely with an end face of the first flange portion 9b. If the protruding portion 26f will not mate closely, then the engaging protrusions 26e are not properly engaged with the engaging recesses 21a and the engaging protrusions 26e and the engaging recesses 21a should be realigned and engaged with one another again. Finally, the screw through holes 26g and the threaded holes 9j are aligned with one another and screw members 28 are installed so as to fasten the cover member 26 to the first flange portion 9b. In this way, the friction disk 21 is prevented from rotating with respect to the spool 4. As explained previously, it is easy to verify visually whether the engaging protrusions 26e and engaging recesses 21a are engaged with one another because a gap will exist between the protruding portion 26f and the end face of the first flange portion 9b if the engaging protrusions 26e are not engaged with the engaging recesses 21a. In this embodiment, the cover member 26 – not the storage space 36 – serves to prevent the friction disk 21 from rotating.

Consequently, the cylindrical portion 26a of the cover member 26 can be fit snugly into the storage space 36 and the size of the gap between the cover member 26 and the storage space 36 can be decreased. Furthermore, since the protruding portion 26f mates closely with the end face of the first flange portion 9b, the friction disk 21 can be prevented from rotating while allowing the storage space 36 to have a shape that is easier to seal.

[0107] Additionally, since the cylindrical portion 26a is configured to have such a length along an axial direction of the spool shaft that the distal end of the cylindrical portion 26a can be in close proximity to a side face of the friction disk 21 when the cover member 26 is fastened to the first flange portion 9b, it is difficult for the friction disk 21 to wobble even when the brake disk 22 is separated from the friction disk 21.

[0108] The axial length of the engaging protrusions 26e along an axial direction of the spool shaft is set such that a gap exists between the engaging protrusions 26e and an outward facing surface of the first flange portion 9b. Consequently, the distal ends of the engaging protrusions 26e do not contact the outward facing surface of the flange portion 9b when the cover member 26 is fastened to the flange portion 9b and the gap between the cover member 26 and the storage space 36 can be reduced even further.

[0109] Constituent Features of the Spool Sound Generating Mechanism

[0110] As shown in Figure 8 and Figure 11, the spool sound generating mechanism 18 comprises a sound generating member 75, a striker member 76, a knob member 77, and a force applying member 78. The sound generating member 75 is fixed to an outward facing surface of the second flange portion 9c of the spool unit 9. The striker member 76 is installed in the second side plate 13b such that it can move freely toward and away from a sound generating position where it contacts the sound generating member 75 and a soundless position where it is separated from the sound generating member 75. The knob member 77 moves the striker member 76. The force applying member 78 applies a force acting to load the striker member 76 toward a neutral position.

[0111] The sound generating member 75 is made of, for example, a synthetic resin material and has a circular disk-shaped mounting portion 75a fixed to the spool unit 9 and an undulated portion 75b formed integrally with the mounting portion 75a and having multiple gear tooth-like undulations formed on an external circumference thereof. The sound generating member 75 is arranged to rotate together with the spool 4.

[0112] The striker member 76 is made of, for example, a synthetic resin material and has a proximal end portion 76a pivotally supported in the knob member 77, a striker portion 76b that extends from the proximal end portion 76a in a tapered shape that is narrow at a distal end and is contrived to repeatedly strike against the undulated portion 75b, and a narrow neck portion 76c formed between the proximal end portion 76a and the striker portion 76b. When the striker member 76 retracts to the soundless position, it is arranged in a portion where the second escape portion 19f of the second cylindrical portion 11b is formed. Consequently, the striker member can be arranged further outward in a radial direction than in a conventional reel and a larger sound generating member 75 can be used. Thus, a larger number of undulations can be provided on the undulated portion 75b and a finer clicking sound can be generated.

[0113] The knob member 77 serves as an operating member for moving the striker member 76 to and from the sound generating position and the soundless position. The knob member 77 is a flanged shaft-like member having a shaft portion 77a and a knob portion 77b that is formed on a proximal end portion of the shaft portion 77a and has a larger diameter than the shaft portion 77a. The shaft portion 77a is guided by an elongated

hole 13g passing from an outside surface to an inside surface of the second side plate 13b. The striker member 76 is pivotally coupled to a distal end of the shaft portion 77a.

[0114] The force applying member 78 is made of, for example, a synthetic resin material and has a C-shaped cylindrical spring portion 78a having an opposing faces portion 78c shaped like a place where a portion of a circle has been cut out and a plate-like mounting portion 78b formed on an intermediate portion of the spring portion 78a. The spring portion 78a is configured such that when the striker member 76 advances to the sound generating position, the neck portion 76c of the striker member 76 can contact the space of the opposing faces portion 78c. A middle portion of the mounting portion 78b has a fastening hole 78d configured for a screw member 79 to pass through and a pair of positioning protrusions 78e and 78f provided on opposite sides of the fastening hole 78d. The fastening hole 78d is arranged such that it can align with a threaded hole 13h that is formed in the inside surface of the second side plate 13b and configured for the screw member 79 to screw into, and the positioning protrusions 78e and 78f engage with positioning holes 13i and 13j formed on opposite sides of the threaded hole 13h. As a result, the force applying member 78 can be positioned more precisely and the number of parts can be reduced because the number of screw members used to fasten the force applying member can be reduced from two (the number used with a conventional force applying member) to one.

[0115] Procedure for the Setting Drag Force Adjustment Range

[0116] In a dual-bearing reel configured as described heretofore, the drag adjustment knob 51 is used to set a drag force adjustment range of the drag mechanism 6. When the drag adjusting knob 51 is rotated counterclockwise, it moves slightly leftward toward the state illustrated in the upper portion of Figure 5 such that the drag force adjustment range is slightly weakened. Conversely, when the drag adjusting knob 51 is rotated clockwise, it moves slightly rightward toward the state illustrated in the lower portion of Figure 5 such that the drag force adjustment range is slightly strengthened. More specifically, the drag adjustment range is adjusted such that a drag force will be produced when a weight having a prescribed mass is attached to the end of a fishing line and the fishing line is pulled while the drag adjusting lever 2 is in the strike position.

[0117] In order to adjust the strength of the drag force of the drag mechanism 6, a user rotates the drag adjusting lever 2. When the drag adjusting lever 2 is rotated fully toward the user to a drag release position indicated in Figure 2 with a double-dot chain line, the cam receiving pins 52a are arranged on the first flat surface 49a in the drag release position shown in Figure 10. If the drag adjusting lever 2 is rotated clockwise from the drag release position (clockwise from the perspective of Figure 2), then the cam receiving pins 52a move along the first slanted surface 44c of the protrusion 44a of the cam surface 49 and reach the apex 44b. Meanwhile, the weaker first force applying member 53 is compressed and the cam member 50 gradually moves outward along an axial direction of the spool shaft (rightward in Figure 3) such that the spool shaft 5 and the spool 4 are gradually moved rightward (rightward in Figure 3).

[0118] In a normal drag adjusting range, the friction disk 21 contacts the brake disk 22 and a drag force is generated when the cam receiving pins 52a are positioned in front of the apex 44b, i.e., on the first slanted surface 44c, in a position lower than the lowest position of the curved second slanted surface 44d. The drag force increases as the cam receiving pins 52a move toward the apex 44b of the protrusion 44a and then temporarily weakens when the cam receiving pins 52a pass the apex 44b. Once the cam receiving pins 52a have passed the lowest position of the second slanted surface 44d, the cam receiving pins 52a contact the third slanted surface 49c and the drag force begins to gradually increase. When the cam receiving pins 52a reach the second flat surface 49b, the drag force becomes the largest value in the drag adjustment range. During a pivot operation of the drag adjusting lever 2 toward the apex 44b from the drag release position side, the drag force increases at a lower rate and the drag adjusting lever 2 is easier to operate because the angle of the first slanted surface 44c is smaller than the angle of the second slanted surface 44d (angle  $\alpha <$  angle  $\beta$ ).

[0119] If the drag adjusting lever 2 is rotated further clockwise (clockwise from the perspective of Figure 2) after the brake disk 22 contacts the friction disk 21, then the Belleville springs constituting the second force applying member 54 will gradually compress as the spool shaft 5 moves. The drag force increases proportionally with a compression amount of the Belleville springs. When the strike position is reached, the cam receiving pins 52a enters the recessed portions 49f and the user experiences a small

click-like feeling indicating that the drag adjusting lever 2 is in the strike position. When the drag adjusting lever 2 is in the strike position, a prescribed drag force is obtained in accordance with the adjustment of the drag adjusting knob 51. When the drag adjusting lever 2 is rotated beyond the strike position, the rate at which the drag force increases becomes smaller than prior to reaching the strike position. Finally, the drag force reaches the maximum value of the adjustment range when the cam receiving pins 52a reach the second flat surfaces 49b.

[0120] Conversely, when the drag adjusting lever 2 is rotated in the opposite direction (counterclockwise from the perspective of Figure 2), the four belleville springs constituting the second force applying member 54 and the coil spring constituting the first force applying member 53 spring load the spool 4 and the spool shaft 5 leftward from the perspective of Figure 3 and the drag force gradually weakens. When the spring force exerted by the second force applying member 54 becomes weaker than the spring force exerted by the first force applying member 53, the friction disk 21 separates from the brake disk 22 and the drag mechanism enters a brake released state. When the cam receiving pins 52a reach the protrusion 44a of the rotation restricting portion 44 during a counterclockwise operation of the drag adjusting lever 2, the drag force temporarily increases and the drag adjusting lever 2 becomes more difficult to rotate. Consequently, when the drag adjusting lever 2 is operated toward the drag release position, the drag adjusting lever 2 becomes more difficult to rotate (operate) just before it reaches the drag release position.

#### OTHER EXAMPLE EMBODIMENTS

[0121] (a) Although in the previously explained embodiment the cam receiving portion is provided in the drag adjusting lever and the cam surface is provided on a cam member, the present invention is not limited to such a configuration. For example, it is acceptable to provide a cam surface having a protrusion in the drag adjusting lever and provide a cam receiving pin on a cam member.

[0122] (b) Although the previously described embodiment presents an example of the present invention in which a drag adjusting mechanism is contrived to adjust a drag mechanism provided on a handle side of a dual-bearing reel, the present invention is not limited to such a configuration. For example, the present invention can be applied when a

drag mechanism is provided on the opposite side as a handle. In such a case, the spool is normally press fitted to the drag mechanism through a bearing and a pinion gear.

[0123] (c) Although in the previously described embodiment the second slanted surface 44d is curved in a circular arc-like shape, it is also acceptable for the second slanted surface 44d to be a linear flat slanted surface.

[0124] (d) Although in the previously described embodiment a recessed portion 49f is provided in a strike position, it is also acceptable to provide a protruding portion.

[0125] With the present invention, the angle of the first slanted surface of the protrusion, which is located on the drag release position side of the apex, is smaller than the angle of the second slanted surface. Consequently, when the drag adjusting lever is rotated from the maximum drag position to the rotation restricting portion, the rate of change of the drag force increases before the protrusion is passed and rotation of the drag adjusting lever to the drag release position becomes more difficult before the drag release position is reached. Meanwhile, when the drag adjusting lever is rotated from the drag release position toward the rotation restricting portion, the change in the drag force is smaller and the rotation operation is easier to perform because the slope of the first slanted surface is more gradual.

[0126] As used herein to explain and claim the present invention, the following directional terms “forward, rearward, above, downward, vertical, horizontal, below and traverse” as well as any other similar directional terms referring to those directions of a dual-bearing reel equipped with example embodiments of the present invention. In addition, the terms of degree such as “substantially”, “about” and “approximately” as used herein mean a reasonable amount of deviation of the modified term such that the end result is not significantly changed. Also, the term “configured”, as used herein, describes a component, section or part of a device that is constructed to carry out the desired function.

[0127] While only selected embodiments have been chosen to illustrate the present invention, it will be apparent to those skilled in the art from this disclosure that various changes and modifications can be made herein without departing from the scope of the invention as defined in the appended claims. Furthermore, the foregoing descriptions of the embodiments according to the present invention are provided for illustration only, and

not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

## WHAT IS CLAIMED IS:

1. A drag adjusting mechanism for a dual-bearing reel configured to adjust a drag force of a drag mechanism operating to brake rotation of a spool of the dual-bearing reel in a line reel-out direction by moving the drag mechanism along an axial direction of a spool shaft, the drag adjusting mechanism comprising:

a drag adjusting lever configured and arranged to be rotated about the spool shaft between a drag release position and a maximum drag position such that rotation of the drag adjusting lever operates to regulate the drag force of the drag mechanism; and

a cam mechanism including a cam surface having a height that varies along the axial direction of the spool shaft such that rotation of the drag adjusting lever between the drag release position and the maximum drag position causes the drag mechanism to move along the axial direction of the spool shaft, and a rotation restricting section provided on the cam surface to restrict rotation of the drag adjusting lever when rotated towards the drag release position, the rotation restricting section including a protruding portion having an apex, a first slanted surface that defines a first angle and extends from the apex toward a first position corresponding to the drag release position, a second slanted surface that defines a second angle and extends from the apex to the direction opposite of the drag release position, the first angle being smaller than the second angle.

2. The drag adjusting mechanism according to claim 1, wherein the protruding portion further having a first height at the apex that is smaller than one half of a second height at a second position corresponding to the maximum drag position.

3. The drag adjusting mechanism according to claim 1, wherein the cam surface further having a first flat surface at the first position and arranged substantially perpendicular to the spool shaft, a second flat surface at the second position and arranged parallel to the first flat surface and further outward in an axial direction than the first flat surface, and a third slanted surface arranged to join the first flat surface and the second flat surface together, the protruding portion being arranged between the first flat surface and the third slanted surface.

4. The drag adjusting mechanism according to claim 1, wherein the first slanted surface is a linear surface, and the second slanted surface is a curved surface having a circular arc-like shape such that the second angle of the second slanted surface is larger than the first angle of

the first slanted surface.

5. The drag adjusting mechanism according to claim 4, wherein the drag adjusting lever is arranged on the same side of the spool as the drag mechanism.

6. The drag adjusting mechanism according to claim 5, wherein the cam mechanism further including

a cam member provided with the cam surface and mounted to a reel unit such that it can move freely along an axial direction of the spool shaft but cannot rotate,

an adjusting knob arranged to contact the cam member on side of the cam member facing outward along an axial direction of the spool shaft and configured to screw onto the spool shaft,

a cam receiving portion provided on the drag adjusting lever such that it can contact the cam surface and serving to move the cam member in a first axial direction away from the drag adjusting lever when the drag adjusting lever is rotated in a first direction, and

a force applying member configured and arranged to act through the adjusting knob so as to move the cam member in a second axial direction opposite to the first axial direction when the drag adjusting lever is rotated in a second direction.

7. The drag adjusting mechanism according to claim 6, wherein the rotation restricting section temporarily restrict rotation of the drag adjusting lever when the drag adjusting lever is rotated to a position where the cam receiving portion is just in front of the drag release position.