(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 052 365 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.11.2000 Bulletin 2000/46

(51) Int. Cl.[7]: **E06B 9/308**, E06B 9/307

(21) Application number: **00303940.1**

(22) Date of filing: **10.05.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **11.05.1999 EP 99201457**

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(54) Operating mechanism for a venetian blind

(57) An operating mechanism is provided which can raise, lower and tilt slats of a venetian blind, particularly an outside blind mounted externally of a building, and which comprises: a support body for rotatably receiving a rotatable drive shaft; a releasable clutch mechanism having at least a first element mounted for rotation by the drive shaft and a second element releasably engaged with the first element for moving the slats between opposite first and second angular positions; means defining the first and second angular positions; arresting means on the support body adapted to cooperate with the second element for establishing the opposite first and second angular positions; a retractable stop engageable with the second element to arrest the second element in an intermediate position between the opposite first and second positions and a lost motion mechanism interposed between the drive shaft and the retractable stop for engaging the retractable stop with the second element only after a predetermined number of revolutions of the drive shaft.

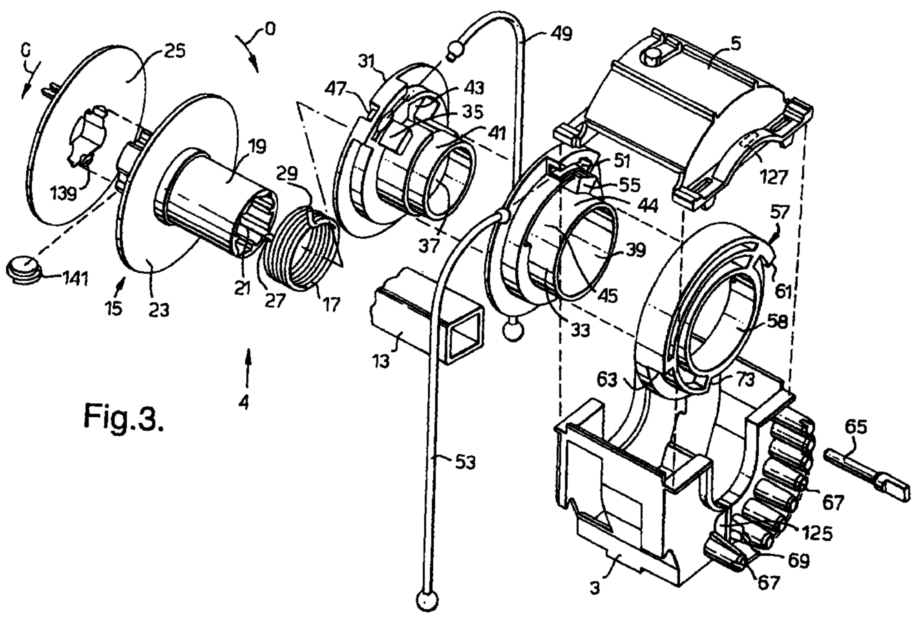

Fig.3.

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2.16.7 (HRS)/3.6

Description

[0001] The invention relates to a venetian blind, particularly an outside blind mounted externally of a building. The invention especially relates to a venetian blind with an operating mechanism for raising, lowering and tilting its slats and a drive mechanism for moving the operating mechanism in opposite directions so that the operating mechanism can tilt the slats while their direction of movement is changed between lowering and raising them. The invention particularly relates to a venetian blind having an operating mechanism with an intermediate pre-closure tilt position, which can be bypassed by reverse rotation of the slats. The invention quite particularly relates to an operating mechanism having an adjustable full tilt-open stop, so that two or more, operating mechanisms can be used, for example, in tandem to operate two or more different (e.g., upper and lower) sections of slats in a blind to obtain different angles of full closure. The invention also quite particularly relates to a transmission which is operatively interposed between the operating mechanism and the drive mechanism to reduce the speed of movement of the operating mechanism during tilting of the slats. The invention also relates to a tape winding core which can be adjusted to accommodate differences in length of a lifting tape of the blind, for example, for fine tuning the level of its bottom rail when installing the blind or for compensating for differences in elongation of its lift tape over time.

[0002] Venetian blinds with operating and drive mechanisms are generally known, for example from EP 0 684 361, EP 0 356 690, EP 0 190 626, EP 0 097 627, DE 37 18 513 (C2), DE 33 13 833 (C2), GB 1 599 608 and US 2 237 539. Such operating mechanisms have often been somewhat difficult to operate, in that tilting of the slats of their blinds from one end position to the other or continuing tilting beyond one of the end positions could easily result in unintentionally starting to raise the blinds again. Also, such operating mechanisms have frequently been rather difficult to assemble which, at times, has resulted in their faulty operation. In addition, the speed of tilting the slats of their blinds has been the same as the speed of raising and lowering the slats. As a result, increases in the speed of raising and lowering the slats have increased the speed of tilting the slats which has made it more difficult to control accurately the tilt of the slats. This has been a particular problem in venetian blinds, as described in EP 0 684 361 and US 2 237 539, which include a pair of operating mechanisms to tilt lower and upper sections of slats between different angular positions of closure.

[0003] An adjustable tape winding core also is generally known, for example from DE 22 25 853. However, such a core has not always been easy to access in order to make adjustments, and it has also required a number of additional components in the operating mechanism in order to function properly.

[0004] In accordance with this invention, an operating mechanism is provided which can raise, lower and tilt slats of a venetian blind, particularly an outside blind mounted externally of a building, and which comprises: a support body for rotatably receiving a rotatable drive shaft; a releasable clutch mechanism having at least a first element mounted for rotation by said drive shaft and a second element releasably engaged with said first element for moving the slats between opposite first and second angular positions; means defining the first and second angular positions; arresting means on the support body adapted to cooperate with the second element for establishing the opposite first and second angular positions; a retractable stop engageable with the second element to arrest the second element in an intermediate position between the opposite first and second positions and a lost motion mechanism interposed between the drive shaft and the retractable stop for engaging the retractable stop with the second element only after a predetermined number of revolutions of the drive shaft.

[0005] This operating mechanism can be made to operate reliably and efficiently even in a hostile environment on the exterior of a building. It can also be more easily and less expensively assembled and operated.

[0006] Advantageously, the means defining the first and second angular end positions of the operating mechanism include arresting means on the support body adapted to operatively cooperate with the second element.

[0007] Also advantageously, the second element of the releasable clutch mechanism is adapted to move the slats by means of a pivotal tilt element including a first ring a second ring and a timer ring, all rotatably engaged on the first element, the pivotal tilt element thereby being adapted to tilt the slats between the opposite first and second angular end positions.

[0008] Further advantageously, the lost motion mechanism includes a driven member drivingly engaged by the drive shaft and having a first circumferential projection, at least one lost motion disc has a second circumferential projection and an annular cam member, the first projection is adapted to engage the lost motion disc only upon a predetermined amount of rotation after each change of rotational direction, and the second projection is adapted to engage, in turn, the annular cam member.

[0009] Also in accordance with this invention, a transmission is provided for a venetian blind, which can be operatively interposed between a drive mechanism of the blind and the operating mechanism of this invention and which comprises: a planetary gear transmission that has a casing fixedly mounted in a head rail of the venetian blind; a sun gear drivingly engaged by the drive mechanism for rotation in opposite directions; a plurality of planet gears, in driven engagement with the sun gear; a planet gear output carrier carrying the planet gears and drivingly engaging the operating mechanism; an internally toothed ring gear surrounding the plurality of planet gears in driven engagement therewith; a wrap spring positioned concentrically between the casing and the ring gear for releasably retaining the ring gear in the casing against rotation; the ring gear having a protrusion, engaging a tang at one end of the second wrap spring; and a finger on the planet carrier engaging a tang at the other end of the wrap spring in a direction of releasing the wrap spring and the ring gear from the casing for rotation with the sun gear after a predetermined amount of rotation in either of the opposite directions. With such a transmission, it has been possible to obtain speed reductions in the ratio of between 2:1 and 4:1, depending on the size of head rail and the forces to be transmitted.

[0010] Further in accordance with this invention, a venetian blind, particularly an outside blind mounted externally of a building, is provided and comprises the operating mechanism and/or the transmission of this invention. Advantageously, the venetian blind includes at least two operating mechanisms, an upper section of slats, and a lower section of slats; wherein a first operating mechanism has one of its angular end positions differing from those of a second operating mechanism; and wherein the first operating mechanism is adapted to tilt the slats of the lower section and the second operating mechanism is adapted to tilt the slats of the upper section.

[0011] Still further in accordance with this invention, an adjustable tape winding core is provided for a venetian blind, which can be used in the operating mechanism of this invention, which can be adjusted to accommodate differences in length of a lifting tape of the blind, and which comprises: a pulley body with a spool between a pair of pulley flanges; the spool having a screw thread, in which is rotatably received an adjustment screw plug, preferably having a width about equal to the distance between the pulley flanges.

[0012] Further aspects of the invention will be apparent from the detailed description below of particular embodiments and the drawings thereof, in which:

- Figure 1 is a transverse elevation of an operating mechanism of the invention for moving slats of a venetian blind;
- Figure 2 is a longitudinal cross-section of the operating mechanism, taken along line II - II in Figure 1; a front portion of a stop lever engages a timer ring of a clutch mechanism, and a rearward portion of the stop lever follows a cam member of a lost motion mechanism;
- Figure 3 is an exploded view of the clutch mechanism of the operating mechanism, shown in Figure 2;
- Figure 3A is a perspective view of the first ring of the clutch mechanism, shown in Figure 3;
- Figure 3B is a perspective view of the second timer ring of the clutch mechanism, shown in Figure 3;
- Figure 3C is a perspective view of the timer ring of the clutch mechanism, shown in Figure 3, for defining pivotal positions of the slats of the blind;
- Figure 4 is an exploded view of the stop lever and lost motion mechanism of the operating mechanism, shown in Figure 2;
- Figure 4A is a perspective view of a lost motion disc of the lost motion mechanism, shown in Figure 4, but viewed from an opposite side;
- Figure 4B is an elevation of the annular cam member of the lost motion mechanism, shown in Figure 4, but viewed from an opposite side;
- Figure 4C is a bottom elevation of the annular cam member, shown in Figure 4B, showing its axially extending cam;
- Figure 4D is a perspective view of the annular cam member, shown in Figures 4, 4B and 4C;
- Figure 4E is a perspective view of the driven interposer member, shown in Figure 4;
- Figure 4F is a perspective view of the stop lever, shown in Figure 4;
- Figure 5 is a longitudinal cross-section, similar to Figure 2, showing the operating mechanism with its retractable stop lever out of engagement with the timer ring of the clutch mechanism;
- Figure 6 is a schematic front elevation of another embodiment of a venetian blind, provided with four of the operating mechanisms of Figures 1-5, driven by a single drive mechanism and a pair of transmissions;
- Figure 7 is a schematic ghost view of one longitudinal side of one of the transmissions of Figure 6, as viewed along line VII - VII in Figure 6, but without the head rail of the blind;
- Figure 8 is a cross-section of the transmission of Figure 7, taken along line VIII - VIII in Figure 7; and
- Figure 9 is an exploded view of one of the transmissions of Figures 6-8.

In these Figures, corresponding parts in different embodiments are referred to by corresponding names and by the same last two reference numerals.

[0013] An operating mechanism 1 of this invention is shown in Figures 1-5. It includes a support body 3 which, together with a support body cover 5, forms a housing enclosing components of a clutch mechanism 4 for engaging and disengaging rear and front, ladder side cords 7 and 9 that pivotally tilt the slats 11 of an otherwise conventional venetian blind 12.

[0014] The support body 3, as best shown in Figure 3, has a longitudinally-extending, rotatable drive shaft 13 extending axially through it. The drive shaft 13 is driven by a conventional reversible motor or the like, either directly or through a transmission as shown in Figures 7-9. The clutch mechanism 4, within the support body 3, is mounted for rotation by the drive shaft 13. The clutch mechanism includes: as a first element, a pulley body 15 that rotates with the drive shaft 13; and as a second element, a first wrap spring 17 that is releasably engaged, by friction with the pulley body 15. The pulley body 15 takes the form of a conventional pulley body for a spool for winding a lift tape (not shown) in order to raise the slats of a blind. The pulley body 15 includes an outwardly cylindrical, rearwardly-extending first hub 19 for accommodating the first wrap spring 17 on its exterior surface and a central non-circular axially-extending first bore 21 within it. The first bore 21 has a cross-sectional shape that is complementary to the rectangular cross-section of the drive shaft 13, within it. The pulley body 15 also includes a rearward first pulley flange 23 and a frontal second pulley flange 25, which are parallel and together form a spool for winding a lift tape (not shown) at the front end of the pulley body. The second pulley flange 25 is preferably formed as a separate element which simplifies the manufacture of the pulley body 15.

[0015] As also seen in Figure 3, the first wrap spring 17 has a first radially outwardly-deflected tang or end 27 and a second radially outwardly-deflected tang 29. The first tang 27 of the first wrap spring 17 engages a first ring 31, and its second tang 29 engages a second ring 33 that is adjacent to, and rearwardly of, the first ring. In this regard, the front of the first ring 31 has a frontally-open radially-extending first groove 31A (shown in Figure 3A), in which the first end 27 of the first wrap spring 17 is accommodated in a conventional manner, and the front of the second ring 33 has a frontally-open radially-extending second groove 33A (shown in Figure 3B), in which the second tang 29 of the first wrap spring 17 is accommodated in a conventional manner. The first ring 31 also has a rearwardly-extending first finger 35, spaced radially away from the drive shaft 13.

[0016] A central axial second bore 37 through the first ring 31 enables it to be journalled about the first hub 19 of the rotatable pulley body 15 while leaving an annular gap around the front part of the first hub to accommodate the first wrap spring 17. The radially-extending first groove 31A on the front of the first ring 31 also opens on to the second bore 37. The second ring 33 has a central axial third bore 39, by which the second ring is journalled on an outwardly cylindrical, rearwardly-extending second hub 41 of the first ring 31. The first ring 31 and the front of its second hub 41 have a radially- and axially-extending third groove 43 to accommodate the second end 29 of the first wrap spring 17 when jounalling the second ring 33 on the second hub 41. The radially-extending second groove 33A on the front of the second ring 33 also opens on to its third bore 39 and the third groove 43 of the first ring in the assembled operating mechanism 1.

[0017] The second ring 33 also has an outwardly cylindrical, rearwardly-extending third hub 44 and an axially-open radially-curved window 45, which is spaced radially away from the drive shaft 13 by the same distance as the first finger 35. The front of the second ring 33 has a surface member 46 which covers the front of the window 45 between the second groove 33A of the second ring and an adjacent lateral side 45A of the window. The first finger 35 of the first ring 31 extends rearwardly into the front of the window 45, adjacent the lateral side 45A of the window and the surface member 46, when the first and second rings 31 and 33 are concentrically journalled on the first hub 19 of the pulley body 15 in the operating mechanism 1. The first finger 35 can move, within the window 45, laterally away from the lateral side 45 A of the window, but is prevented by the first tang 27 of the wrap spring 17 from moving laterally towards the lateral side 45A of the window.

[0018] The outer circumference of the first ring 31 has a first cavity 47 that is open to one lateral side for receiving and holding a tangentially-extending end portion of a first slat tilting cord 49 that is part of, or connected to, the rear ladder side cord 7. The outer circumference of the second ring 33 has a similar second cavity 51 that is open to the opposite lateral side for receiving and holding a tangentially-extending end portion of a second slat tilting cord 53, that is part of, or connected to, the front ladder side cord 9. As a result, rotation of the first and second rings 31,33 together causes the slat tilting cords 49, 53 to be wound in opposite directions about the first and second rings, which causes the front and rear ladder side cords 7,9 to move in opposite vertical directions, and thereby causes the front and rear edges of the slats 11 of the blind 12 to move in vertically opposite directions between first and second, angular end positions (i.e., open and closed positions).

[0019] As further seen in Figure 3, the second ring 33 has a rearwardly-extending second finger 55, spaced radially away from the drive shaft 13 by the same distance as the first finger 35. The second finger 55 borders circumferentially on one end of the axially-open window 45. The second finger 55 extends into a mating radially-curved fourth groove (not shown) in the front of a timer ring 57 that is adjacent to, and rearward of, the second ring. In this regard, the fourth groove is spaced radially away from the drive shaft 13 by the same distance as the second finger 55 and has the about same length and width as the second finger.

[0020] The timer ring 57 establishes the first and second angular end positions of the slats 11. The timer ring 57 engages and rotates coaxially together with the first and second rings 31,33. In this regard, the timer ring 57 has a central axial fourth bore 58, by which it is journalled on the third hub 44 of the second ring 33 and a frontally-extending third finger 59 (shown in Figure 3C). The third finger 59 is spaced radially away from the drive shaft 13 by the same distance as the first and second fingers 35, 55 and is circumferentially located on the front of the timer ring between the first and second fingers in the operating mechanism 1. The third finger 59 extends into the rear of the axially-open window 45 of the second ring 33, between, and closely adjacent to, the first and second fingers 35,55 and rearwardly of the front surface member 46 of the second ring when the first and second rings and the timer ring are all concentrically journalled about the first hub 19 of the pulley body 15. The rear of the timer ring 57 (shown in Figure 3C) also has a slat tilt-open, angular position stop 61 and a slat tilt-closed, angular position stop 63 at different circumferential locations as described below.

[0021] The support body 3 is adapted to cooperate with the slat tilt-open and slat tilt-closed stops 61, 63 on the timer ring 57. Thereby, with the cooperation of the first and second rings 31,33 and the first wrap spring 17, the support body can be used to establish opposite first and second, angular tilt positions for the slats 11. For this purpose, an abutment or arresting pin 65 can be inserted in a selected one of a plurality of frontally-extending holes 67 in the rear of the support body 3. As shown in Figure 3, the holes 67 are arranged in a circumferential arc about the drive shaft 13. Also for this purpose, a frontally-extending central opening 69 is provided at the lower rear end of the support body 3, between holes 67, as shown in Figure 3 and described below.

[0022] As shown in Figures 2, 4 and 5, an elongated, retractable stop lever 71 extends frontally through the central opening 69 of the support body 3. As shown in Figure 4F, the rear end 72 of the stop lever is adapted to serve as a handle, and a portion of the front end 72A can act, through the central opening 69, on an intermediate slat position stop 73 on the rear of the timer ring 57, at a circumferential location between its slat tilt-open and slat tilt-closed stops 61, 63.

[0023] When the front end 72A of the stop lever 71 is urged to move frontally against the intermediate stop 73, the lever stops rotation of the timer ring 57, and thereby stops rotation of the first and second rings 31,33, in the direction for lowering the slats of the blind 12 (i.e., in the direction of arrow "C" in Fig. 3). However, the first hub 19 of the pulley body 15 can continue to rotate in this direction with the drive shaft 13 within the fourth bore 58 of the timer ring 57 while the first and second rings 31,33 remain on the first hub 19 at an intermediate position of angular tilt, between the open and closed positions of the slats 11. In addition, the first ring 31 can continue to rotate a small distance with the first wrap spring tang 27, relative to the second ring 33 and the second wrap spring tang 29, as the wrap spring continues to frictionally engage the first hub 19. This loosens somewhat the grip of the wrap spring 17 on the first hub 19, so as to allow the pulley body 15 and drive shaft 13 to continue to rotate, even after the first and second rings 31,33 and the timer ring 57 no longer rotate.

[0024] As shown in Figures 4 and 5, a lost motion mechanism, generally 74, is operatively interposed between the drive shaft 13 and the stop lever 71. The lost motion mechanism 74 is adapted to move the stop lever 71 axially, in and out of engagement with the intermediate stop 73 of the timer ring 57, only after a predetermined number of revolutions of the drive shaft 13. The lost motion mechanism 74 includes a driven interposer member 75 (shown in Figure 4E) which is directly engaged with the drive shaft 13. The front of the interposer member 75 has a flange 77, connected to a rearwardly-extending, outwardly cylindrical, fourth hub 79. A first engagement projection 81 extends rearwardly from the rear of the flange 77. The rear of the fourth hub 79 has a plurality of circumferentially-spaced, rearwardly-extending, flexible tongues 83, separated by axial slots 85 and each carrying a detent ridge 87 on its free rear end.

[0025] The lost motion mechanism 74, shown in Figure 4, also includes two identical, adjacent, lost motion discs 89,90 (shown in Figure 4A) and an adjacent annular cam member 91 (shown in Figures 4B-D). Both lost motion discs 89,90 and the cam member 91 are rotatably journalled on the fourth hub 79 of the driven interposer member 75, while being axially retained thereon by the detent ridges 87. The rear of each lost motion disc 89,90 has a rearwardly-extending second engagement projection 93,94, and the front of each lost motion disc (shown in Figure 4A) has an annular first groove 95,96 that is frontally open. In operation, the first engagement projection 81 of the interposer member 75 engages the first groove 95 of the adjacent lost motion disc 89, and the second engagement projection 93 of the adjacent lost motion disc 89 thereafter engages the first groove 96 of the other lost motion disc 90. The front of the cam member 91 (shown in Figure 4B) is also provided with an annular second groove 97 which is open frontally and engages the second engagement projection 94 of the adjacent disc 90. Preferably, the annular extent of each annular groove 95,97 is about 300° to provide a lost motion of approximately 900° of revolution of the drive shaft 13, but the grooves can have smaller or greater annular extents to provide less or more lost motion.

[0026] Laterally opposite sides of the cam member 91 have outwardly biased circumferential brake segments 99 and 101 which frictionally engage an inner cylindrical surface of a generally cylindrical housing 102 for the lost motion mechanism 74. The rear of the housing 102 has a circular hole 103, the edge of which is adapted to engage the detent ridges 87 on the rear of the flexible tongues 83 of the fourth hub 79 of the interposer member 75 when the rear of the fourth hub, carrying the journalled lost motion discs 89,90 and cam member 91, is urged rearwardly through the hole 103 to assemble the lost motion mechanism 74.

[0027] At the bottom of the housing 102 is an axially-extending channel-shaped extension 104 which accommodates the stop lever 71. A bottom portion 105 of the extension 104 extends rearwardly of the housing 102. On the bottom surface of the housing 102, within the extension 104, is a laterally- and downwardly-extending pivot 106. As shown in Figures 2, 4 and 5, the bottom of an upwardly-and frontally-inclined spring 107 is rearwardly and upwardly biased against the front of an upstanding projection (not shown) on the bottom of the extension 104 of the housing 102. Front portions of the spring 107 enclose a rearwardly-extending projection 107A on the bottom of the stop lever 71, so that the front of the spring biases the stop lever upwardly and frontally, towards the timer ring 57. As a result: a front stepped-end portion 109 of the stop lever 71 is urged frontally and upwardly against the rear of the timer ring 57; a laterally-extending shallow groove 110 atop a middle portion of the stop lever is urged upwardly and frontally against the pivot 106; and a rear stepped-end portion 111 of the stop lever is urged frontally and upwardly through a longitudinally-extending opening (not shown) in the bottom of the housing 102 and against the rear of the cam member 91.

[0028] The rear of the cam member 91 (shown in Figures 4C-D) has a rearwardly-facing circumferential cam surface 112 which includes the rear surfaces of its brake segments 99,101. The cam member 91 has, between its brake segments 99, 101, a rearwardly-extending projection 113 on its cam surface 112. The projection 113 has a pair of laterally opposite sides 113A that converge somewhat radially inwardly of the cam member 91 (as shown by phantom lines in Figure 4C) and that also converge rearwardly towards a radially-extending flat rear side 113B. As a result of rotation of the cam member 91, the upwardly-extending rear stepped portion 111 of the stop lever 71 follows the cam surface 112 around the rear of the cam member until the rear portion 111 comes to the projection 113. As the rear portion 111 then continues to follow the cam surface 112, the rear portion is moved rearwardly by the sides 113A of the projection 113 until the rear portion reaches the flat rear side 113B of the projection. This causes the front portion 109 of the stop lever 71 also to move rearwardly, away from the timer ring 57 (i.e., in a direction away from the position shown in Figure 5 and towards the position shown in Figure 2).

[0029] Movement of the stop lever 71 is further guided by a stepped guide track 114 on the rear of the timer ring 57 as best shown in Figure 3C. The stepped guide track 114 is generally formed by a rearwardly-facing, radially inner, raised annular track 115 and a rearwardly-facing, radially outer, annular track 117, in front of the inner track 115. Each track 115, 117 extends circumferentially between the slat-open and slat-closed angular position stops 61, 63 on the rear of the timer ring 57. The intermediate stop 73 is formed as part of a recess 119 in the inner track 115. The recess 119, in one rotational direction of the timer ring 57, is bordered by the intermediate stop 73, and in the opposite direction of rotation, it is bordered by an inclined ramp surface 121 leading to the outer track 117.

[0030] With the stop lever 71 in the position of Figure 2 (where the blind 12 is open and its slats 11 are substantially horizontal), its front portion 109 is frontally biased by the spring 107 against the inner track 115 of the timer ring 57. In this position, if the direction of rotation of the drive shaft 13 is changed from a direction for raising the slats 11 of the blind 12 (i.e., the direction of arrow "O" in Figures 3 and 3C) to a direction for lowering the slats (i.e., the direction of arrow "C" in Figs. 3 and 3C), the pulley body 15 rotates with the drive shaft, causing: the first wrap spring 17 to rotate with the pulley body; the first ring 31 and its first finger 35 and the second ring 33 and its second finger 55 to rotate with the first wrap spring; the first slat tilting cord 49 to be wrapped about the circumference of the first ring 31 and the second slat tilting cord 53 to be unwrapped from about the circumference of the second ring 33; and thereby the rear ladder side cord 7 to move upwardly and the front ladder side cord 9 to move downwardly, so as to tilt the slats 11 of the blind 12 frontally downward. Such rotation of the second finger 55 of the second ring 33 also causes: the timer ring 57 (which had been at rest against the slat-open angular position stop 61) and its third finger 59 to rotate with the second finger; and the front portion 109 of the stop lever 71 to move along the inner track 115 of the timer ring 57 until the front portion 109 reaches, and is pushed frontally and upwardly by the spring 107 into, the recess 119 where the front portion finally abuts against the intermediate stop 73. Then, such rotation of the timer ring 57 and first and second rings 31,33 will be stopped by the stop lever 71, causing the vertical movement of the ladder side cords 7,9 to stop. Thereby, the slats 11 will not tilt further and will have only a partially closed angle of tilt. This is desirable from a users point of view because it will only partly darken the inside of a room during lowering of the blind slats.

[0031] If the direction of rotation of the drive shaft 13 is then changed again (i.e., in the direction of arrow "O" in Figs. 3 and 3C), a small amount of rotation of the rings 31,33,57 with the drive shaft causes the front portion 109 of the stop lever 71 to move away from engagement with the intermediate stop 73 of the timer ring 57, and then frontally and downwardly out of its recess 119, via its inclined ramp 121, onto its outer track 117. In this position of the stop lever 71, shown in Figure 5, the timer ring 57 and its operatively connected, first and second rings 31,33 and first wrap spring 17 can be rotated further by the drive shaft 13 in either direction (i.e., in the direction of arrow "O" or arrow "C" in Figs. 3 and 3C) between the timer ring's slat-open and slat-closed angular position stops 61, 63. In this regard, each angular position stop 61,63 will rotate with the timer ring 57 about the drive shaft 13 until the angular rotation of the stop causes it to hit the abutment pin 65, inserted in one of the holes 67 in the support body 3, on either side of the centrally-positioned stop lever 71.

[0032] When an angular position stop 61, 63 hits the abutment pin 65 is the moment in the tilting of the slats 11 when they are either in their full tilt-open or full tilt-closed position. Thereafter, further rotation of the drive shaft 13 can be used to either open or close the blind 12 but not to further tilt-open or tilt-close the slats 11. Further rotation of the drive shaft 13 will also cause rotation of the interposer member 75, lost motion discs 89,90 and cam member 91, with its cam surface 112 and rearwardly-extending projection 113. This will cause the rear portion 111 of the stop lever 71, following the cam surface 112, to move rearwardly along the sides 113A of its projection 113 and, in turn, cause the front portion 109 of the stop lever 71 also to move rearwardly from the outer ring 117 of the timer ring 57 to its inner ring 115 (i.e., in a direction away from the position shown in Figure 5 and towards the position shown in Figure 2).

[0033] The function of the lost motion mechanism 74 is to delay the repositioning or reselling of the stop lever 71 into the position of Figure 2 (i.e., engaging the inner track 115 of the timer ring 57) until after a predetermined number of rotations of the drive shaft 13 have occurred after reversing its direction of rotation. As explained above, each of the engagement projections 81, 93,94 of the interposer member 75 and lost motion discs 89,90 is engaged in an annular groove 95,96,97 of an adjacent disc 89,90 or cam member 91 of the lost motion mechanism. Each engagement projection 81,93,94 will not rotate its neighboring lost motion disc or cam member until the former engages an end of any of the annular grooves 95,96,97 of the latter. In the lost motion mechanism of Figure 4, this will result in well over two, but less than three, full revolutions of lost motion delay before the cam member 91, rotating in one direction due to rotation of the interposer member 75, is caused to rotate in the opposite direction by a change in the direction of rotation of the interposer member.

[0034] Since resetting the stop lever 71 into the inner track 115 of the timer ring 57 results in its eventually encountering the intermediate stop 73, this could produce an undesirable effect upon reverse rotation of the drive shaft 13 when the angular orientation of the slats is being moved back and forth -- without wanting to raise the blind 12 (which would occur if the reverse rotation from a slat-closed position continues too far). For this reason, a lost motion of two or more revolutions is preferably provided which generally ensures that the operating mechanism 1 can stay in a full-tilt mode. Less lost motion or none could be provided in one or more of the lost motion discs 89,90 and cam member 91 of the lost motion mechanism 74 by respectively: shortening the angular length or extent of one or more of their annular grooves 95,96,97; or providing a hole 122,123 in the front of one or both lost motion discs (as shown in Figure 4A) and/or a like hole (not shown) in the front of the cam member 91, in which hole(s) the mating engagement projections 81,93,94 could be inserted. In this way, the manufacturer or the owner of the blind 12 can modify its operating mechanism 1 to have just the amount of lost motion appropriate to the blind.

[0035] As shown in Figures 1, 2 and 5, the rectangular drive shaft 13 passes through the center of the assembled operating mechanism 1 and its clutch mechanism 4 and lost motion mechanism 74 within its support body 3. In order to assemble the operating mechanism, the support body 3 has: a receiving recess 125 between its lowermost axially-extending holes 67 and its central opening 69; and a cavity 127 in its cover 5 as shown in Figure 3. As shown in Figure 4, ridges 129 on the bottom of the housing 102 for the lost motion mechanism 74 can be snap-fit in the receiving recess 125, and a detent 131, on top of the housing 102, can be snap-fit in the cavity 127.

[0036] From Figure 4, it is also seen that the extension 104 of the housing 102 has rearwardly-open recesses 133,134 in the laterally opposite rear vertical walls 135 of its bottom portion 105. The recesses 133,134 are adapted to temporarily hold laterally-extending pins 137 on laterally opposite sides of the rear portion 111 of the stop lever 71 when the housing 102 is to be attached to the support body 3 and clutch mechanism 1, shown in Figure 3. After assembly, the pins 137 should be moved out of the recesses 133,134 and upwardly, so that the pins can then freely move axially on smooth horizontal surfaces 138 on top of the bottom portion 105 of the extension 104, between its rear vertical walls 135 and the rear of the housing 102, and thereby allow free axial movement of the stop lever 71 within the extension 104.

[0037] As also seen from Figures 2, 3 and 5, a screw thread 139 is provided in the spool 140 of the pulley body 15 for rotatably receiving an adjustment screw plug 141. Preferably, the width of the screw plug 141 equals the axial distance between the pulley flanges 23,25. By screwing or unscrewing the plug 141 from the spool 140, the diameter of the spool for winding the lift tape (not shown) can be changed. The spool 140 can, thereby, be adjusted to accommodate differences in length of the lifting tape. This can be used for fine tuning the level of the bottom rail of the blind 12, when installing it, or to compensate for changes in the length of the lift tape over time.

[0038] In Figure 3, the use of only a single abutment pin 65 is shown, whereas two of them may be used to establish the rotational limits of the slat-open and slat-closed angular position stops 61, 63 of the timer ring 57. The slat-closed stop for obtaining full closure is preferably provided as an integral fixed stop or abutment formation on the inside of the support body 3. The slat-open stop can, likewise, be provided as a fixed stop on the support body 3. However, it is preferred that the slat-open stop be in the form of the abutment pin 65 which can be selectively inserted in any one of the holes 67 of the semi-circular array of holes in the rear of the support body 3. This adjustable full-open stop allows one type of operating mechanism 1 of this invention to be used in a number of different ways. For example, two or more such operating mechanisms can be readily used in a tandem arrangement, as described below, to operate upper and lower sections of slats in a blind to obtain different angles of full opening of the slats.

[0039] Figure 6 shows such an alternative embodiment of a venetian blind 212, which is similar to the blind 12 of Figure 1 and for which corresponding reference numerals (greater by 200) are used below for describing the corresponding parts.

[0040] The blind 212 has a conventional longitudinally-extending head rail 214, in which are housed a plurality of operating mechanisms 201A, 201B, 201C and 201D of this invention that are each the same as the operating mechanism 1 of Figures 1-5. The blind 212 also has a separately operated, upper section 216 of slats 211 and lower section 218 of slats 211.

[0041] A first pair of the operating mechanisms 201B and 201D tilt the upper section 216 of slats by means of a first pair of conventional ladder cords 220 and 222, each of which is connected to one of the first operating mechanisms 201B, 201D, respectively. Each of the first operating mechanisms 201B,201D is also connected to one of a pair of conventional lift tapes 224 and 226, respectively, with which the first operating mechanisms can raise and lower both the upper and lower sections 216,218 of slats 211. Each lift tape 224,226 is also connected to a conventional bottom rail 228 which can be raised and lowered with the slat sections 216,218.

[0042] A second pair of operating mechanisms 201A and 201C are each offset to the left of one of the first operating mechanisms 201B,201D, respectively, and tilt the lower section 218 of slats 211 by means of a second pair of conventional ladder cords 230 and 232, each of which is connected to one of the second operating mechanisms 201A,201C, respectively. In order that the ladder cords 220,222,230,232 and lift tapes 224,226 do not unduly obstruct vision through the blind 212, the second ladder cords 230,232 (for the lower slat section 218) are each guided and extend in close proximity to the first ladder cords 220,222 (for the upper slat section 216), respectively, and lift tapes 224,226, respectively. For this purpose, the head rail 214 is provided with guiding pins 234 and 236, around which the second ladder cords 230,232 pass.

[0043] The blind 212, shown in Figure 6, is thus especially adapted to regulate the amount of daylight passing through a window into a room so as, for example, not to interfere with the use of computer monitors in the room. In this regard, the abutment pins 65 (shown only in Figures 1-5) of the first operating mechanisms 201B,201D can be positioned to allow a greater angle of opening of the slats 211 of the upper section 216 than the angle of opening of the slats of the lower section 218, allowed by the position of the abutment pins 65 in the second operating mechanisms 201A,201C. This can provide a room with both protection against glare from sunlight (entering through the lower slat section 218) and sufficient daylight illumination (entering through the upper slat section 216). As a result, artificial illumination of a room can be reduced, which is desirable from an environmental point of view.

[0044] Although the advantages of regulating daylight in a room by controlling the orientation of the slats of venetian blinds is well known (e.g., from EP 0 684 361), the blind 212 of Figure 6 provides such control, using only operating mechanisms 201A-201D with generally conventional components. Further light regulation with the blind 212 cart be obtained in a known manner (e.g., from EP 0 303 107) by providing the slats 211 of the upper section 218 and the slats 211 of the lower section 216 with different reflective properties and/or different shapes and/or profiles and/or by providing different reflective properties on the upper and lower surfaces of the different slats.

[0045] Because the second operating mechanisms 201A,201C for the slats of the lower section 216 do not require a lift tape, their winding spool components 23,25 (shown only in Figures 1-5) can, of course, be omitted to reduce costs.

[0046] As seen from Figure 6, the operating mechanisms 201A-201D are preferably all driven by a common longitudinally-extending, motor-driven shaft 238. The motor-driven shaft 238 is coupled to a reversible electric motor 240 and is used both to lower and raise the slats 211 at a relatively rapid speed and to adjust their angle of tilt at a moderate speed.

[0047] To obtain a lower speed of tilting with possibly a higher speed of raising and lowering the slats 211 of the blind 212, opposite ends of the motor-driven shaft 238 are provided with a pair of gear transmissions, generally 400 and 402 connected, respectively, to: the pair of operating mechanisms 201A,201B for the ladder cords 230,220 on one longitudinal side of the blind 212; and the operating mechanisms 201C,201D for the pair of ladder cords 232,222 on the other longitudinal side of the blind. The gear transmissions 400,402 are each driven by the motor-driven shaft 238, extending from opposite sides of the motor 240, while the operating mechanisms are driven by output shafts 404 and 406 of the gear transmissions extending to and through the pairs of operating mechanisms 201A,201B and 201C,201D, respectively, on longitudinally opposite sides of the blind.

[0048] Figures 7-9 show one of the gear transmissions 400 which is preferably identical to the other gear transmission 402. The transmission 400 preferably is an epicyclic or planetary gear transmission having a stationary casing 408. The casing 408 is provided with holding elements 410, 412, 414 and 416 for fixedly mounting the casing in the head rail 214 (not shown in Figures 7-9). The gear transmission 400 has an input drive member 418 that is drivingly engaged by the motor-driven shaft 238 (see Figure 6) and is integrally formed with a sun gear 420 that can rotate about a common longitudinally-extending axis of the drive shaft, input drive member and the casing 408. In driven engagement with the sun gear 420 are four circumferentially-spaced, planet gears 422, 424, 426 and 428 which can revolve about the axis of the casing 408 and are rotatably journaled on a planet gear output carrier 430. The planet gear carrier 430 has, on longitudinally opposite sides, a first half 430A (journalled on the input drive member 418) and a second half 430B (connected to the output shaft 404). Each planet gear carrier half 430A,430B is integrally formed with four journal shaft portions 432A,434A,436A,438A and 432B, 434B,436B,438B, respectively, for the planet gears 422,424,426,428.

[0049] The journal shaft portions 432A-438A,432B-438B and the planet carrier halves 430A,430B are connected to each other, within the planet gears 422,424, 426,428, and are held together by snap-fit arms 440A, 442A, 444A and 446A on the first half 430A, inserted into snap-fit apertures 440B, 442B, 444B and 446B on the second half 430B. The planet gear carrier 430 also has a protruding output socket 447 on its second half 430B for drivingly engaging the adjacent output shaft 404. (See Figure 6.)

[0050] Preferably, the input drive member 418 of the gear transmission 400 accommodates a hexagonally contoured, motor-driven shaft 238, and the output socket 447 accepts a square-contoured, hollow output shaft 404, like the drive shaft 13 of Figures 1-5. Thereby, the hexagonal motor-driven shaft 238 can be rotatably received and accommodated in the hollow interior of the output shaft 404. This allows each transmission 400,402 to be used in larger blinds than that of Figure 6, in which additional sets of ladder cords are necessary.

[0051] The transmission 400 also has an internally toothed, ring gear 448, surrounding and meshing with the planet gears 422,424,426,428. A second wrap spring 450 is concentrically positioned between the stationary casing 408 and the ring gear 448 for releasably retaining the ring gear in the casing and preventing the ring gear from rotating. In this regard, one or more, preferably a pair of, protrusions 452 and 454, on the outside circumference of the ring gear 448 engage the second wrap spring 450, between its radially-inwardly deflected tangs 456 and 458. Rotation of the ring gear 448 with respect to the casing 408 is prevented by either one of the protrusions 452,454 acting on a confronting one of the tangs 456,458 in a direction expanding the second wrap spring 450 against an inner cylindrical surface 460 of the casing. The second wrap spring 450 is biased in frictional engagement with the inner cylindrical surface 460 of the casing 408, and such frictional engagement is enhanced by any reaction force of the ring gear 448 through its protrusions 452,454 acting on the tangs 456,458 of the second wrap spring.

[0052] The planet gear carrier 430 also has a fourth finger 462 protruding from its first half 430A and received in an aperture 464 on its second half 430B. The fourth finger 462 rotates with the planet gear carrier 430 to sweep through an arcuate path available between the second wrap spring 450 and the ring gear 448 and engage, at opposite ends of this path, one of the tangs 456, 458 of the second wrap spring in a direction of contracting the second wrap spring to release it from the inner surface 460 of the casing 408.

[0053] The operation of each epicyclic gear transmissions 400,402 is generally as follows. The blind 212 of Figure 6 and its bottom rail 228 and upper and lower sections 216,218 of slats 211 are lowered by unwinding the lift tapes 224,226 from their spool components 23,25 (shown only in Figures 1-5) in the first operating mechanisms 201B,201D. As a result, the finger 462 on the planet gear carrier 430 rotates in the same direction as the sun gear 420 rotates and the planet gears 422-428 revolve. This continues until the fourth finger 462 ends up firmly engaged against one of the second wrap spring tangs 456,458 and thereby against one of the protrusions 452,454 on the ring gear 448, causing the ring gear also to rotate in the same direction as the sun gear 420.

[0054] When the direction of rotation of the motor 240 and the motor-driven shaft 238 is reversed, a lost motion mechanism 74 (shown only in Figures 1-5) on each operating mechanism 201A-201D allows tilting of the slats 211 before the bottom rail 228 and slats start to be raised. Simultaneously with this tilting action, the fourth finger 462 disengages itself from the adjacent second wrap spring tang 456 or 458 and starts moving in the opposite rotational direction with the sun gear 420 and planet gears 422-428. This causes the ring gear protrusions 452,454 to engage the second wrap spring tangs 456,458 in the direction of expanding the second wrap spring 450 against the inner surface 460 of the casing 408, so as to lock the ring gear against the casing. This produces a speed reduction between the drive shaft 213, driving the operating mechanisms 201A-201D, and the output shafts 404,406 during a substantial part of a complete revolution of each planet gear carrier 430. With the transmissions 400,402 as they have been described, a speed reduction rate of about 3-to-1 is available. With such a reduction in rotational speed during tilting, it is possible to very accurately tilt the slats 211 of the upper and lower sections 216,218 to any desired angular position, while providing sufficient speed for raising and lowering the blind 212.

[0055] As also seen from Figures 8 and 9, an internal sleeve 466 is closely fitted within the second wrap spring 450 to restrict and control its inward contraction. Without this sleeve 466, the second wrap spring 450 would tend to deform substantially more in the region of its tangs 456, 458, rather than deforming with a more desirable, progressive contraction throughout the full length of its windings. The internal sleeve 466 substantially eliminates this adverse tendency found in generally all wrap springs with radially deflected ends.

[0056] As also seen from Figure 9, each ring gear protrusion 452,454 has a recessed portion 468 and 470, respectively, for accommodating the confronting the second wrap spring tangs 456, 458. The remaining outer surface of each ring gear protrusion 452,454 distributes the engagement force directly on the fourth finger 462 of the planet gear carrier, rather than only via the second wrap spring tangs 456,458. This has been found desirable because during lifting of the blind 212, the entire force from the input drive member 418 to the output socket 447 will be transferred through the fourth finger 462 of the planet gear carrier 430 and the ring gear protrusions 452,454.

[0057] As further seen from Figure 9, a removable locking pin 472 can be provided for locking each gear transmission 400,402 in one of its end positions. The locking pin 472 can be used to synchronize the functioning of the gear transmissions 400, 402 which is preferred, for example, if it is desired that the transmissions, as shown in Figure 6, rotate in opposite directions. Each locking pin 472 can be fitted in a gear transmission 400,402 prior to assembly of the blind 212 but will be removed after assembly and before the blind is put into service. The locking pin 472 can also assist in the assembly of the transmission itself, which can then always be assembled, for example, as a right hand drive transmission. (In case a left hand drive transmission is desired, one can simply take out the locking pin, rotate the sun gear 420 and planet gear carrier 430 through their full rotation in an opposite direction, and then reinsert the locking pin.)

[0058] This invention is, of course, not limited to the above-described embodiments which can be modified without departing from the scope of the invention or sacrificing all of its advantages. In this regard, the terms in the foregoing description and the following claims, such as "longitudinally" "laterally", "axially", "upwardly", "downwardly", "radially", "tangentially", "horizontal" "vertical", "front" and "rear", have been used only as relative terms to describe the relationships of the various elements of the operating mechanism for a venetian blind and its preferred gear transmission. For example, the operating mechanisms 201A-201D of the blind 212 of Figure 6 could also be conventional operating mechanisms, such as those described in GB 1 599 608, EP 0 356 690, EP 0 190 626 or EP 0 097627.

Claims

1. An operating mechanism for raising, lowering and tilting the slats of a venetian blind; the operating mechanism comprising:

- a support body for rotatably receiving a rotatable drive shaft;
- a releasable clutch mechanism having at least a first element mounted for rotation by the drive shaft and a second element releasably engaged with the first element for moving the slats between opposite first and second angular end positions;
- means defining the first and second angular end positions;
- a retractable stop operatively engageable with the second element to arrest the second element in an intermediate position between the first and second angular end positions; and
- a lost motion mechanism between the drive shaft and the retractable stop for activating and deactivating the operative engagement of the retractable stop with the second element only after a predetermined number of revolutions of the drive shaft

2. The operating mechanism of claim 1 wherein the means defining the first and second angular end positions include arresting means on the support body, adapted to operatively cooperate with the second element.

3. The operating mechanism of claim 1 or 2 wherein the second element is adapted to move the slats by means of a pivotal tilt element including a first ring, a second ring and a timer ring, all rotatably engaged on the first element; the pivotal tilt element being adapted to tilt the slats between the first and second angular end positions.

4. The operating mechanism of claim 3 wherein the timer ring includes a slat tilt-open stop and a slat tilt-closed stop.

5. The operating mechanism of claim 4 wherein the timer ring includes an intermediate stop, between the slat tilt-open stop and the slat tilt-closed stop.

6. The operating mechanism of any one of claims 1-5 wherein the lost motion mechanism includes a driven member, drivingly engaged by the drive shaft and having: a first circumferential projection; a lost motion disc having a second circumferential projection; and an annular cam member; the first projection being adapted to engage the lost motion disc only upon a predetermined amount of rotation after each change of rotational direction; and the second projection, in turn, being adapted to engage the annular cam member.

7. The operating mechanism of any one of claims 3-6 wherein the timer ring includes a stepped annular track having an inner raised annular track and an outer annular track and the retractable stop is adapted to engage either one of the inner and outer annular tracks.

8. The operating mechanism of claim 7 wherein the intermediate stop is formed in the inner annular track.

9. The operating mechanism of any one of claims 2-8 wherein the arresting means on the support body is an abutment pin selectively insertable in a selected one of a plurality of openings, arranged in an arc on the support body.

10. The operating mechanism of any one of claims 1-9 wherein the first element is a pulley body that rotates with the drive shaft and the second element is a first wrap spring that is releasably engaged, preferably by friction, with the pulley body; wherein the pulley body includes an outwardly cylindrical, axially-extending sleeve for accommodating the first wrap spring on its exterior surface and a central non-circular axially-extending bore, within it, having a cross-sectional shape that is complementary to the cross-section of the drive shaft, within it.

11. An adjustable tape winding core for a venetian blind, which can be adjusted to accommodate differences in length of a lifting tape of the blind, which can be used in the operating mechanism of any one of claims 1-10, and which comprises: a pulley body with a spool between a pair of pulley flanges; the spool having a screw thread, in which is rotatably received an adjustment screw plug, preferably having a width about equal to the distance between the pulley flanges.

12. A venetian blind, particularly an outside blind mounted externally of a building, comprising the operating mechanism of any one of claims 1-10.

13. The venetian blind of claim 12 which includes at least two operating mechanisms; an upper section of slats; and a lower section of slats; wherein a first operating mechanism has one of its first and second angular end positions differing from those of a second operating mechanism; and wherein the first operating mechanism is adapted to tilt the slats of the lower section and the second operating mechanism is adapted to tilt the slats of the upper section.

14. The venetian blind of claim 12 or 13 wherein the operating mechanism is adapted to tilt the slats while their direction of movement is changed between lowering and raising; and wherein the venetian blind further includes: a drive mechanism for effecting movement of the operating mechanism in opposite directions; and a transmission operatively interposed between the operating mechanism and the drive mechanism to reduce the speed of movement of the operating mechanism during tilting of the slats.

15. The venetian blind of claim 14 wherein the transmission is an epicyclical gear transmission having:

- a casing fixedly mounted in a head rail of the venetian blind;
- a drive input member, drivingly engaged by the drive mechanism;
- a sun gear in driven engagement with the drive input member to rotate in opposite directions about an axis of the casing;
- a plurality of planet gears in driven engagement with the sun gear to revolve about the axis of the casing;
- a planet gear output carrier that carries the planet gears, is adapted to rotate about the axis of the casing and drivingly engages the operating mechanism;
- an internally toothed, ring gear that surrounds, and is in driven engagement with, the plurality of planet gears and is releasably retained in the casing against rotation about the axis of the casing;
- a second wrap spring that is between the casing and the ring gear for releasably retaining the ring gear in the casing and that includes deflected tangs on its opposite ends;
- a protrusion on the ring gear for engaging a confronting one of the tangs in a direction of expanding the diameter of the second wrap spring in the casing about the axis of the casing; and
- a finger on the planet gear carrier for engaging a confronting one of the tangs in a direction of contracting the diameter of the second wrap spring, after a predetermined amount of rotation of the planet gear carrier about the axis of the casing, to release the ring gear from the casing for rotation with the sun gear.

16. The venetian blind of claim 15 wherein the second wrap spring is axially aligned with respect to the sun gear.

17. The venetian blind of claim 16 wherein the deflected tangs on the second wrap spring are inwardly bent.

18. The venetian blind of claim 17 wherein the transmission has an internal sleeve closely fitting within the second wrap spring to control inward contraction thereof.

19. The venetian blind of any one of claims 14-18 wherein the drive mechanism comprises an electric motor, particularly wherein the transmission is driven by a drive shaft and drives the operating mechanism through an output shaft and wherein the output shaft is hollow and the drive shaft is rotatably accommodated within the hollow output shaft.

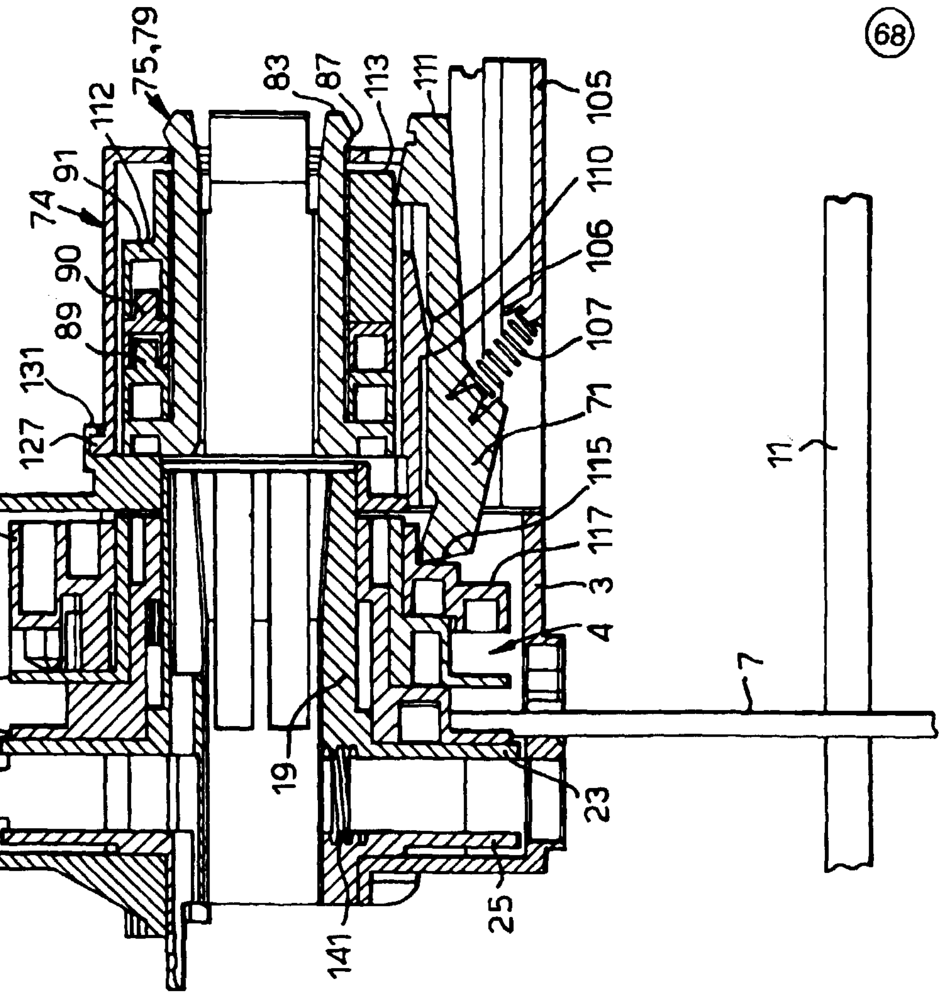

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Fig.2.

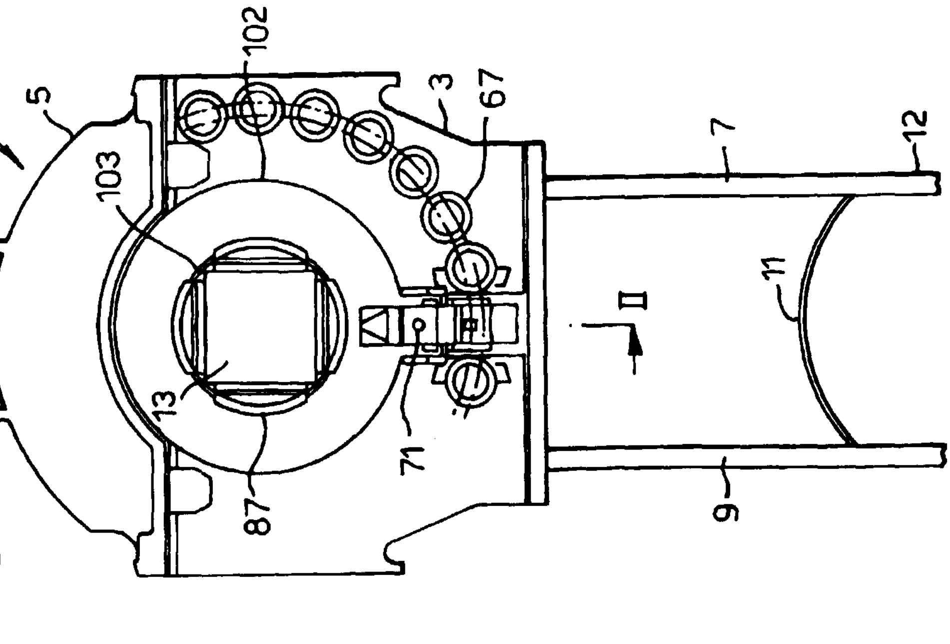

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Fig.1.

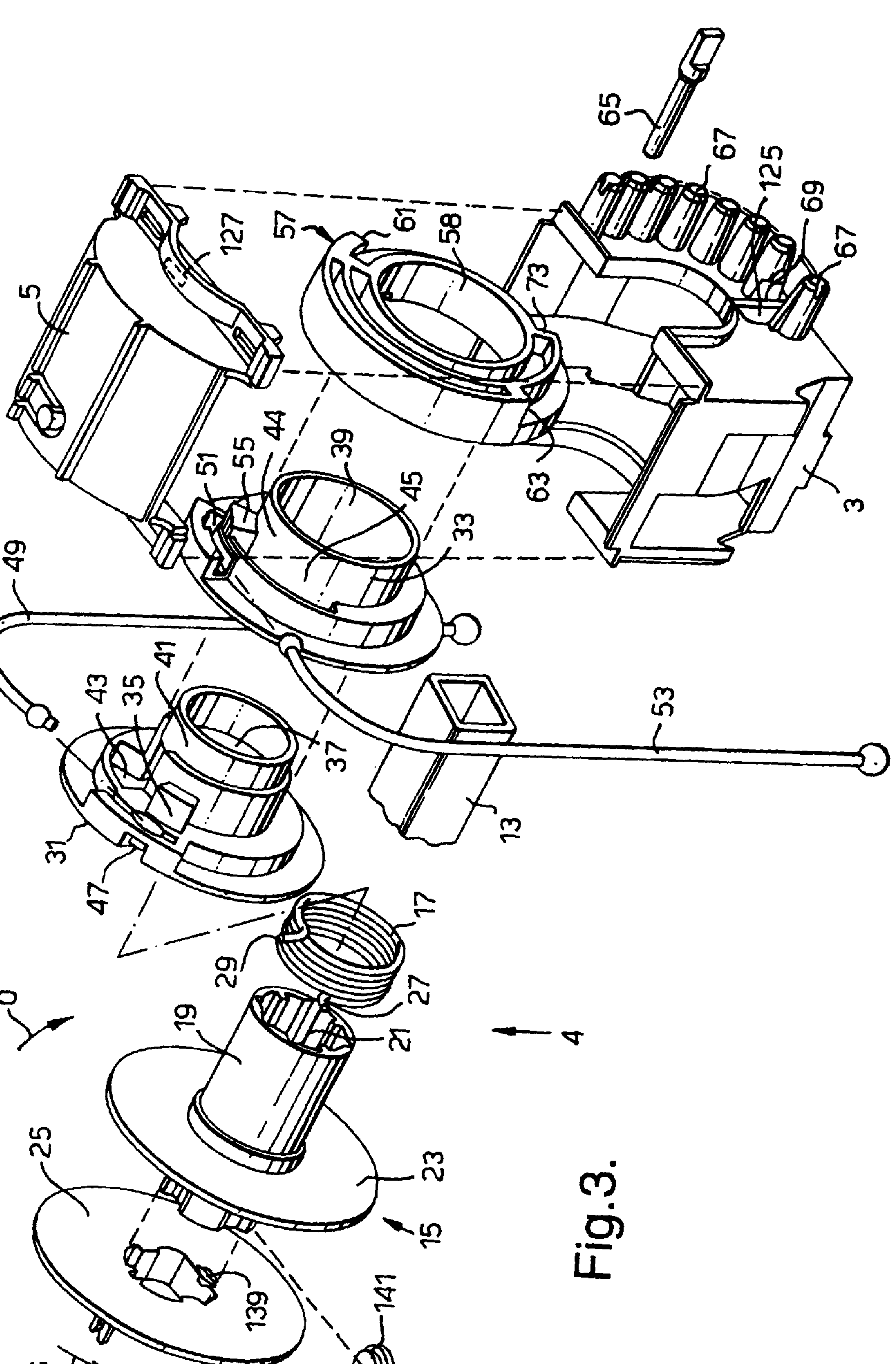

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Fig.3.

Fig.3A.

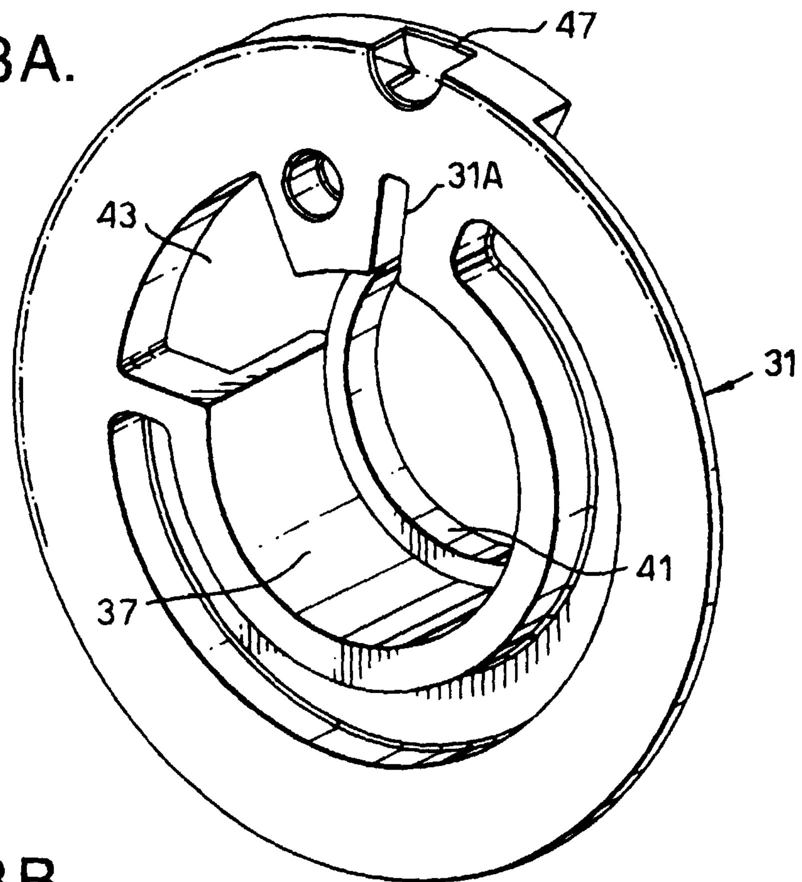
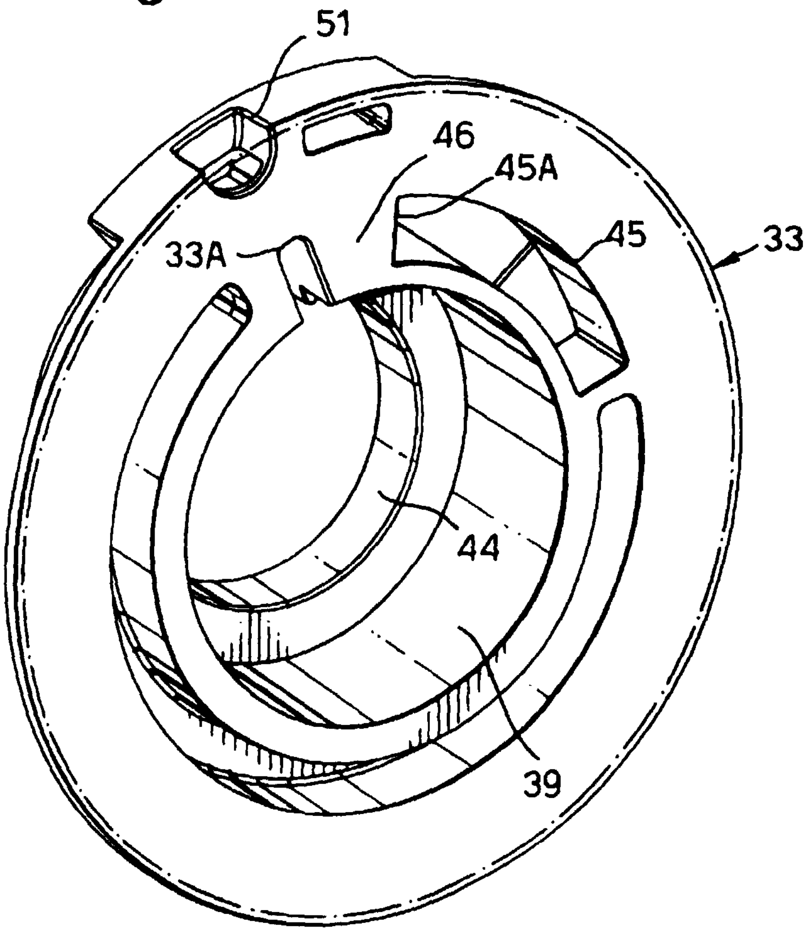


Fig.3B.



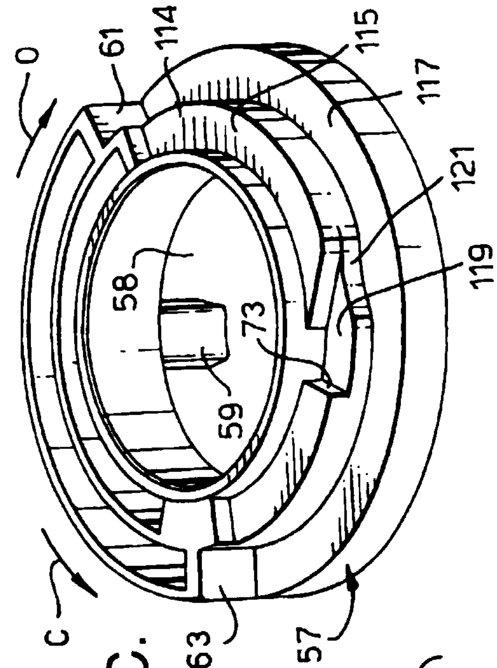

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Fig.3C.

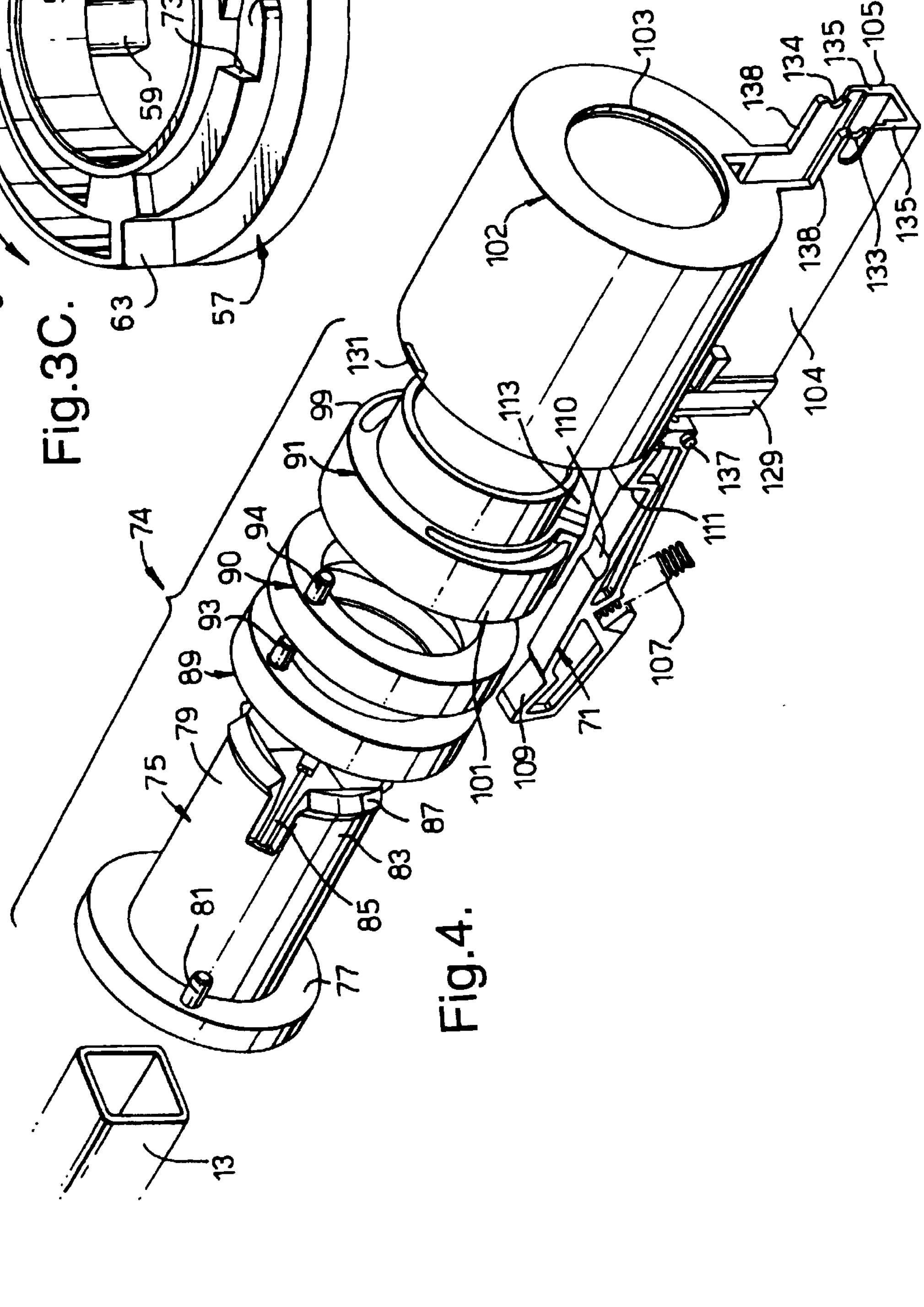
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Fig.4.

Fig.4A.

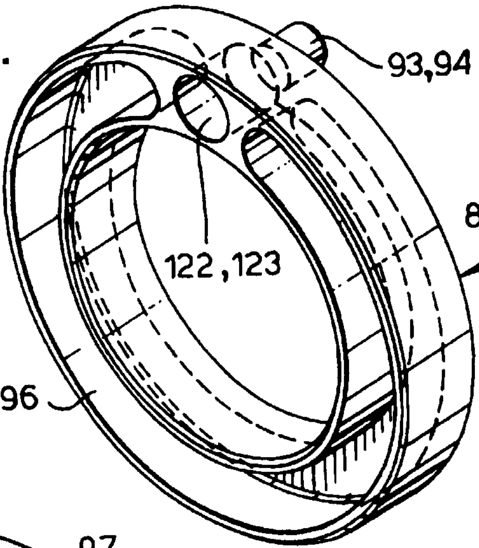


Fig.4B.

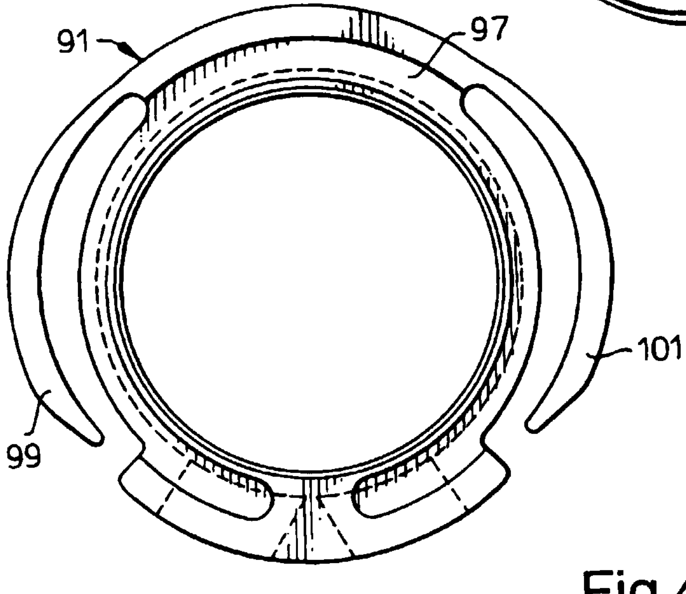


Fig.4C.

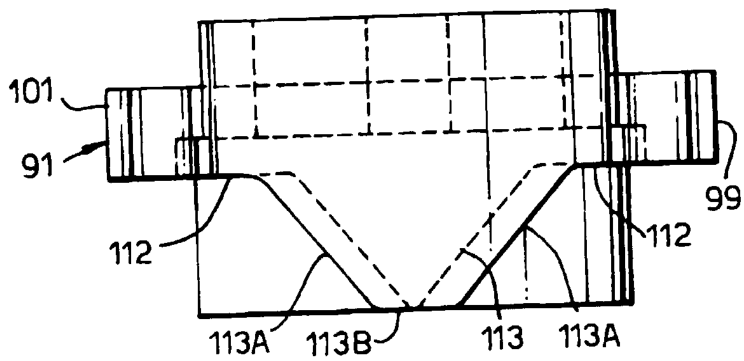
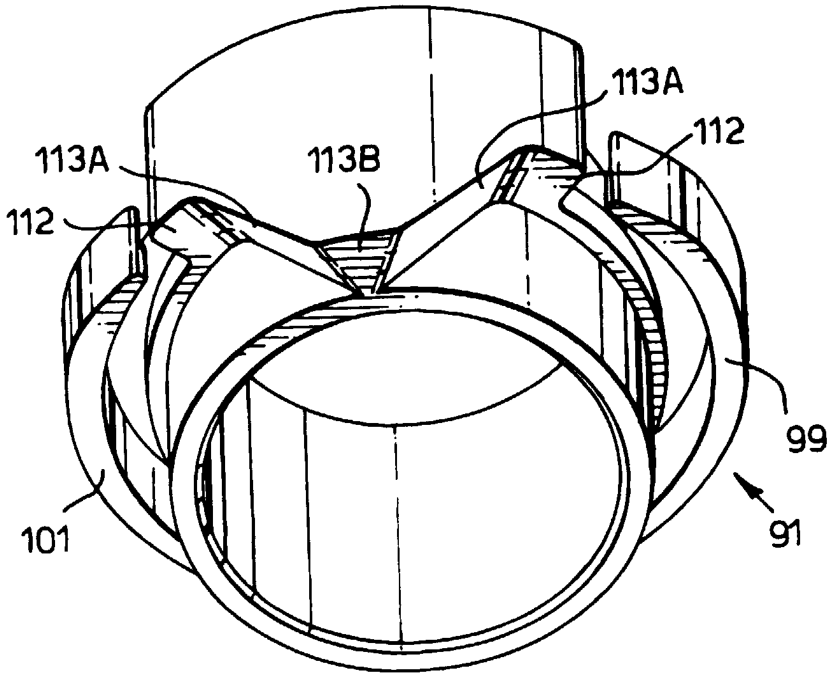


Fig.4D.



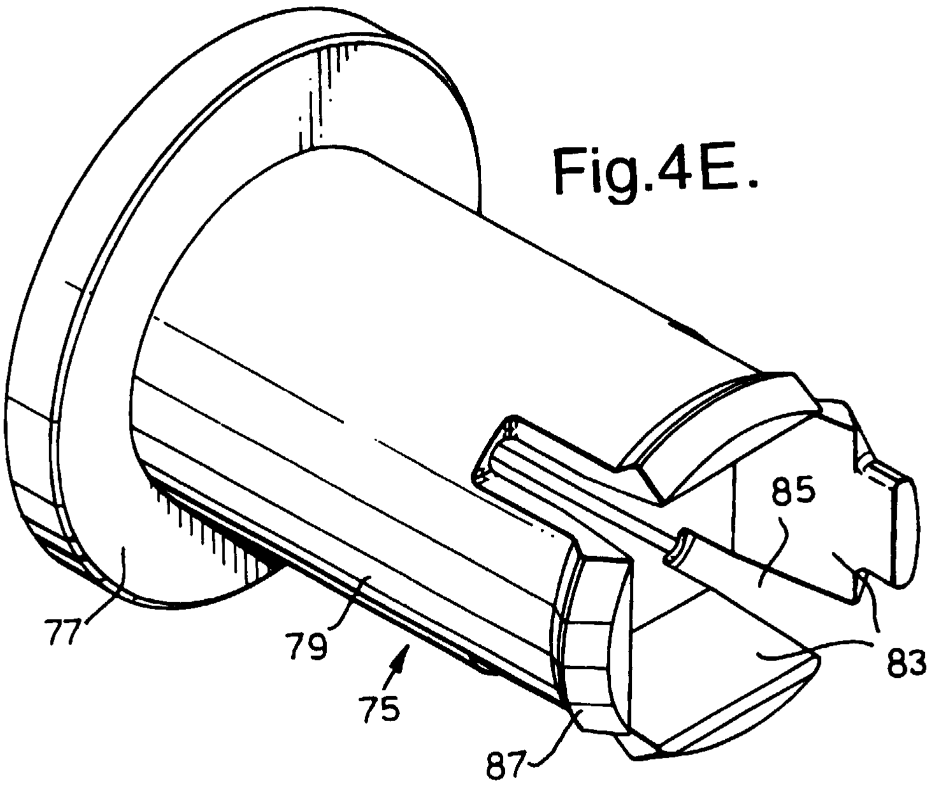


Fig.4E.

Fig.4F.

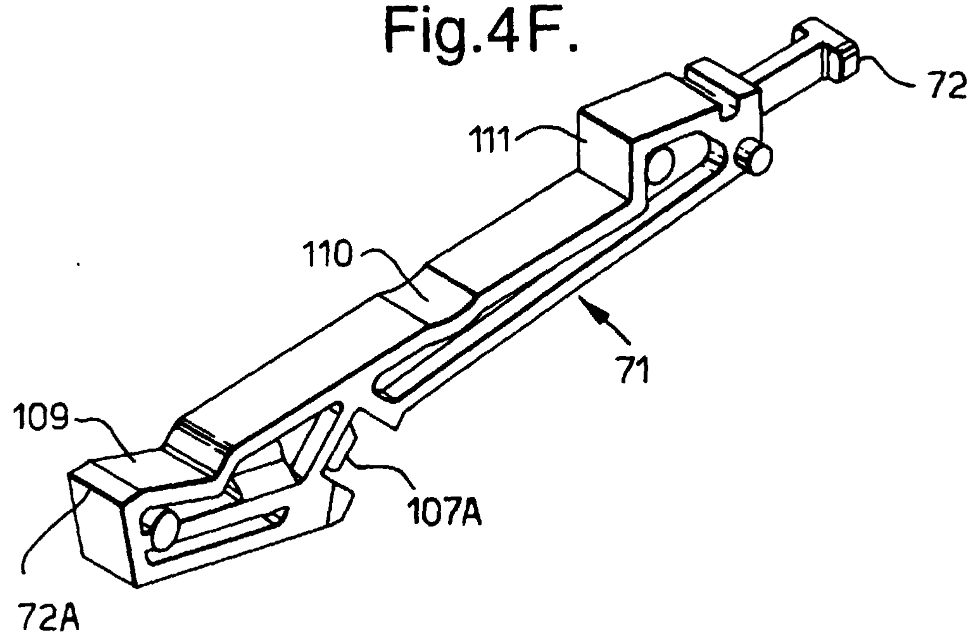

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Fig.5.

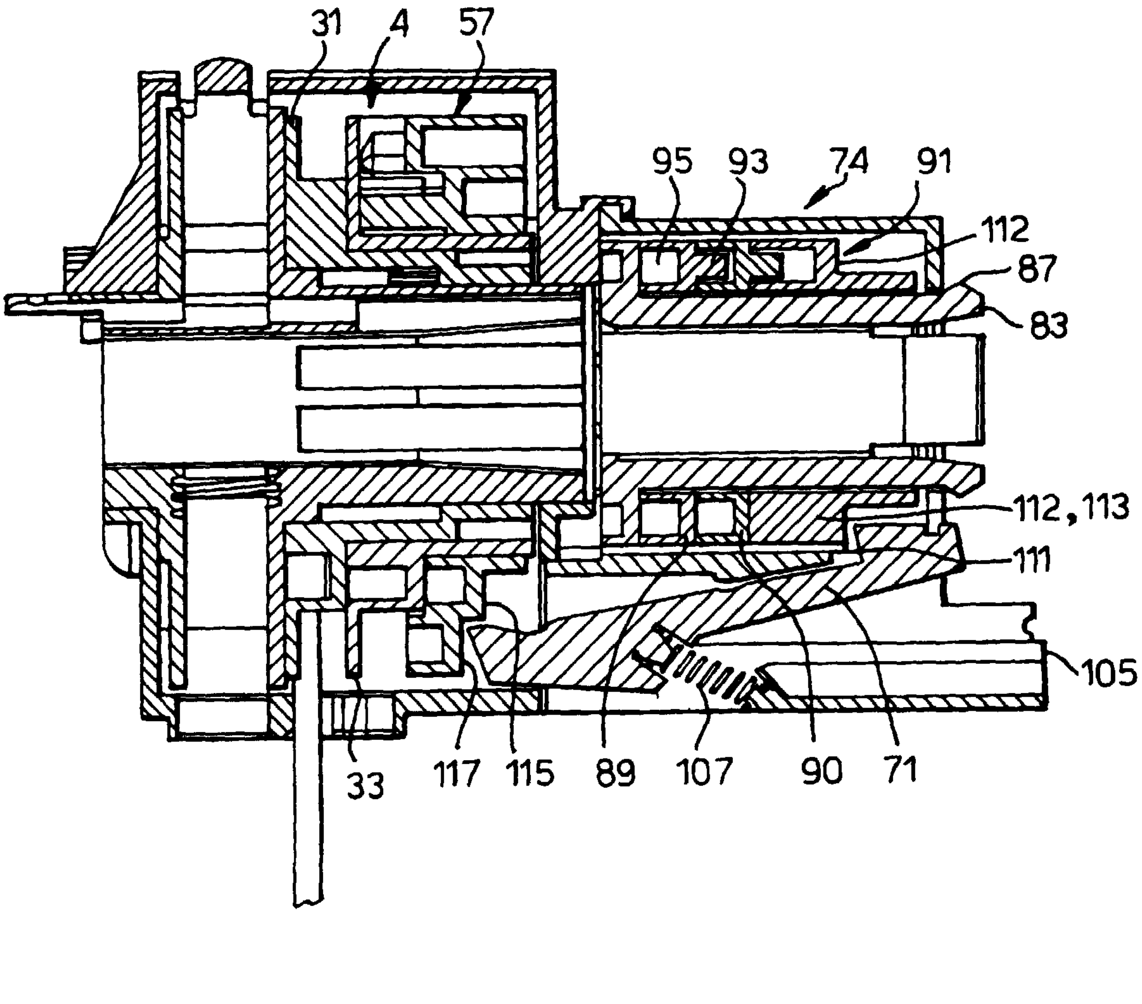
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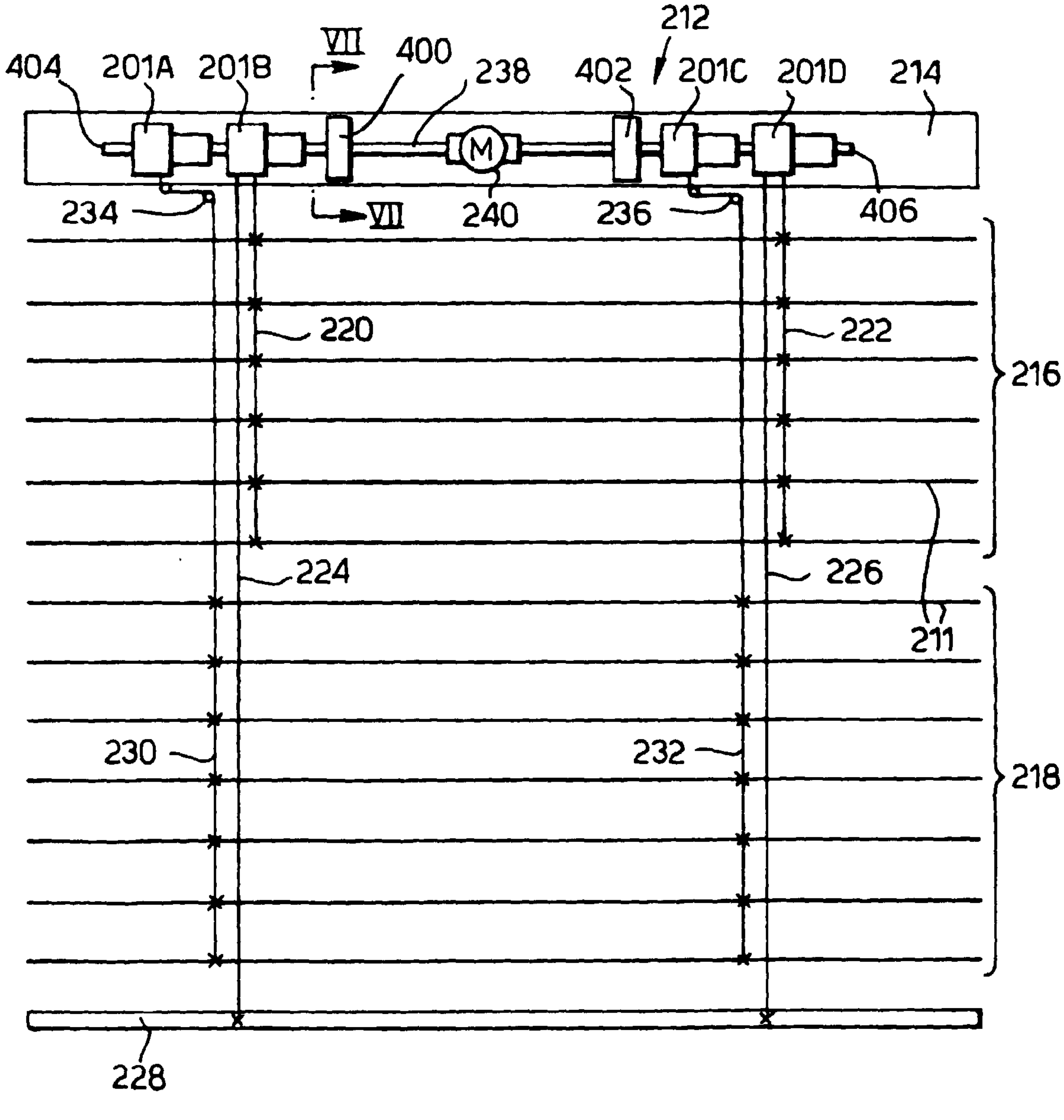
Fig.6.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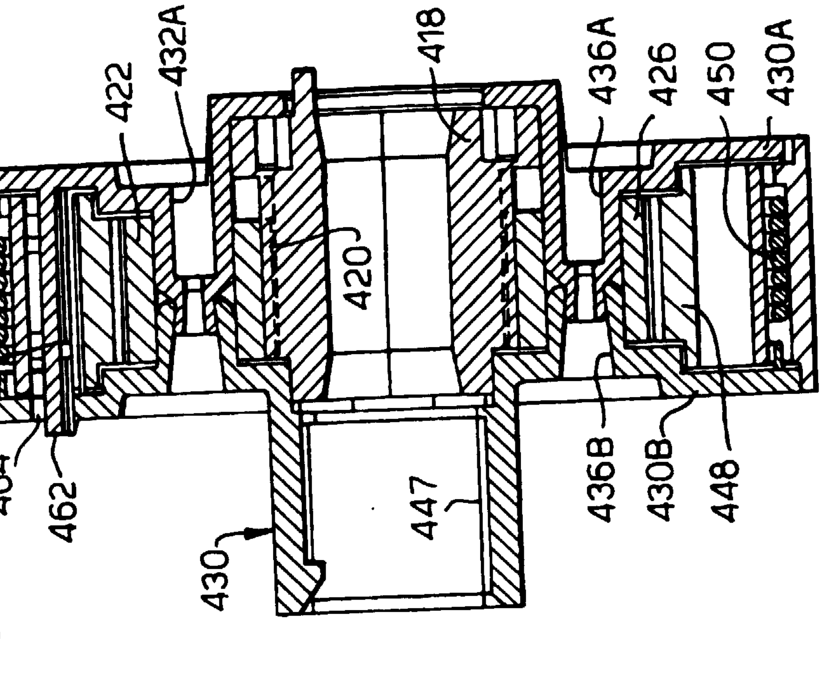
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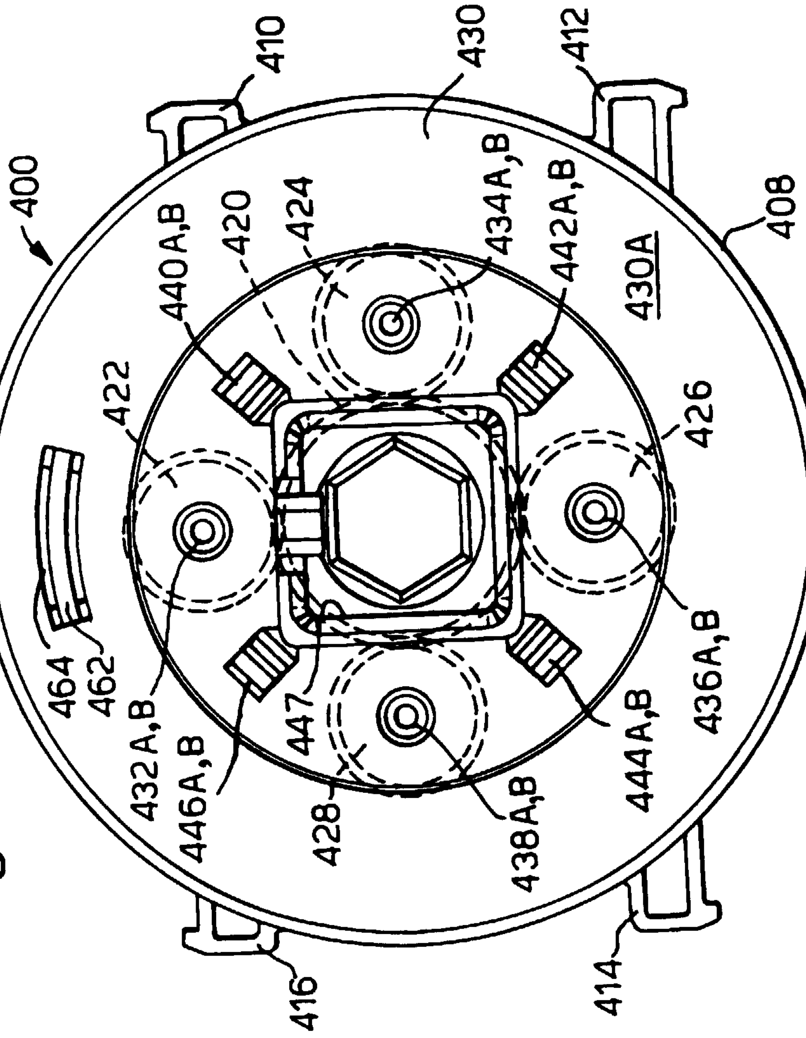
Fig.8.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440A,B
434A,B
442A,B
430A
422
426
VIII
VIII
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462
432A,B
446A,B
447
428
438A,B
444A,B
436A,B
416
414

Fig.7.

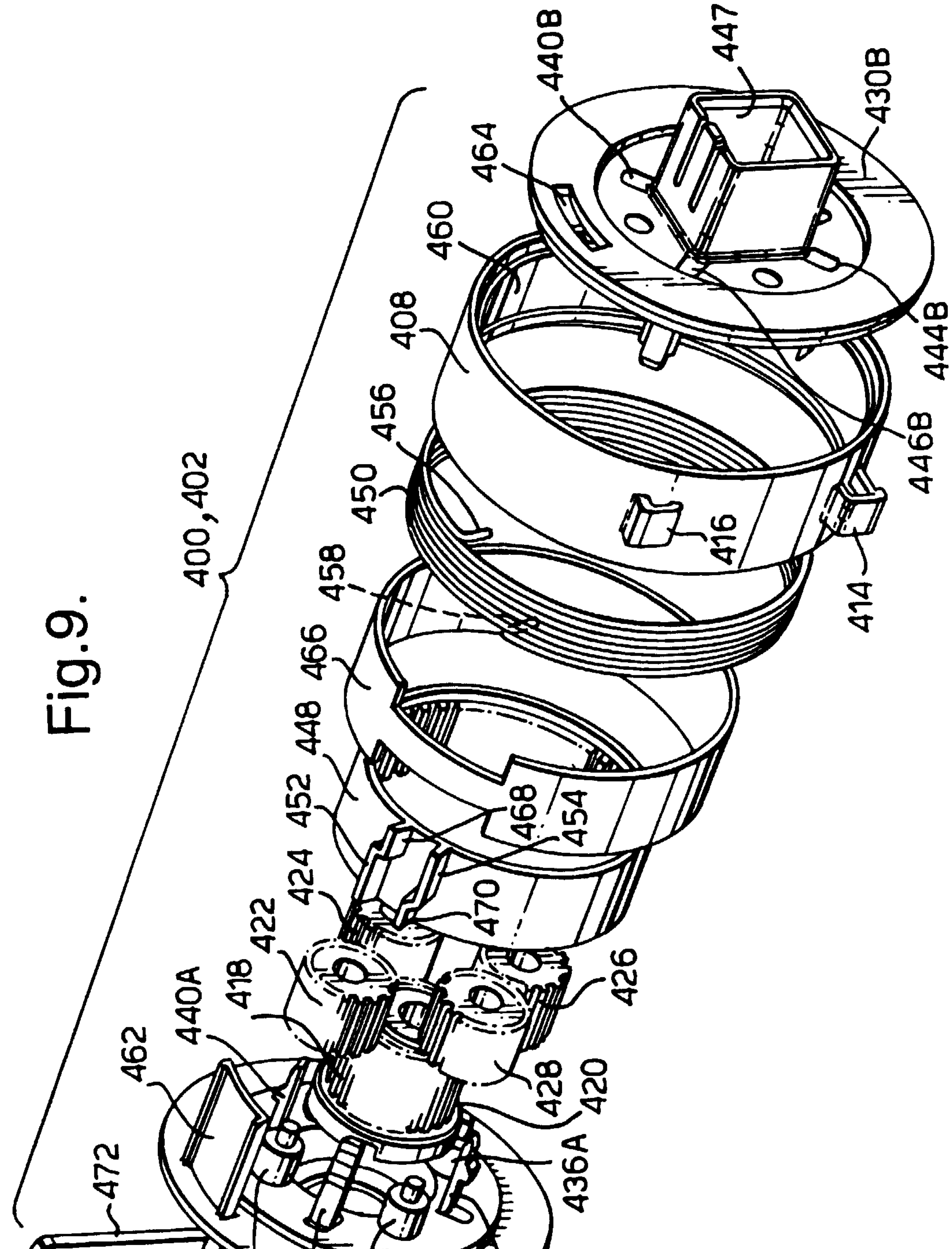
400,402
408
414
416
418
420
422
424
426
428
430A
430B
432A
436A
438A
440A
440B
444A
444B
446A
446B
447
448
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Fig.9.