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**Tsumiyama et al.**

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(54) **BICYCLE CONTROL DEVICE**

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(73) Assignee: **Shimano Inc.**, Sakai, Osaka (JP)

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**Related U.S. Application Data**

(60) Division of application No. 09/995,060, filed on Nov. 26, 2001, now Pat. No. 6,647,823, which is a continuation-in-part of application No. 09/823,287, filed on Mar. 30, 2001, now abandoned.

(51) **Int. Cl.**
***F16C 1/10*** (2006.01)

(52) **U.S. Cl.** ..... **74/502.2**

(58) **Field of Classification Search** ..... 74/471 XY, 74/489, 501.6, 502.2, 512, 560
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 598,762 | A | 2/1898 | Behrens | 475/215 |
| 648,059 | A | 4/1900 | Sutch | 74/485 |
| 1,185,546 | A | 5/1916 | Rodgers | 74/286 |
| 1,666,793 | A | 4/1928 | Sanguineti | 74/489 |
| 1,709,346 | A | 4/1929 | Garrard | 475/215 |
| 2,242,145 | A * | 5/1941 | Rushfeldt | 74/512 |
| 2,336,682 | A | 12/1943 | Grosse et al. | 74/489 |
| 2,422,343 | A | 6/1947 | Duer | 74/282 |
| 2,490,783 | A | 12/1949 | Cullen | 475/280 |
| 2,745,297 | A | 5/1956 | Andrus | 74/689 |
| 2,789,648 | A | 4/1957 | Huffman | 180/66 |
| 2,796,773 | A | 6/1957 | Wooler et al. | 74/489 |
| 2,931,250 | A | 4/1960 | Ebert | 74/687 |
| 3,029,916 | A * | 4/1962 | Luijt | 477/214 |
| 3,298,174 | A | 1/1967 | Stoyke et al. | 60/19 |
| 3,331,479 | A * | 7/1967 | Pascual | 477/215 |
| 3,478,617 | A | 11/1969 | Maeda | 74/489 |
| 3,534,629 | A | 10/1970 | Schwerdhofer | 192/4 |
| 3,554,158 | A | 1/1971 | Shimano et al. | 74/489 |
| 3,567,250 | A | 3/1971 | Wolf | 280/289 |

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1185397 A 6/1998

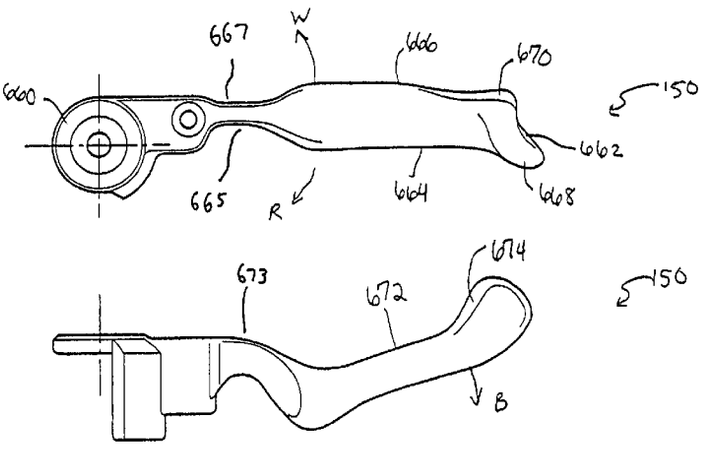
(Continued)

*Primary Examiner*—Chong H Kim
(74) *Attorney, Agent, or Firm*—Jeffer, Mangels, Butler & Marmaro LLP

(57) **ABSTRACT**

A bicycle control device is disclosed having a control lever that is operable in a first direction to operate the brake control mechanism, a second direction to operate the shift control mechanism in the pulling direction and a third direction to operate the shift control mechanism in the release direction. In a preferred embodiment of the invention, when viewed from the perspective of a rider on the bicycle, the first direction is the direction of movement of the lever toward the handlebar. The second direction is the direction of movement of the control lever downward and the third direction is the direction of movement of the control lever upward. In a more preferred embodiment, the second and third directions are perpendicular to the first direction.

**23 Claims, 14 Drawing Sheets**



U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 3,595,351 | A | | 7/1971 | Ishida ..... 74/489 |
| 3,605,522 | A | | 9/1971 | Grosseau ..... 74/689 |
| 3,709,338 | A | * | 1/1973 | Glen ..... 477/192 |
| 3,808,907 | A | | 5/1974 | Yamaguchi ..... 74/471 |
| 3,934,492 | A | | 1/1976 | Timbs ..... 74/740 |
| 4,002,350 | A | | 1/1977 | Timbs ..... 192/4 |
| 4,100,820 | A | | 7/1978 | Evett ..... 192/4 |
| 4,132,296 | A | | 1/1979 | Evett ..... 74/489 |
| 4,319,673 | A | | 3/1982 | Kojima ..... 192/4 |
| 5,241,878 | A | | 9/1993 | Nagano ..... 74/502.2 |
| 5,251,878 | A | | 10/1993 | Mann et al. ..... 254/344 |
| 5,257,683 | A | | 11/1993 | Romano ..... 74/489 |
| 5,287,766 | A | | 2/1994 | Nagano ..... 74/502.2 |
| 5,400,675 | A | * | 3/1995 | Nagano ..... 74/502.2 |
| 5,479,776 | A | | 1/1996 | Romano ..... 74/502.2 |
| 5,775,168 | A | * | 7/1998 | Furuta ..... 74/489 |
| 5,806,372 | A | | 9/1998 | Campagnolo ..... 74/473.14 |
| 5,881,602 | A | | 3/1999 | Cirami ..... 74/473.14 |
| 6,095,309 | A | | 8/2000 | Mione ..... 74/422 |
| 6,142,281 | A | | 11/2000 | Campagnolo ..... 192/217 |
| 6,216,078 | B1 | | 4/2001 | Jinbo et al. ..... 701/70 |

FOREIGN PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| EP | 0 994 269 A2 | 4/2000 | |
| FR | 1007339 | 2/1952 | ..... 74/502.2 |
| GB | 134931 | 11/1919 | ..... 74/502.2 |
| GB | 2135028 | 8/1984 | ..... 74/502.2 |
| IT | 561377 | 4/1957 | ..... 74/502.2 |
| IT | 567858 | 10/1957 | ..... 74/502.2 |
| JP | 04331689 A | 11/1992 | |
| JP | 2002154468 A | 5/2002 | |

* cited by examiner

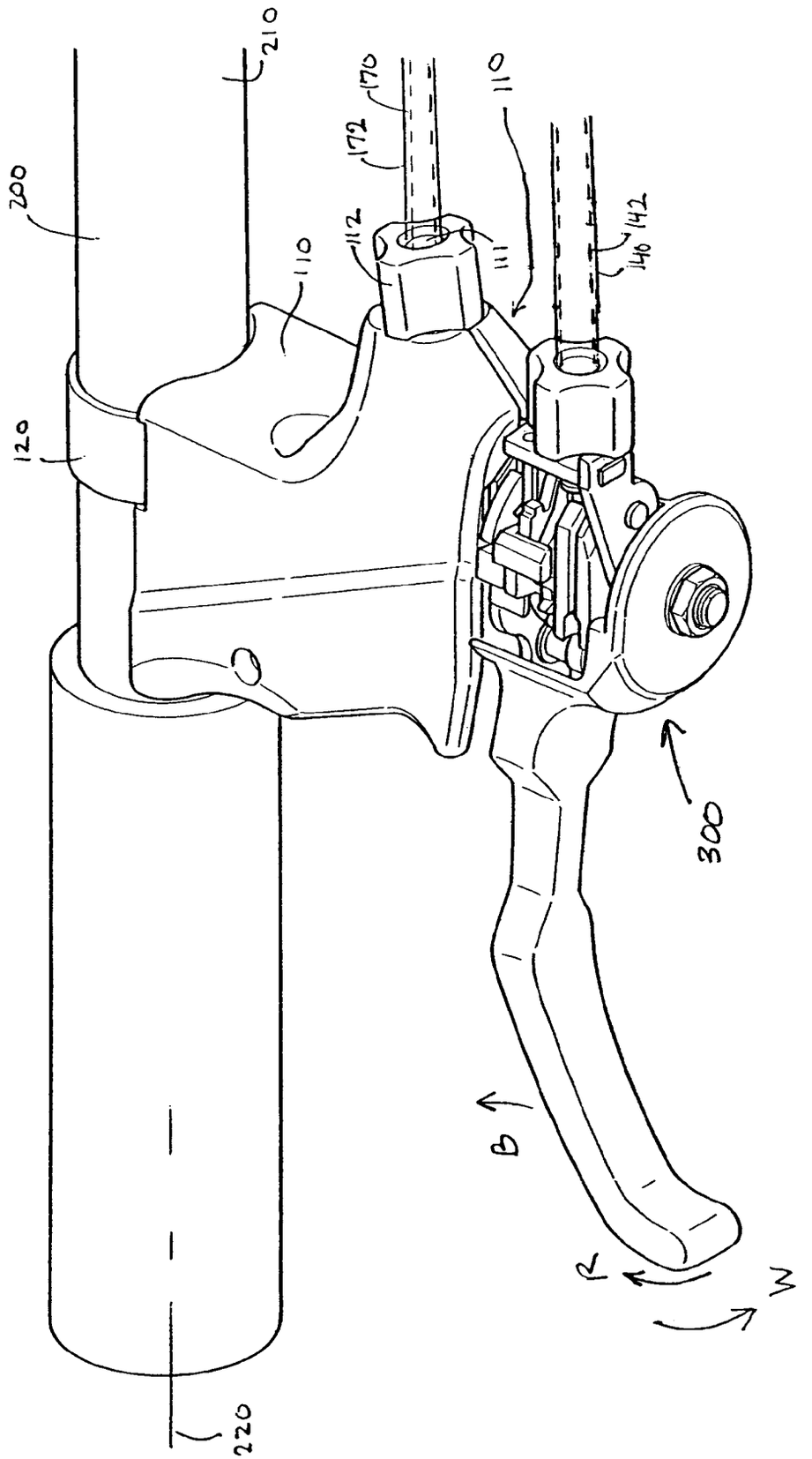



FIG. 1

FIG. 2

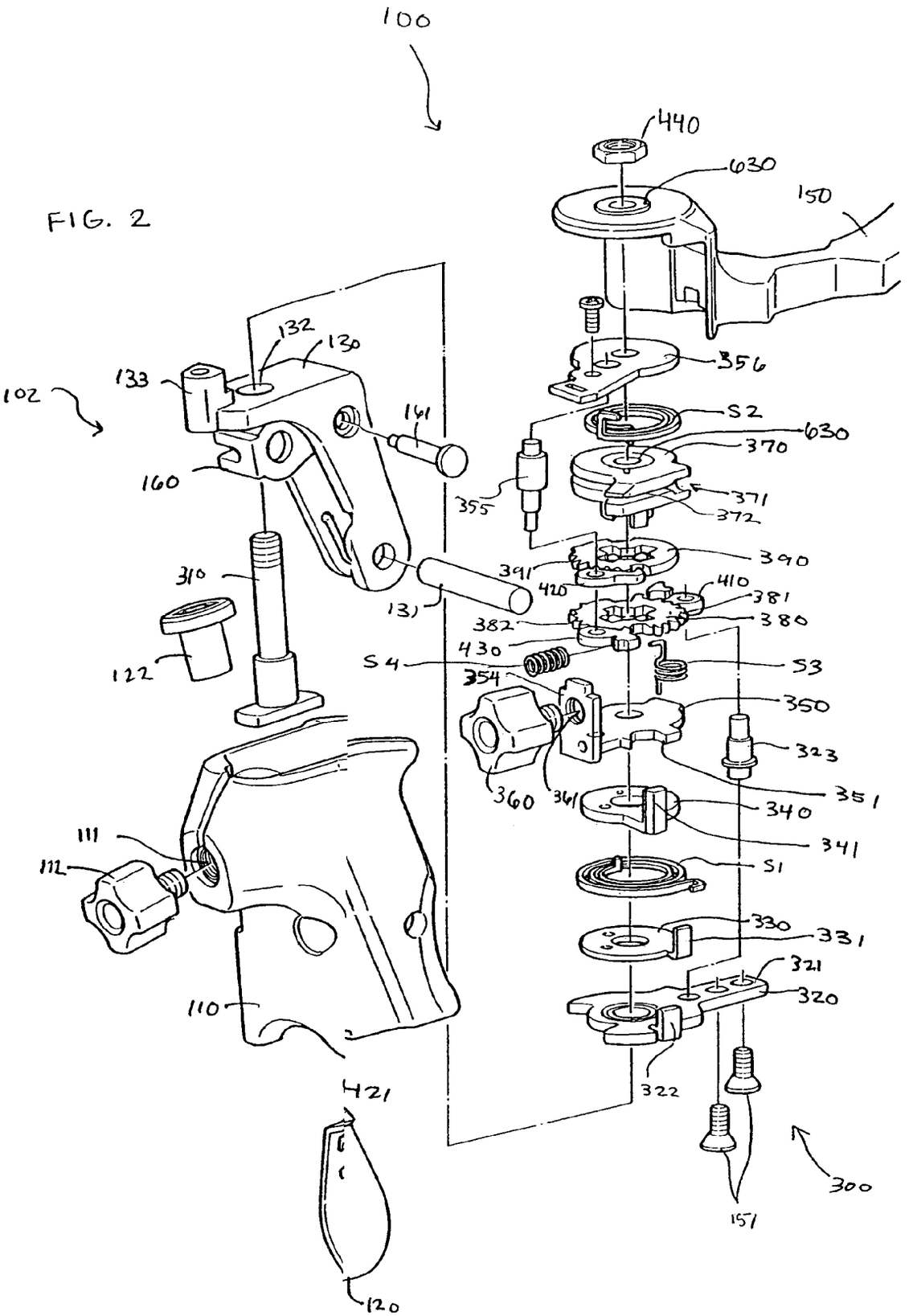

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FIG. 3

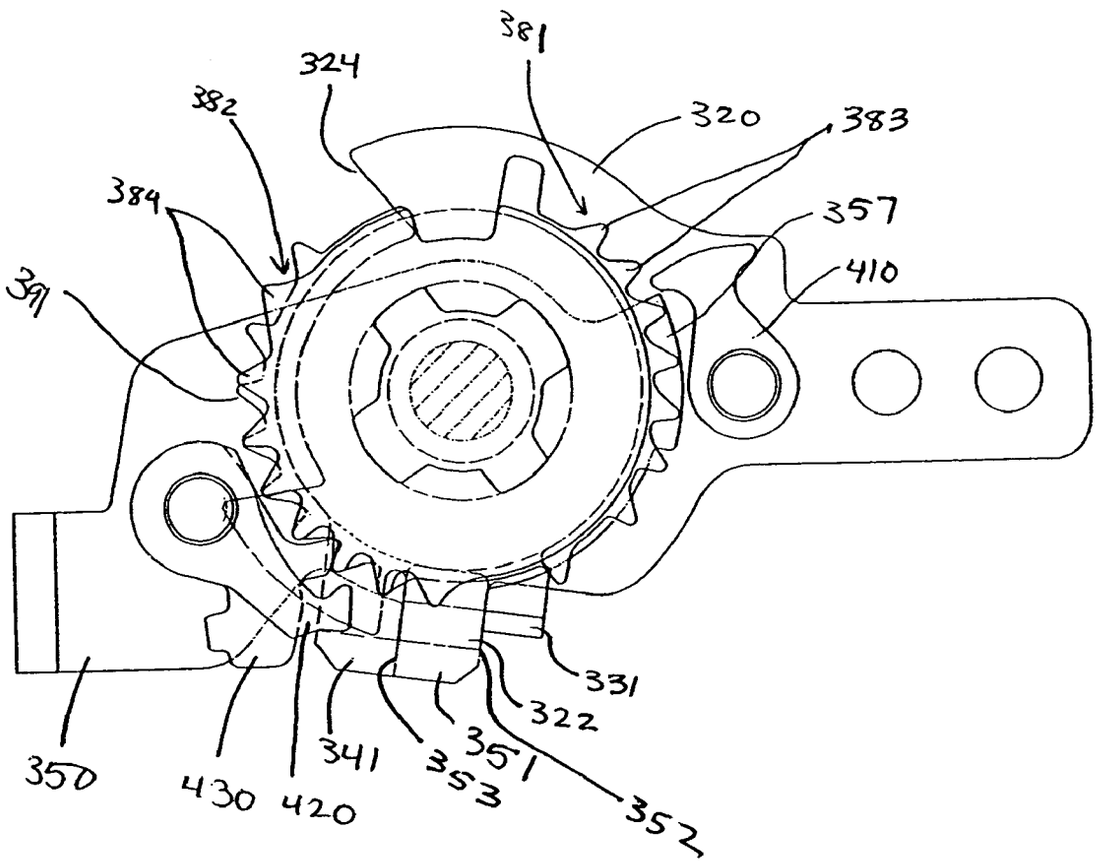
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FIG. 4a

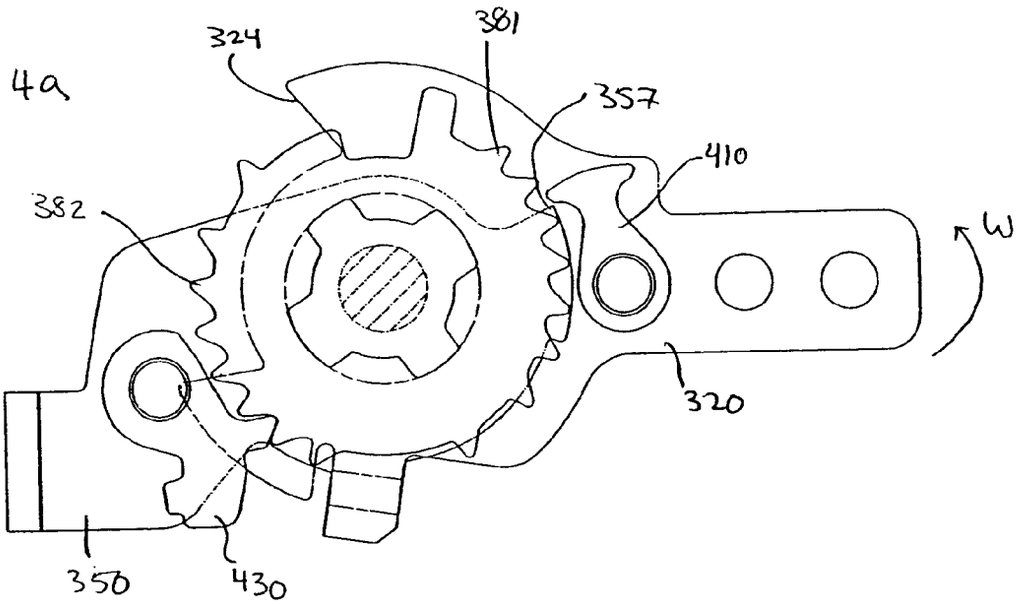
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FIG. 4b

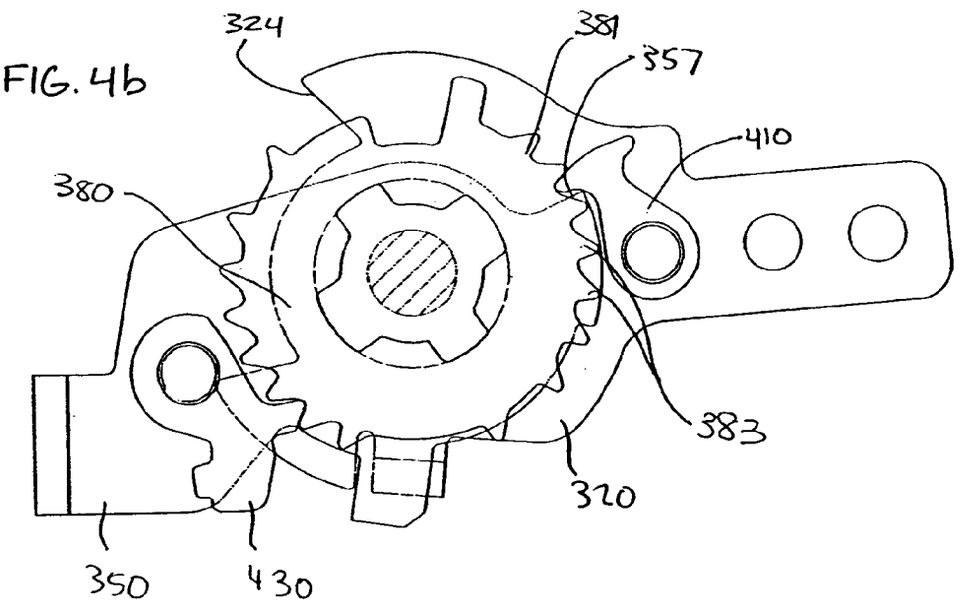
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FIG. 4C

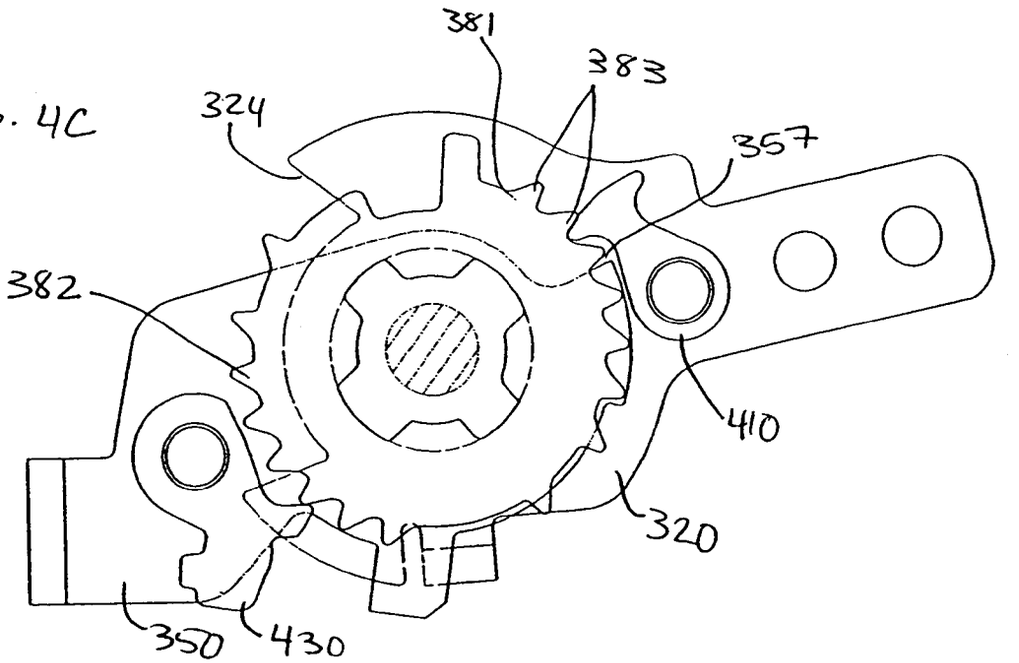
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FIG. 4d

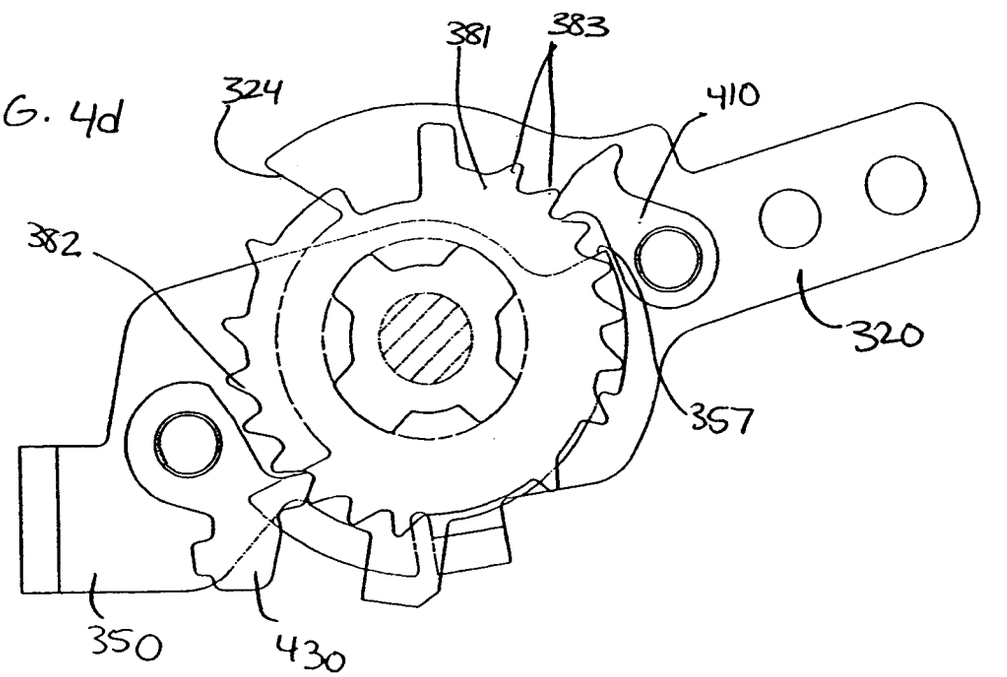
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FIG. 4e

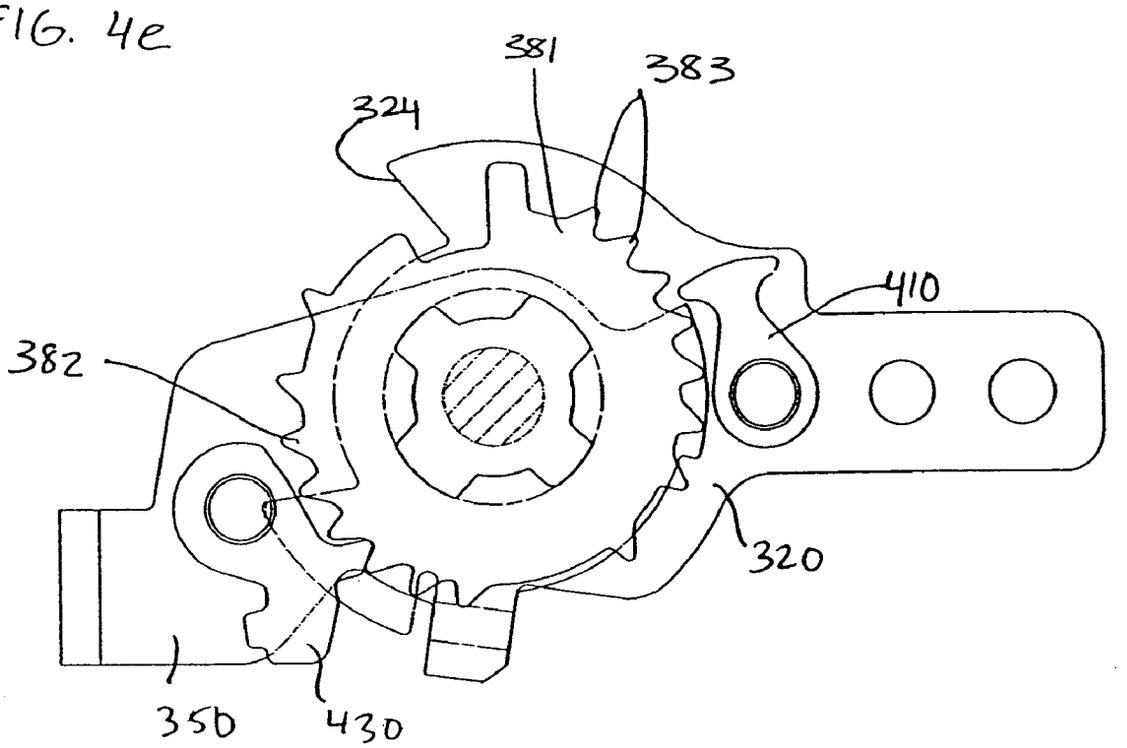


FIG. 5A

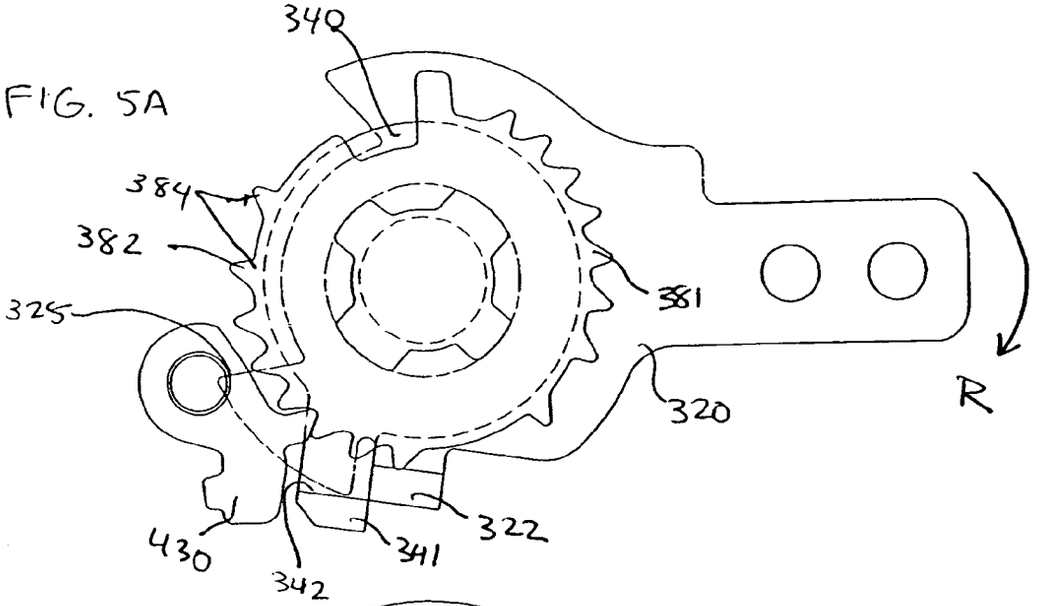



FIG. 5B

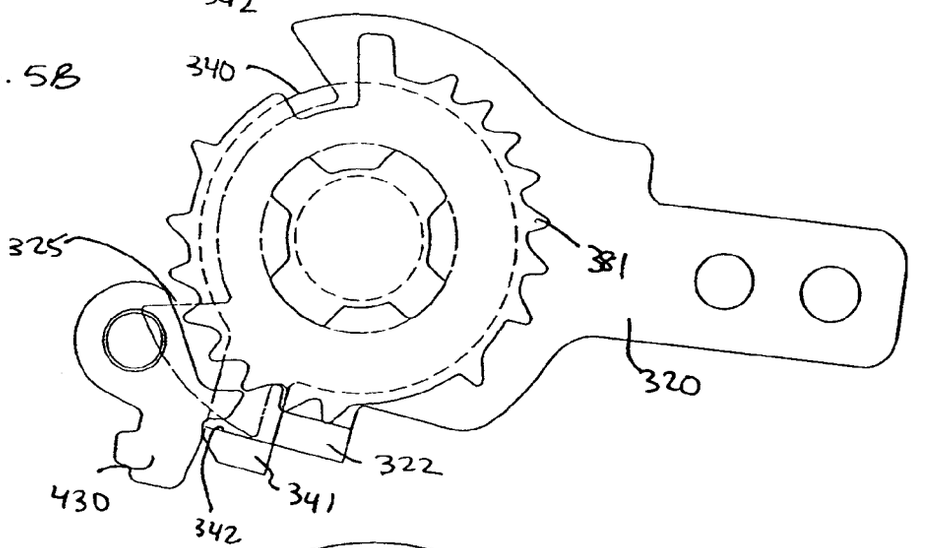



FIG. 5C

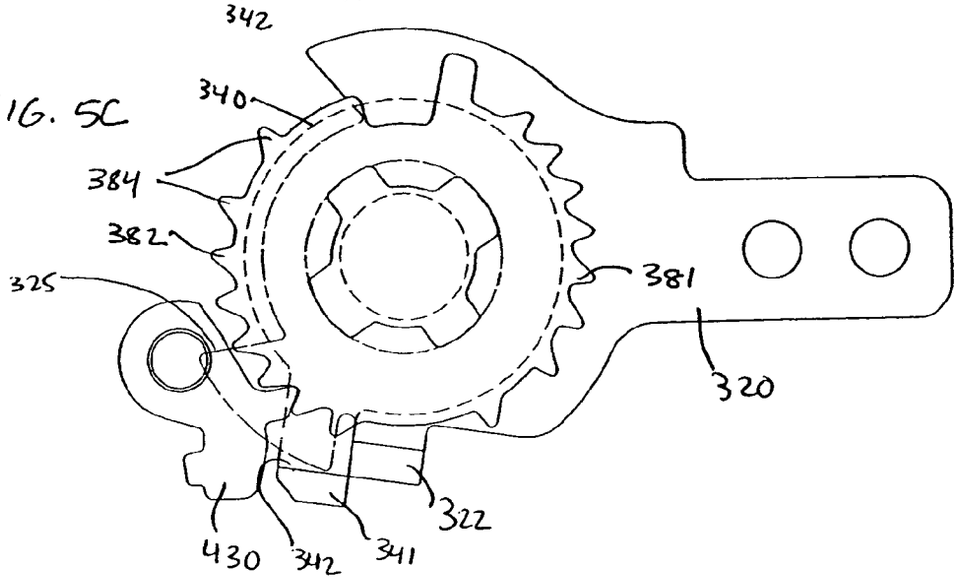


FIG. 6A

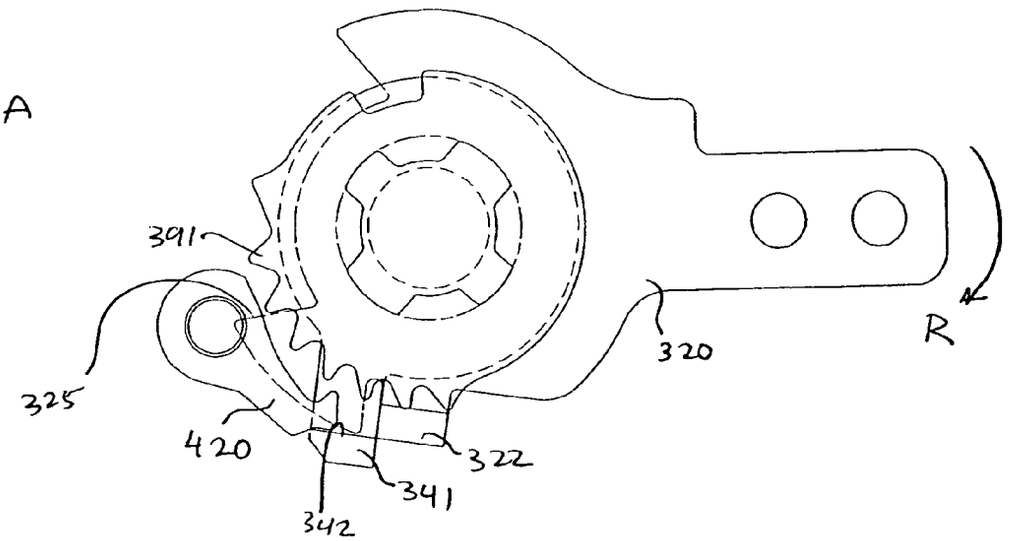



FIG. 6B

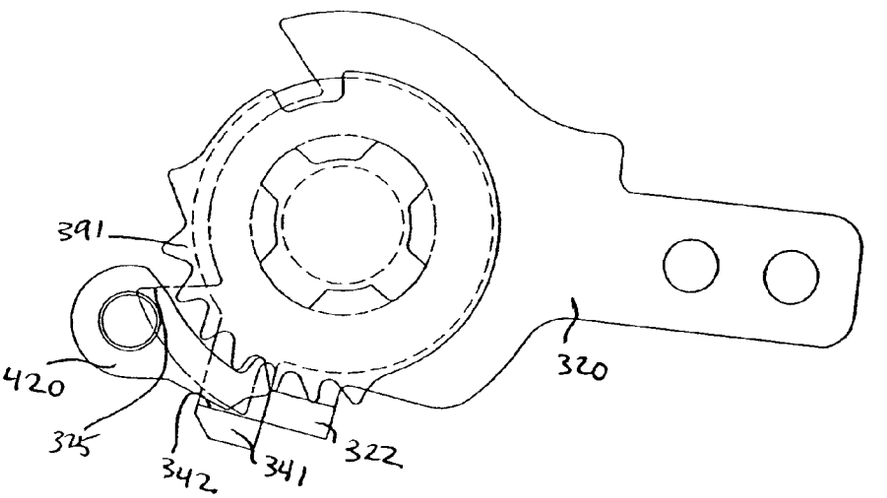



FIG. 6C

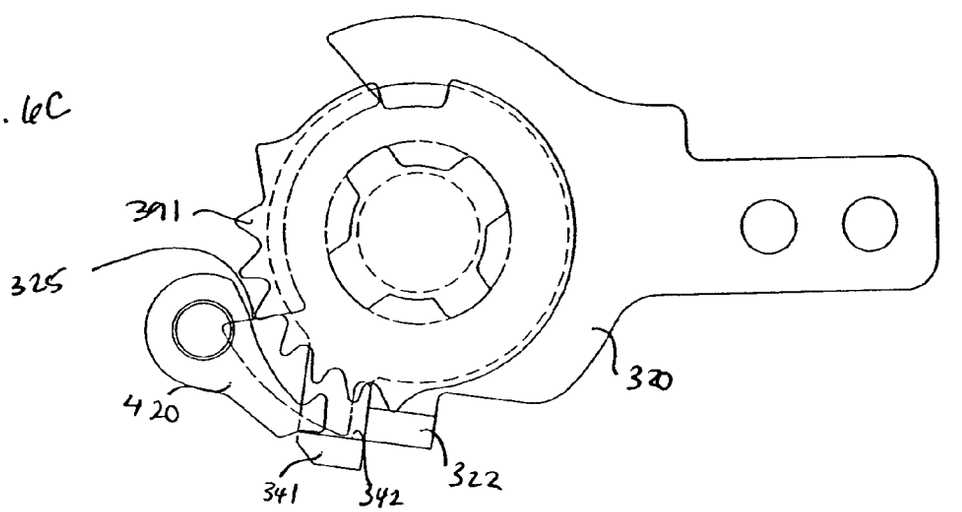


FIG. 7A

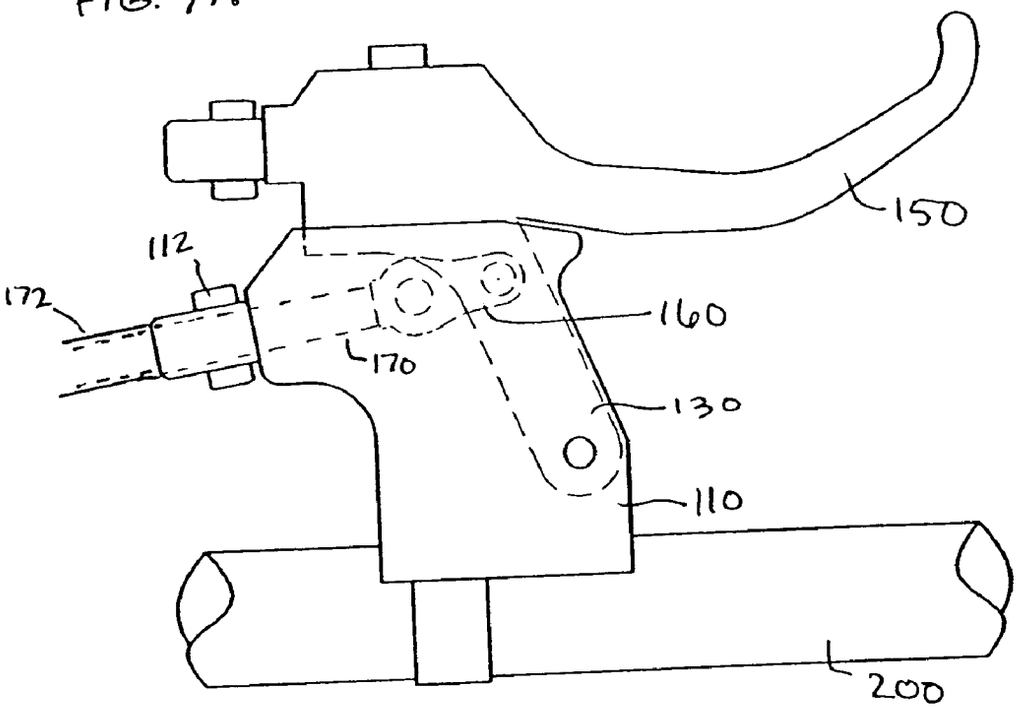
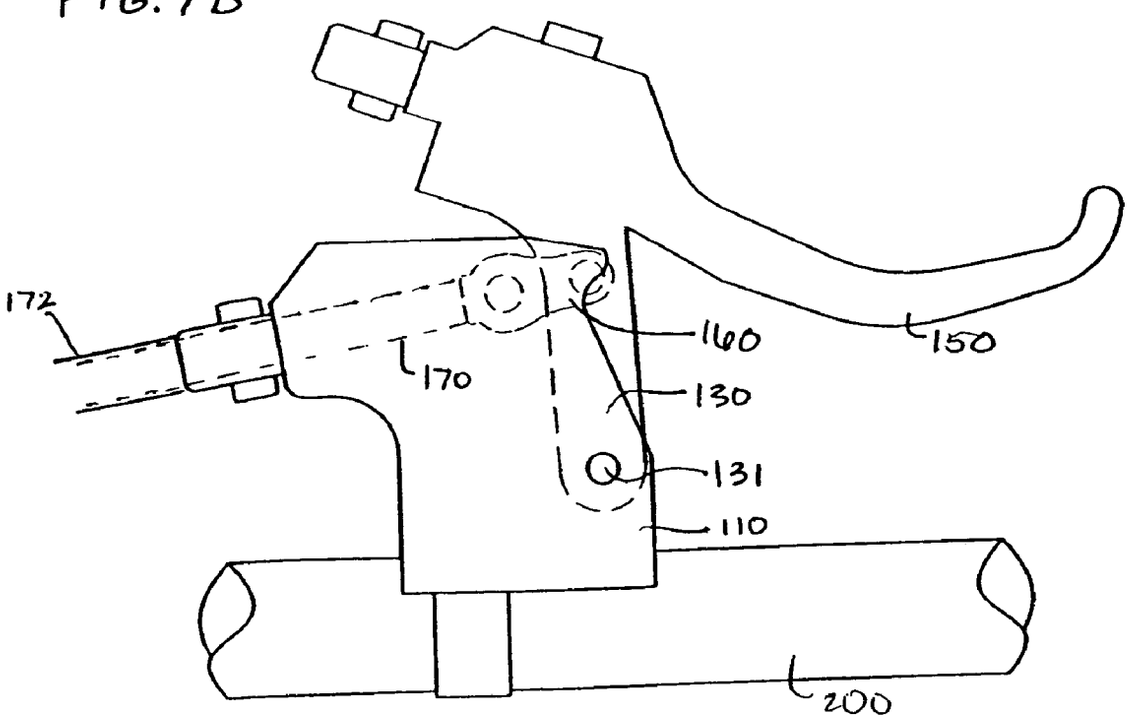



FIG. 7B



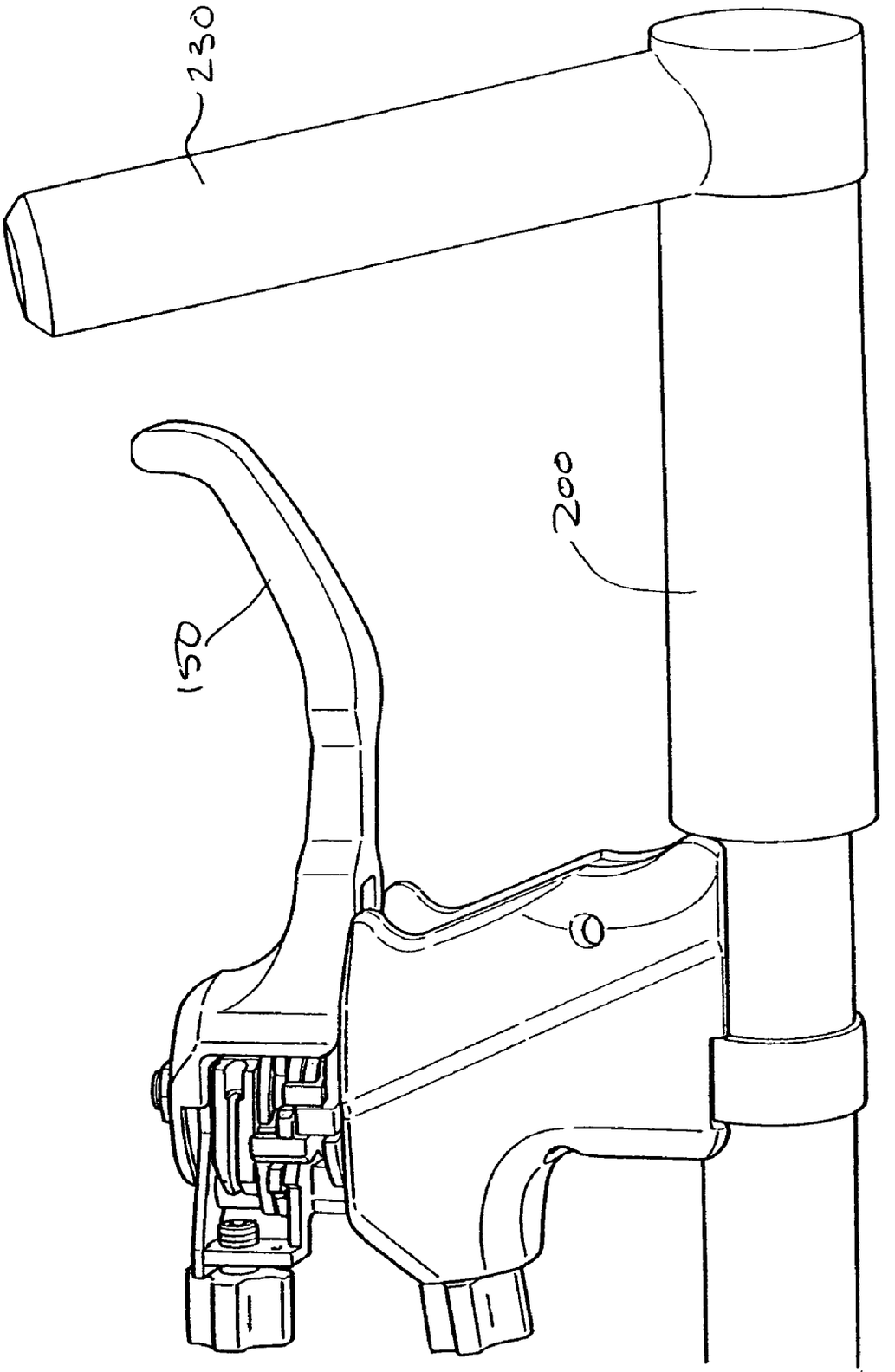



FIG. 8

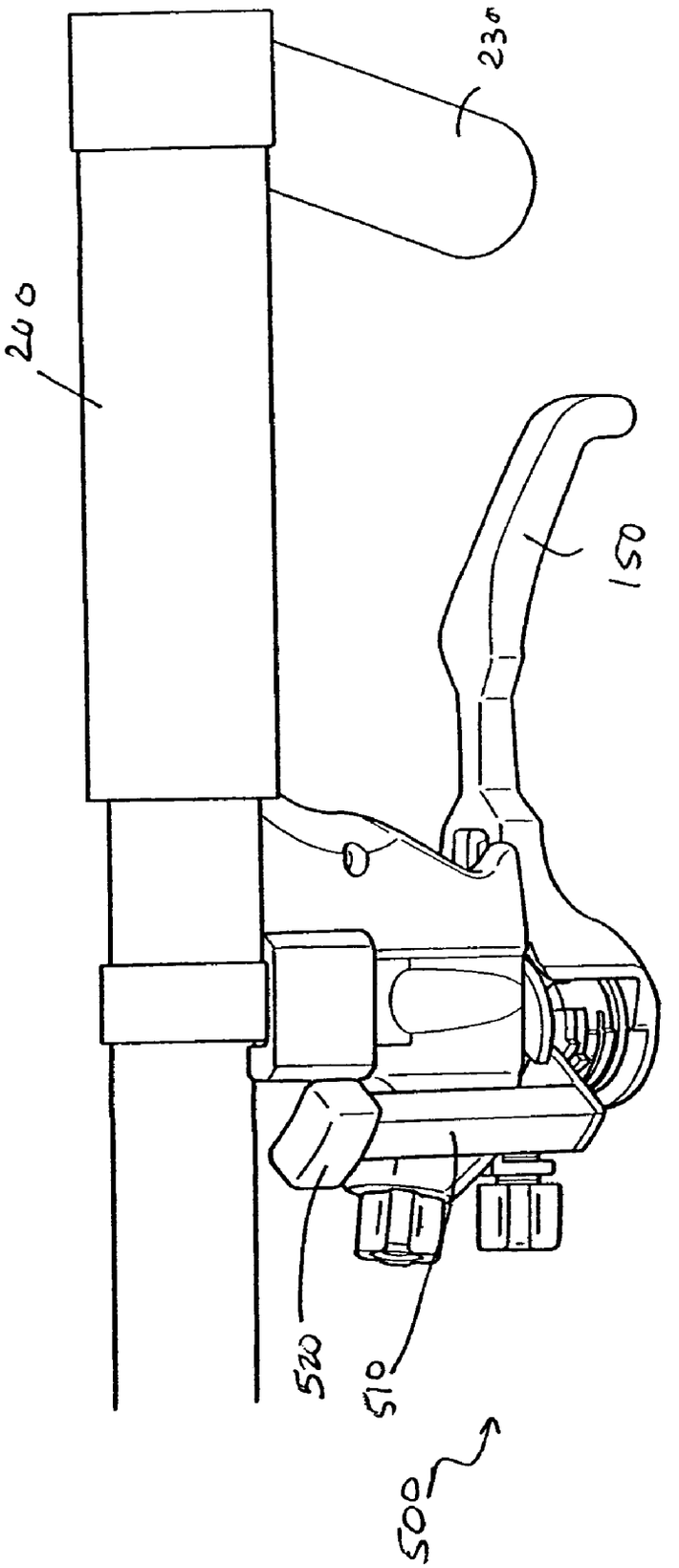



FIG. 9

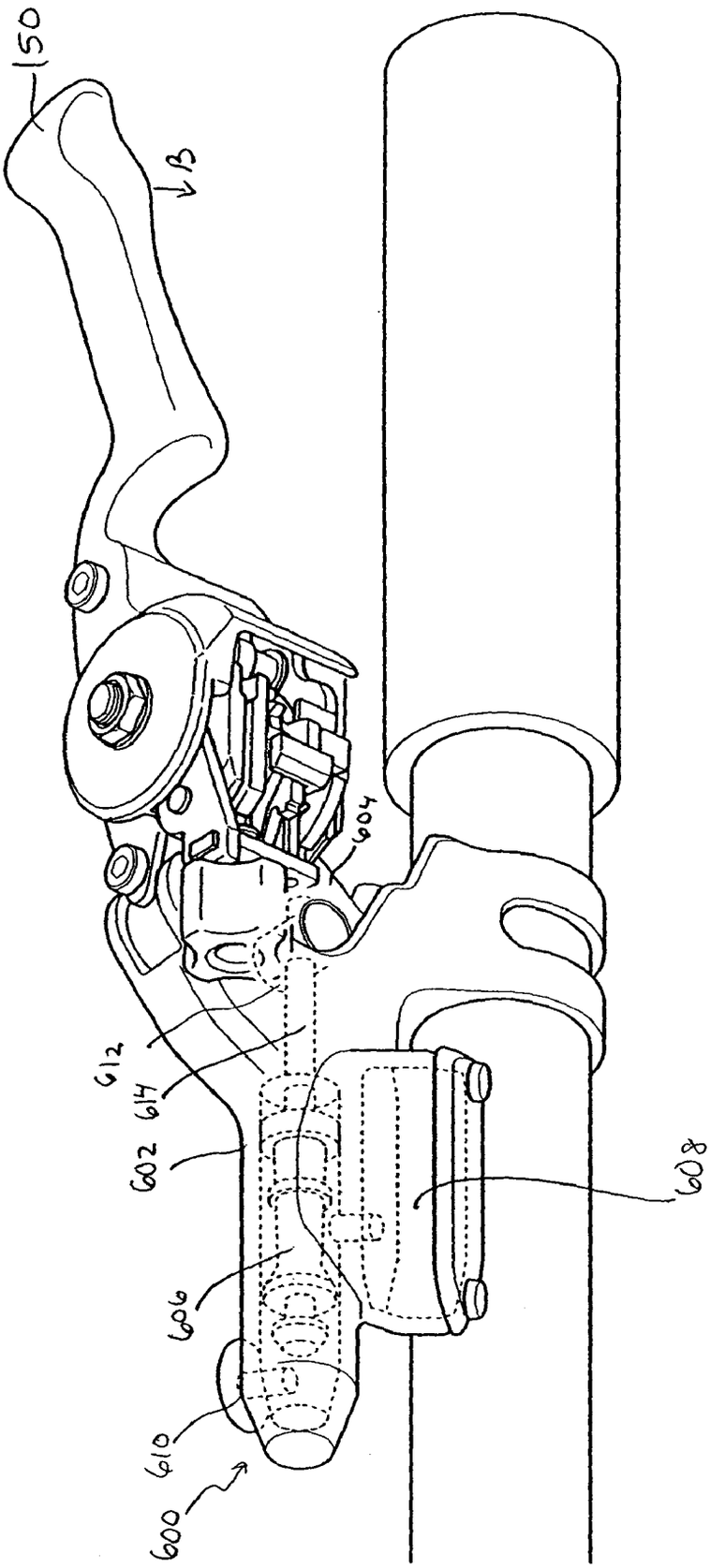
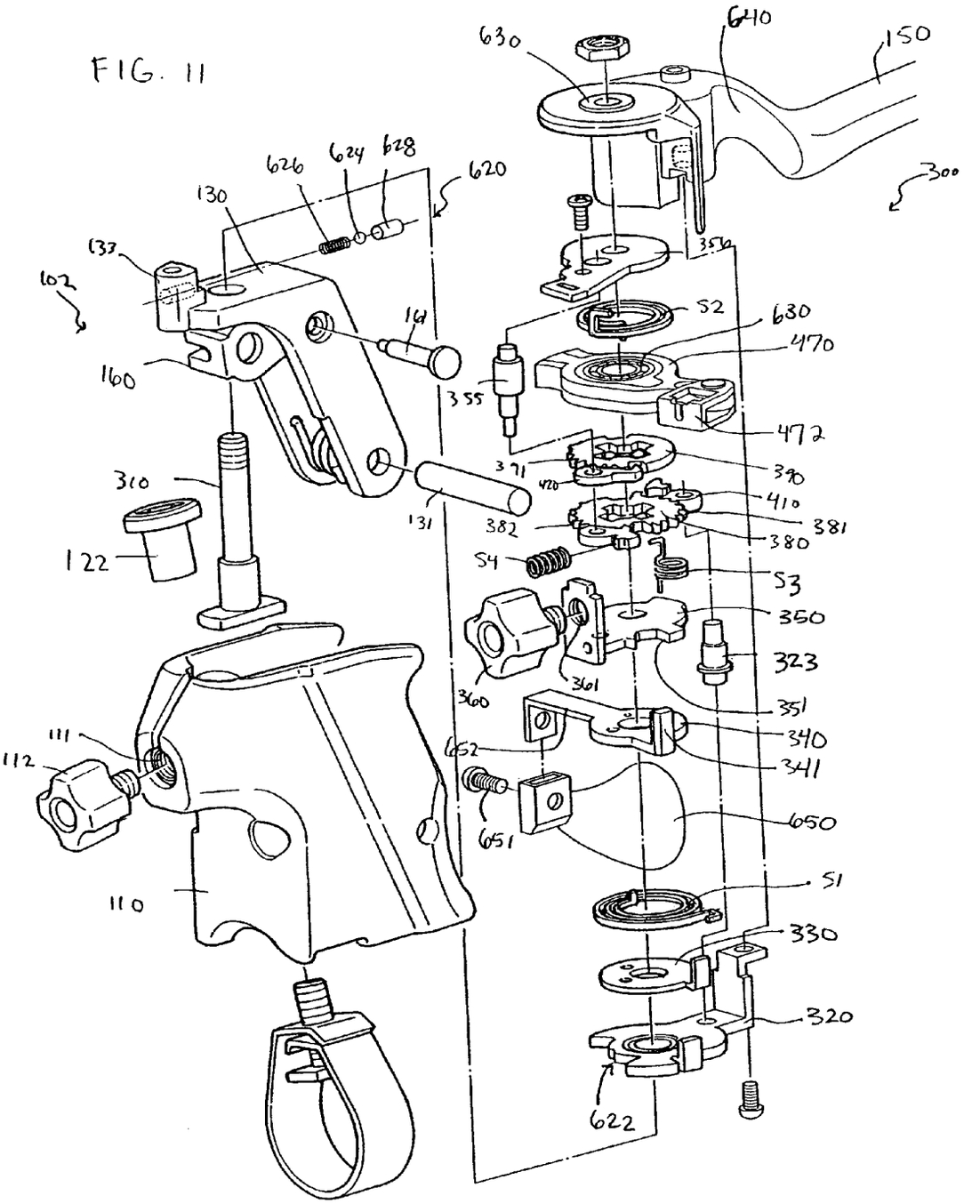



FIG. 10

FIG. 11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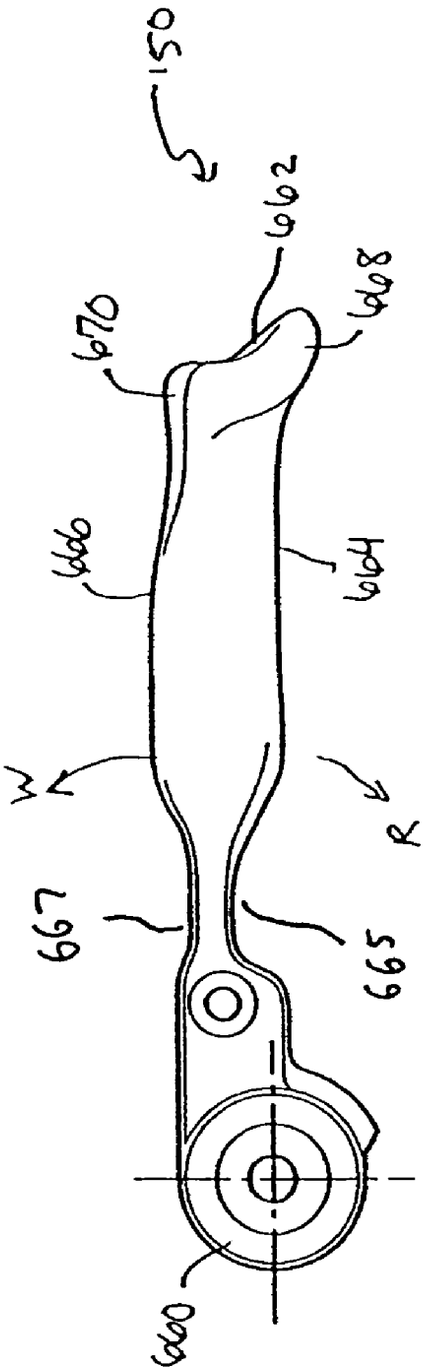


FIG. 12


FIG. 13

# BICYCLE CONTROL DEVICE

## CROSS-REFERENCE TO RELATED APPLICATION

This is a divisional of U.S. application Ser. No. 09/995,060 filed Nov. 26, 2001, now U.S. Pat. No. 6,647,823 which is a continuation-in-part of U.S. application Ser. No. 09/823,287 filed Mar. 30, 2001, now abandoned which is incorporated by reference herein in its entirety.

## FIELD OF THE INVENTION

The present invention relates generally to a bicycle control device mountable on the handlebar of a bicycle for operating cable actuated bicycle components. More particularly, the invention relates to a bicycle control device having a control lever that operates both the brake mechanism and the gear shifting mechanism.

## BACKGROUND OF THE INVENTION

Generally, when riding a bicycle, it is desirable to be able to operate the brake control mechanism and the shift control mechanism of the bicycle quickly and easily. Known bicycle devices have made it easier for riders to shift and brake while maintaining control of the handlebar by providing a single lever for operation of the shifting mechanism. However, the known devices still require the removal of the rider's thumb from the handlebar for shifting. To prepare for an unexpected need for braking, experienced riders prefer to keep an index finger and/or a middle finger on the brake lever at all times, especially in rugged conditions such as off-road riding. When the fingers are on the brake lever, it is important to maintain one's thumb on the handlebar to have better control of the bicycle. By requiring the removal of the rider's thumb from the handlebar for shifting, the known control devices reduce the rider's control of the bicycle during shifting.

Some devices have attempted to alleviate this problem by providing a shift control device that is operable in the winding direction using the rider's brake-operating fingers. The problem with the known devices is that the rider is still required to remove his fingers from the brake lever to operate the shift control mechanism in a release direction. Additionally, the known devices are designed for use with drop-bar type handlebars and cannot be used with flat-bar type handlebars.

Accordingly, it is desirable to provide a bicycle control device that enables the rider to operate the brake control mechanism and shift control mechanism of a bicycle without requiring the removal of the rider's fingers from the handlebar or from the brake control lever.

It is also desirable to provide a shift control device that can be operated while the rider is gripping handlebar extensions.

## SUMMARY OF THE PREFERRED EMBODIMENTS

A bicycle control device is disclosed having a control lever that is operable in a first direction to operate the brake control mechanism, a second direction to operate the shift control mechanism in the winding direction and a third direction to operate the shift control mechanism in the release direction. In a preferred embodiment of the invention, when viewed from the perspective of a rider on the bicycle, the first direction is the direction of movement of the lever toward the handlebar. The second direction is the direction of movement of the control lever downward and the third direction is the direction of movement of the control lever upward. In a more preferred embodiment, the second and third directions are perpendicular to the first direction.



The brake control mechanism preferably includes a brake lever base pivotably connected on the bracket wherein the operation of the control lever in the first direction pivots the brake lever base on the bracket and pulls a brake cable attached to a cable hook on the brake lever base.

The shift control mechanism preferably includes a support shaft fixedly connected to the brake lever base of the brake control mechanism. A winding member is rotatable in the winding direction and in the release direction about the support shaft to wind and release a shifting cable thereon. A winding mechanism is provided having a winding pawl engageable with a winding latch to rotate the winding member in a winding direction. The winding member is preferably biased in the release direction. To limit the rotation of the winding member in the release direction, the bicycle control device includes a release and hold mechanism. The release and hold mechanism preferably includes a first latching plate having a releasing latch and a second latching plate having an interrupting latch wherein the release pawl engages with the releasing latch and an interrupting pawl engages with the interrupting latch alternately to limit the rotation of the winding member in the release direction.

The bicycle control device of the present invention is preferably configured to be used with a flat-bar type handlebar. In another embodiment of the invention, the bicycle control device can be used with a flat-bar type handlebar having handlebar extensions extending upward from the handlebar. In this embodiment, the rider is able to operate the control lever in a winding and release direction while gripping the handlebar extensions.

In another embodiment of the invention, the bicycle control device includes a release lever that is configured to be operable by a rider's thumb when the rider is gripping the handlebar.

Other objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed description. It is to be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the present invention, are given by way of illustration and not limitation. Many changes and modifications within the scope of the present invention may be made without departing from the spirit thereof, and the invention includes all such modifications.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more readily understood by referring to the accompanying drawings in which:

FIG. **1** is a perspective view of a preferred embodiment of the bicycle control device of the present invention as attached to a bicycle handlebar;

FIG. **2** is an exploded perspective view of a preferred embodiment, of the bicycle control device of the present invention;

FIG. **3** is a top cross-sectional view of the shift control mechanism of the present invention in a neutral position;

FIGS. **4***a*-**4***e* are top cross-sectional views of the shift control mechanism of the present invention in operation in a winding direction;

FIGS. **5***a*-**5***c* are top cross-sectional views of the shift control mechanism of the present invention depicting the motion of the positioning pawl when the control device is operated in a release direction;

FIGS. **6***a*-**6***c* are top cross-sectional views of the shift control mechanism of the present invention depicting the motion of the limiting pawl when the control device is operated in a release direction;

FIGS. **7***a*-**7***b* are side views of the brake mechanism of the present invention;

FIG. **8** is a perspective view of the control device of the present invention attached to a handlebar equipped with handlebar extensions;

FIG. **9** is a back view of another embodiment of the control device of the present invention having a supplemental release lever;

FIG. **10** is a perspective view of another preferred embodiment of the bicycle control device of the present invention connected to a hydraulic brake mechanism, shown in phantom;

FIG. **11** is an exploded perspective view of another preferred embodiment of the bicycle control device of the present invention;

FIG. **12** is a plan view of a preferred embodiment of the control lever of the present invention having risings; and

FIG. **13** is a side view of the control lever shown in FIG. **12**.

Like numerals refer to like parts throughout the several views of the drawings.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIGS. **1** and **2**, the bicycle control device **100** of the present invention is attachable to the handlebar **200** of a bicycle by a bracket **110**. In a preferred embodiment of the invention, the handlebar **200** is a flat-bar type handlebar having a cylindrical body **210** that extends substantially along a handlebar axis **220**. The bicycle control device **100** is secured to the handlebar **200** of a bicycle preferably by a clamp band **120**, a bolt **121** and a nut **122**, as best shown in FIG. **2**.

The bicycle control device **100** includes a control lever **150** that, as will be described in further detail below, operates cable actuated bicycle components such as the brake control mechanism **102** and the shift control mechanism **300**. In a preferred embodiment of the invention, the control lever **150** is configured such that operation of the control lever **150** in a first direction, B, operates the brake control mechanism, in a second direction, W, operates the shift control mechanism in a winding direction, and in a third direction, R, operates the shift control mechanism in a release direction. In a more preferred embodiment, as shown in FIG. **1**, when viewed from the position of the rider on the bicycle, the first direction, B, is the direction of movement of the control lever **150** from a neutral position toward the handlebar **200** of the bicycle; the second direction, W, is the direction of movement of the control lever **150** from a neutral position downward; and the third direction, R, is the direction of movement of the control lever **150** from a neutral position upward.

As shown in FIGS. **1** and **2**, the brake control mechanism **102** of the bicycle control device **100** preferably includes a brake cable receiving bore **111** and a brake cable adjuster **112**. The brake cable receiving bore **111** receives the outer casing **172** of the brake cable **170** and the brake cable **170** is threaded into the bracket **110**. The brake cable adjuster **112** controls the brake cable tension and can be adjusted to a desired tension level.

As best shown in FIG. **2**, a brake lever base **130** is pivotally connected to the bracket **110** by a pivot pin **131**. To actuate the brake cable **170**, a cable hook **160** is pivotably connected to the brake lever base **130** by pivot pin **161**. The cable hook **160** is configured to receive the end of the brake cable **170** such that a movement of the cable hook **160** corresponds to a movement in the brake cable **170**.

In another preferred embodiment of the present invention, as shown in FIG. **10**, the control lever **150** operates a hydraulically actuated brake mechanism **600**. As with the cable actuated brake mechanism, the control lever **150** is configured such that operation of the control lever **150** in a first direction, B, operates the hydraulic brake mechanism **600**. The hydraulic brake mechanism **600** preferably includes a hydraulic brake bracket **602** pivotally fixed with brake lever base **604**. A piston **606** is housed within the brake bracket **602** and controls communication between a fluid reservoir **608** and an outlet **610** that connects to a brake line (not shown). A nipple **612** and pin **614** are fixedly attached and are movable relative to the brake lever base **604**. When the control lever **150** is moved in the first direction B, the base **604** moves with the lever, causing the nipple **612** to rotate. The rotation of the nipple **612** causes the pin **614** to push the piston **606**. The piston **606**, in turn, pushes the brake fluid toward the outlet **610**.

In reference to FIG. **2**, according to a preferred embodiment of the invention, the shift control mechanism **300** includes a pivot shaft **310** and a winding member **370** rotatably supported on the pivot shaft **310**. The winding member **370** includes a shift cable attachment portion **371** and a winding groove **372**. The shift cable attachment portion **371** securely receives an end of the shift cable **140** and the winding groove **372** receives the shift cable **140** as it is wound on the winding member **370**.

The rotation of the winding member **370** operates to wind or release a shift cable thereon to control a gear change mechanism, such as a derailleur, in a manner known by those skilled in the art. The winding member **370** rotates about the pivot shaft **310**, which is preferably fixedly attached to the top plane **132** of the brake lever base **130**. In a more preferred embodiment of the invention, the pivot shaft **310** is press fitted perpendicular to the top plane **132** of the brake lever base **130**.

In a preferred embodiment of the invention, the shift control mechanism **300** includes an operating plate **320**, a winding plate **330**, a releasing plate **340** and a fixed plate **350**. The operating plate **320** is rotatably supported on the pivot shaft **310** and includes a brake lever mounting portion **321** and an operating abutment **322**. The brake lever mounting portion **321** of the operating plate **320** is preferably fixedly connected to the control lever **150** via fasteners **151** such that the control lever **150** and operating plate **320** rotate together about the pivot shaft **310** when the control lever **150** is operated. The use of fasteners **151** to fix the control lever **150** to the operating plate **320** reduces the replacement costs in the event of damage to the control lever **150**. If the bicycle falls hard, the control lever **150** absorbs the shock and, possibly suffers damage. In the preferred embodiment, because the control lever is separable from the operating plate **320**, the control lever **150** can be removed and a new control lever installed. This eliminates the need for replacing the entire gear shift mechanism.

In another preferred embodiment of the invention, as shown in FIG. **11**, the control lever **150** includes a narrow portion **640**. The operating plate **320** is preferably fastened to the control lever **150** at the narrow portion **640**. The control lever **150** is removably fastened to the narrow portion **640** and can be unfastened and replaced with a new control lever.

Referring to FIG. **2**, the winding plate **330** and releasing plate **340** are each rotatably supported on the pivot shaft **310**. The winding plate **330** includes a winding abutment **331** and the releasing plate **340** includes a releasing abutment **341** extending therefrom. The fixed plate **350** is fixedly supported on the pivot shaft **310**. In a preferred embodiment of the invention, the fixed plate **350** is fixedly connected to a mounting member **133** of the brake lever base **130**. The fixed plate **350** includes a fixed abutment **351** and a cable stop **354**.

The cable stop **354** is configured to receive an end of the shift cable **140** (shown in FIG. **1**). As best shown in FIG. **1**, the outer casing **142** of the shift cable **140** is received by the shift cable adjuster **360** and the shift cable **140** is threaded through the shift cable receiving bore **361** of the shift cable adjuster **360** to the cable stop **354**. The shift cable adjuster **360** is threadingly engaged with the cable stop **354** for adjusting the tension of the shift cable **140**. The shift cable **140** is preferably substantially parallel to the control lever **150** at the point where the cable **140** is received by the shift control mechanism **300**.

In a preferred embodiment of the invention, the winding abutment **331** of the winding plate **330** and the release abutment **341** of the release plate **340** are biased toward the fixed abutment **351** of the fixed plate **350** by a first spring S**1**. In a neutral position, the winding abutment **331** abuts a first side **352** of the fixed abutment **351** and the releasing abutment **341** abuts a second side **353** of the fixed abutment **351**. The operating abutment **322** is preferably positioned between the winding abutment **331** and the releasing abutment **341**. As will be described in further detail below, the operating abutment **322** moves the winding abutment **331** in the winding direction, W, when the control lever **150** is rotated in the winding direction and moves the releasing abutment **341** in the release direction, R, when the control lever **150** is rotated in the release direction.

The winding member **370** is preferably biased in the release direction, R, by second spring, S**2**. To facilitate the rotation of the winding member **370**, a first latch plate **380** and a second latch plate **390** are fixedly coupled to winding member **370** such that the winding member **370**, the first latch plate **380** and the second latch plate **390** rotate about the pivot shaft **310** simultaneously, as a unitary body. To operate the winding member **370** in a winding direction, a winding mechanism **104** is provided including a winding latch **381** defined peripherally of the first latch plate **380** having a plurality of teeth **383**, a winding pawl **410** for engaging the teeth **383** of the winding latch **381**, and a third spring S**3** for urging the winding pawl **410** toward an engaging position. The winding pawl **410** is preferably rotatably supported on a pivot shaft **323** fixed on the operating plate **320**.

To operate the winding member **370** in a release direction, a hold and release mechanism **106** is provided including an interrupting latch **391** defined peripherally on the second latch plate **390** having a plurality of teeth **392** and an interrupting pawl **420** for engaging the teeth **392** of the interrupting latch **390**. The interrupting pawl **420** is preferably freely rotatably supported on a pivot shaft **355** that is fixedly connected to an upper plate **356**. The hold and release mechanism **106** further includes a positioning latch **382** having a plurality of teeth **384** defined peripherally on the first latch plate **380**, a positioning pawl **430** for engaging the teeth **384** of the positioning latch **382**, and a fourth spring S**4** for urging the positioning pawl **430** toward an engaging position. The positioning pawl **430** is preferably rotatably supported on the pivot shaft **355**. The positioning latch **382** is preferably spaced apart from the winding latch **381**.

The upper plate **356** is fixedly supported on the cable stop **354**, the pivot shaft **355** and the main pivot shaft **310**.

To securely retain the parts installed on the main pivot shaft **310**, a nut **440** is threaded onto the main pivot shaft **310**. To minimize friction and ensure smooth operation of the control lever **150** and the winding member **370**, bearings **630** are provided in the shift control mechanism. In a preferred embodiment of the invention, the bearings **630** are ball bearings. In another embodiment of the invention, solid bearings can be used. The bearings **630** of the present invention are not limited to those described herein but may include any bearing that facilitates the smooth operation of the control lever **150** and the winding member **370**.

In another preferred embodiment of the invention, as shown in FIG. **11**, the winding member **370** is replaced with a cable pulling member **470**. The cable pulling member **470** operates to pull and release the shift control cable without winding the cable thereon. In a preferred embodiment of the invention, the cable pulling member **470** includes a cable hook **472** for securely receiving the shift cable **142** (shown in FIG. **1**). In a more preferred embodiment of the invention, the shift cable **142** is substantially parallel to control lever **150** at the point where the cable is received by the shift control mechanism **300**.

FIG. **3** depicts the shift control mechanism **300** of the present invention in a neutral position. In the neutral state, the operating plate **320** remains stationary. The winding abutment **331** abuts the first side **352** of the fixed abutment **351** and the releasing abutment **341** abuts the second side **353** of the fixed abutment **351**. In a neutral state, the operating abutment **322** is positioned between the winding abutment. **331** and the releasing abutment **341**. The winding abutment **331** and the releasing abutment **341** are preferably biased toward the fixed abutment **351**, effectively squeezing the operating abutment **322** and the fixed abutment **351** therebetween.

In the neutral position, the winding pawl **410** preferably rests on a cam **357** formed peripherally on the fixed plate **350**. The interrupting pawl **420** is positioned between the interrupting latch **391** and an inside edge **342** of the releasing abutment **341**. Because the interrupting pawl **420** is not biased toward the interrupting latch **391**, in the neutral state, the interrupting pawl **420** does not engage the teeth **392** of the interrupting latch **391**.

In the neutral state, the winding member **370** is biased in the release direction (clockwise in FIG. **3**) by second spring S**2** and by the spring tension of the gear change mechanism (not shown) that is transmitted via the shift cable **140** (shown in FIG. **1**). To maintain the position of the winding member **370**, the positioning pawl **430** engages the positioning latch **382** thereby holding the winding member **370**, the first latch plate **380** and second latch plate **390** in a stationary position.

In a more preferred embodiment of the invention, as shown in FIG. **11**, to prevent against unwanted movement of the operating plate **320** caused by vibrations, the operating plate **320** is held in a neutral position using a detent assembly **620**. The detent assembly **620** preferably includes a slot **622** defined in the operating plate **320**, configured to engage a ball **624** when the operating plate is in the neutral

position. The ball **624** is preferably biased toward the slot **622** by a spring **626**. As best shown in FIG. **13**, in a preferred embodiment of the invention, the spring **626**, ball **624**, and cover **628** are inserted in the mounting member **133** of the brake lever base **130**. By maintaining the operating plate **320** in a neutral position, the detent assembly **620** prevents unintentional shifting of the shift control mechanism.

FIGS. **4***a* through **4***e* depict the operation of the shift control mechanism **300** in a winding direction. To actuate the shift control mechanism **300** in a winding direction W, the control lever **150** is activated in a winding direction. As discussed above, in a-preferred embodiment of the-invention, as viewed from the rider's perspective, the winding direction W is defined as the direction of movement of the control lever **150** from the neutral position downward. In a more preferred embodiment of the invention, the winding direction W is perpendicular to the braking direction B. In FIGS. **9***a* through **4***e*, the elements that do not relate to the winding operation are eliminated for ease of understanding.

FIG. **4***a* depicts the shift control mechanism **300** of the present invention in a neutral position. Because the operating plate **320** is fixedly attached to the control lever **150**, as the control lever **150** is operated in the winding direction, the operating plate also operates in the winding direction. As best shown in FIG. **4***b*, the rotation of the operating plate **320**, causes the winding pawl **410** to slide off of the fixed plate cam **357**. Because the winding pawl **410** is biased toward the winding latch **381**, the winding pawl **410** engages one of the teeth **383** of the winding latch **381**. When the winding pawl has engaged one of the teeth **383** of the winding latch, rotation of the operating plate **320** translates to a rotation of the first latch plate **380**.

As best shown in FIG. **4***c*, the rotation of the first latch plate **380** driven by winding pawl **410** causes the positioning pawl **430** to disengage from the teeth **384** of the positioning latch **382**. As the first latch plate **380** is further rotated, the positioning pawl **430** moves toward a tooth of the positioning latch **382** adjacent the previously engaged tooth. Because the first latch plate **380** is fixedly connected to the winding member **370**, the winding member **370** rotates simultaneously with the first latch plate **380** in the winding direction W, thus winding the shift cable thereon.

As best shown in FIG. **4***d*, because the positioning pawl **430** is biased toward the positioning latch **382**, the positioning pawl **430** engages a tooth of the positioning latch **382** adjacent the previously engaged tooth. In a preferred embodiment of the invention, the positioning pawl **430** produces an audible click when the positioning pawl **430** engages the positioning latch **382**. Moreover, the bicycle rider can feel the snap of the positioning pawl **430** engaging the positioning latch **382**. The audible click and the snapping motion alerts the rider that the positioning pawl **430** has advance by one tooth completing one step of a multi-step shift mechanism. Upon completion of the one step shift, the operating plate **320** returns to the neutral position, as shown in FIG. **4***e*.

In a preferred embodiment of the invention, the shift control mechanism **300** of the present invention is configured to enable the rider to shift more than one step at a time, and more preferably to shift up to three steps at a time. To perform a multi-step winding operation, the bicycle rider rotates the control lever **150** further in the winding direction W. The shift control mechanism **300** operates as describe above in that the winding pawl **410** engages the winding latch **381** driving the winding latch **381** in the winding direction W. The positioning pawl **430** disengages from the positioning latch **382** and engages the tooth adjacent the previously engaged tooth. However, in the multi-step winding operation, the bicycle rider continues to rotate the control lever **150** causing the first latch plate **380** to rotate further, and positioning pawl **430** to continue to engage neighboring teeth **384** of the positioning latch **382** until the first latch plate **380** ceases to rotate. In a preferred embodiment of the invention, a winding stopper **324** is provided on the operating plate **320** for engaging with the mounting member **133** (shown in FIG. **2**) of the brake lever base **130** to limit the angle of rotation of the operating plate **320** in the winding direction W.

To operate the shift control mechanism **300** in the release direction R, the control lever **150** is rotated in the release direction. As previously discussed, in a preferred embodiment of the invention, as viewed from the rider's perspective, the release direction R is defined as the direction of movement of the control lever **150** from the neutral position upward. In a more preferred embodiment of the invention, the release direction R is perpendicular to the braking direction B. To operate the control lever **150** in a release direction, the rider preferably pulls the control lever **150** upward using the rider's index finger, middle finger or both the index and middle fingers. Alternatively, the rider's fingers can be placed under the control lever **150** and the control lever can be moved upward using the nail side of the fingers. One of the advantages of the present invention is that the control lever **150** can be operated without requiring the removal of the rider's thumb from the handlebar **200**. Accordingly, the rider can maintain a control of the handlebar **200** while shifting gears.

The releasing operation of a preferred embodiment of the shift control mechanism **300** is now described. For ease of understanding, the movement of the positioning pawl **430** and the interrupting pawl **420** are shown separately. FIGS. **5***a* through **5***c* depict the movement of the positioning pawl **430** during the releasing operation. FIGS. **6***a* through **6***c* depict the movement of the interrupting pawl **420** during the releasing operation. FIG. **5***a* corresponds temporally to FIG. **6***a*, FIG. **5***b* corresponds temporally to FIG. **6***b*, and FIG. **5***c* corresponds temporally to FIG. **6***c*. Accordingly, the motion depicted in FIG. **5***b*, for example, occurs simultaneously with the motion depicted in FIG. **6***b*.

FIGS. **5***a* and **6***a* illustrate the shift control mechanism **300** in a neutral position. To release the shift cable, the control lever **150** is operated in the release direction R, causing the operating plate **320** to rotate in the release direction. In reference to FIGS. **5***b* and **6***b*, as the operating plate **320** is rotated in the release direction, the operating abutment **322** pushes the releasing abutment **341**, causing the releasing plate **340** to rotate. As shown in FIG. **5***b*, the release abutment **341** contacts the positioning pawl **430** and disengages the positioning pawl **430** from the positioning latch **382**. Because the first latch plate **380** is biased in a release direction, the disengagement of the positioning pawl **430** allows the first latch plate **380**, and hence the winding member **370**, to rotate freely in the release direction R. To limit the rotation of the winding member, as shown in FIG. **6***a*, the releasing abutment **341** includes an inside edge **342** that is configured to contact the interrupting pawl **420** and push the interrupting pawl **420** into engagement with the interrupting latch **391**. The engagement of the interrupting pawl **420** with the interrupting latch **391** limits the rotation of the winding member **370** when the positioning pawl **430** is disengaged from the positioning latch **382**.

In a preferred embodiment of the invention, the rider can feel and hear the click produced by the engagement of the interrupting pawl **420** with the interrupting latch **391**. Upon

hearing or feeling the click, the rider can release the control lever **150** returning the operating plate **320** to its neutral position. In reference to FIG. **5***c*, as the operating plate **320** is returned to its neutral position, the positioning pawl **930** engages a tooth on the positioning latch adjacent the previously engaged tooth. In reference to FIG. **6***b*, as the operating plate is returned to its neutral position, the inside edge **342** of the releasing abutment **341** disengages from the interrupting pawl **420** causing the interrupting pawl to disengage from the interrupting latch **391**. The cable releasing operation for a one step shift is completed and the operating plate **320** returns to its neutral position.

The angle of rotation of the operating plate **320** is preferably limited in the releasing direction by the contact of release stopper **325** with the mounting member **133** of the brake lever base **130** (shown in FIG. **2**). In a preferred embodiment of the invention, the release stopper **325** limits the rotation of the winding member **370** in the release direction to one step.

The drawings depict a shift control mechanism for a nine step shift operation. However, the present invention is not limited to a nine step shift operation and can be configured to vary the number of steps available.

The operation of the brake mechanism of the present invention is described with reference to FIGS. **7***a* and **7***b*. To simplify the illustration, the shift control mechanism **300** of the present invention is not shown in FIGS. **7***a* and **7***b*. In a preferred embodiment, the brake cable **170** is attached to the cable hook **160** and the outer casing **172** of the brake cable **170** is attached to the brake cable adjuster **112**. By pulling the control lever **150** toward the handlebar **200**, the brake base lever **130** pivots about the pivot pin **131**, and the brake cable **170** is extracted from the outer casing **172**. The movement of the brake cable **170** actuates the braking mechanism in a manner known by those skilled in the art. If desired, the braking operation can be performed simultaneously with the shifting operation.

The bicycle control device **100** of the present invention is shown, in FIG. **8**, on a handlebar **200** having handlebar extensions **230**. In a preferred embodiment of the invention, handlebar extensions **230** extend substantially perpendicularly upward from the handlebar **200** and provide the bicycle rider with an alternative position to grip and maneuver the handlebar **200**. As shown in FIG. **8**, the control lever **150** is located proximal to the handlebar extensions **230** and is dimensioned such that a rider can operate the control lever **150** in the winding and releasing directions W, R while maintaining a grip on the handlebar extensions **230**.

Another embodiment of the shift control device **500** is shown in FIG. **9**. Shift control device **500** includes a release lever **510** extending directly from the releasing plate **340**. The release lever **510** includes a control portion **520** to facilitate the activation of the release lever **510** by a rider's thumb. In a preferred embodiment of the invention, the release lever extends below the bracket **110** and is positioned such that the control portion **520** of the release lever **510** is easily accessible to the rider's thumb when the rider is gripping the handlebar **200**. By providing the release lever **510**, the rider is given an additional control option. The rider can utilize the release lever **510** to perform a release operation even if the rider's fingers are not on the control lever **150**.

FIG. **11** discloses another preferred embodiment of the release lever **650** having a knob shape. The release lever **650** is preferably fastened to the releasing plate **340** using fasteners **651**. The release lever **650** is preferably separable form the releasing plate and can be replaced without replacing the entire shift control mechanism. Depending on the shape of the release lever **650**, an extension **652** may be provided on the releasing plate **340** to position the release lever **650** spaced apart from the shift control mechanism, and thus allow room for the release lever **650** to operate smoothly.

As shown in FIGS. **12** and **13**, a preferred embodiment of the control lever **150** includes a plurality of risings to facilitate the operation of the control lever. The control lever **150** preferably includes a proximal end **660** attached to the shift control mechanism **300** and a distal end **662**. To operate the control lever **150** in a winding direction, the user preferably contacts the winding surface **664** and moves the control lever in the winding direction W. Similarly, to operate the control lever **150** in a release direction, the user preferably contacts the releasing surface **666** and moves the control lever in the releasing direction R.

Adjacent proximal end **660** of control lever **150**, winding surface **664** preferably includes winding surface proximal portion **665**. At the distal end **662** of the control lever **150**, the winding surface **664** preferably defines a first projection or rising **668**. The first rising **668** is configured to facilitate operation of the control lever by reducing the chance of the rider's fingers from slipping off of the control lever. Similarly, the releasing surface **666** preferably includes a releasing surface proximal portion **667** adjacent lever proximal end **660** and also defines a second projection or rising **670** at the distal end of the control lever to prevent the rider's fingers from slipping off of the control lever when the rider is moving the control lever in the releasing direction R.

As shown in FIG. **13**, the control lever **150** includes a braking surface **672**. To operate the braking mechanism, the user preferably contacts the braking surface **672** and moves the control level in the braking direction B. Adjacent proximal end **660** of control lever **150**, braking surface **672** preferably includes braking surface proximal portion **673**. At the distal end **662** of the control lever **150**, the braking surface **672** preferably defines a third projection or rising **674**. The third rising **674** is configured to facilitate operation of the control lever by reducing the chance of the rider's fingers from slipping off of the control lever when the rider is performing a braking operation.

The description of the shift control device and the corresponding drawings is directed to a shift control device to be installed on the right hand side of a bicycle handlebar when viewed from the rider's perspective. The shift control device installed on the left hand side of the bicycle handlebar is substantially the mirror image of the shift control device of the right hand side.

The embodiments described above are exemplary embodiments of a bicycle control device. Those skilled in the art may now make numerous uses of, and departures from, the above-described embodiments without departing from the inventive concepts disclosed herein. Accordingly, the present invention is to be defined solely by the scope of the following claims.

What is claimed is:

**1**. A control lever comprising a proximal end and a distal end, the proximal end being configured for pivotal connection to a shaft, the control lever being operable in a shifting plane and a braking plane, the control lever having a pulling direction lying in the shifting plane, a releasing direction lying in the shifting plane, and a braking direction lying in the braking plane, wherein the shifting plane is substantially perpendicular to the braking plane, the control lever comprising:

a releasing surface;

a pulling surface opposite the releasing surface;

a braking surface adjacent the pulling surface and the releasing surface;

the pulling surface having a pulling surface proximal portion adjacent the proximal end of the lever and a first distal projection adjacent the distal end of the lever, wherein the first distal projection projects away from the pulling surface proximal portion in a first direction away from the braking plane;

the releasing surface having a releasing surface proximal portion adjacent the proximal end of the lever and a second distal projection adjacent the distal end of the lever, wherein the second distal projection projects away from the releasing surface proximal portion in a second direction away from the braking plane; and

the braking surface having a braking surface proximal portion adjacent the proximal end of the lever and a third distal projection adjacent the distal end of the lever, wherein the third distal projection projects away from the braking surface proximal portion in a third direction away from the shifting plane.

**2**. The control lever of claim **1**, wherein the first distal projection defines a first distance from the braking plane and the pulling surface proximal portion defines a second distance from the braking plane and the first distance is greater than the second distance.

**3**. The control lever of claim **2**, wherein the second distal projection defines a third distance from the braking plane and the releasing surface proximal portion defines a fourth distance from the braking plane and the third distance is greater than the fourth distance.

**4**. The control lever of claim **3**, wherein the third distal projection defines a first distance from the shifting plane and the braking surface proximal portion defines a second distance from the shifting plane and the first distance is greater than the second distance.

**5**. The control lever of claim **1**, wherein the first distal projection projects away from the second distal projection.

**6**. The control lever of claim **1**, wherein the lever is operable by a rider, the proximal end of the lever and the distal end of the lever define a fourth direction between the proximal end of the lever and the distal end of the lever, and the first distal projection interferes with the movement of the rider's fingers along the pulling surface in the fourth direction.

**7**. The control lever of claim **6**, wherein the second distal projection interferes with the movement of the rider's fingers along the releasing surface in the fourth direction.

**8**. The control lever of claim **7**, wherein the third distal projection interferes with the movement of the rider's fingers along the braking surface in the fourth direction.

**9**. The control lever of claim **8**, wherein the control lever is operable by a rider, and the first, second and third distal projections interfere with the movement of the rider's fingers along the lever in the fourth direction.

**10**. The control lever of claim **9**, wherein the releasing surface proximal portion, pulling surface proximal portion, and braking surface proximal portion defines a narrow portion of the lever.

**11**. The control lever of claim **1**, wherein the third distal projection is larger than the first distal projection.

**12**. The control lever of claim **1**, wherein the first distal projection is larger than the second distal projection.

**13**. The control lever of claim **1**, wherein the third distal projection is larger than the second distal projection.

**14**. A control lever having a proximal end and a distal end defining a lengthwise direction between the proximal end and the distal end, wherein the control lever is operable by a rider in a pulling direction, a releasing direction, and a braking direction, and the proximal end is configured for pivotal attachment to a shaft, the control lever comprising:

a releasing surface;

a pulling surface opposite the releasing surface;

a braking surface adjacent the pulling surface and the releasing surface;

wherein adjacent the distal end, the releasing surface, pulling surface and braking surfaces are each shaped to interfere with the movement of the rider's fingers along the respective surfaces in the lengthwise direction.

**15**. The control lever of claim **14**, wherein the pulling surface defines a first projection adjacent the distal end of the lever, the releasing surface defines a second projection adjacent the distal end of the lever, and the braking surface defines a third projection adjacent the distal end of the lever.

**16**. The control lever of claim **15**, wherein the first, second and third projections are first, second, and third bumps, respectively.

**17**. The control lever of claim **16**, wherein the first, second and third bumps reduce the chance of the rider's fingers slipping off of the control lever.

**18**. The control lever of claim **15**, wherein the first and second projections project away from one another.

**19**. A control lever operable in a pulling direction, releasing direction, and a braking direction, the control lever comprising:

a proximal end and a distal end, the proximal end being configured for pivotal attachment to a shaft;

a releasing surface;

a pulling surface opposite the releasing surface;

a braking surface adjacent the pulling surface and the releasing surface;

the pulling surface having a first bump defined therein adjacent the distal end of the lever;

the releasing surface having a second bump defined therein adjacent the distal end of the lever;

the braking surface having a third bump defined therein adjacent the distal end of the lever.

**20**. The control lever of claim **19**, wherein the control lever is operable by a rider and includes a proximal end and a distal end defining a lengthwise direction between the proximal and the distal ends, and the first bump, second bump, and third bump are each sized to interfere with the movement of the rider's fingers along the lever in the lengthwise direction.

**21**. The control lever of claim **19**, wherein the third bump is larger than the first bump.

**22**. The control lever of claim **19**, wherein the third bump is larger than the second bump.

**23**. The control lever of claim **19**, wherein the first bump is larger than the second bump.

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