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Lumpkin

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[54] **LOW-FRICTION DERAILLEUR CABLE ROUTER**

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[73] Assignee: **Shimano, Inc.**, Osaka, Japan

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **09/303,229**

[22] Filed: **Apr. 28, 1999**

Related U.S. Patent Documents

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Issued: **Apr. 29, 1997**
Appl. No.: **08/552,743**
Filed: **Nov. 3, 1995**

U.S. Applications:

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[51] **Int. Cl.**^{7} **F16H 9/06**; F16H 59/00

[52] **U.S. Cl.** **474/79**; 474/80

[58] **Field of Search** 474/78–82; 180/223, 180/231

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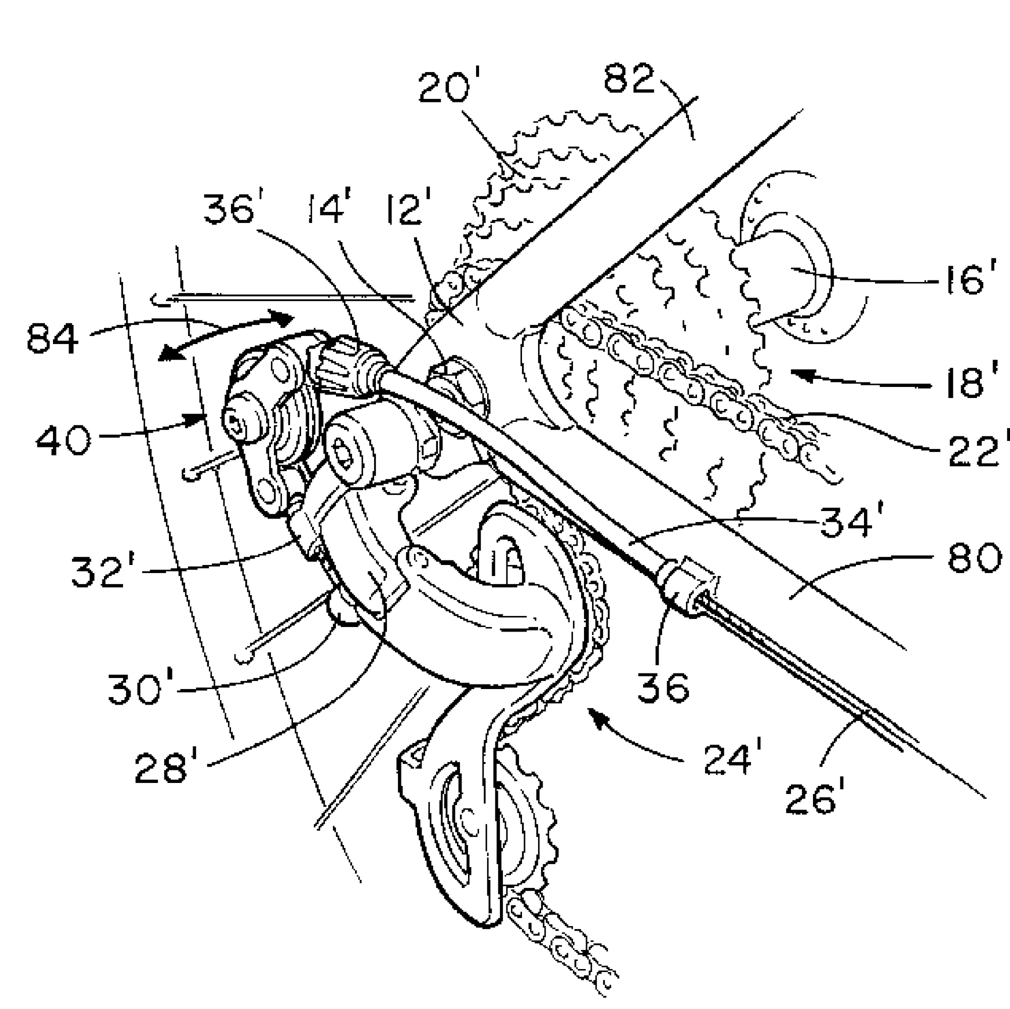
Attorney, Agent, or Firm—James A. Deland

[57] **ABSTRACT**

A derailleur cable router changes the direction of a derailleur cable operatively attached to a rear derailleur to a bicycle frame. The rear derailleur is actuated by variation in tension applied to the derailleur cable from a direction rearward of the derailleur. The tension in the derailleur cable is controlled by a shifter attached to a distal end of the derailleur cable, the shifter being mounted to the bicycle frame forward of the derailleur. The derailleur cable includes a cable housing around at least a portion of the derailleur cable with the derailleur housing being fixed against lengthwise movement relative to the bicycle frame by attachment to the bicycle frame. The derailleur cable router includes a frame having a first and a second end. A housing is provided at the first end of the frame and the housing is provided to a derailleur cable housing. A second housing is provided at the second end of the frame, the second housing being attachable to a derailleur cable feed of a rear derailleur. The first housing includes a first cable channel for receiving a derailleur cable from within a derailleur cable housing and the second housing includes a second cable channel for passing a derailleur cable to a rear derailleur cable feed. A pulley having an axis of rotation in a circumferential groove is mounted to the frame for rotation about its axis of rotation intermediate the first and second ends of the frame with the circumferential groove of the pulley aligned with the first and second cable channels so that a derailleur cable can be received in the first cable channel, engaged with a portion of the circumferential groove and passed through the second cable channel. Preferably the first cable channel, the second cable channel channels so that a derailleur cable can be received in the first cable channel, engaged with a portion of the circumferential groove and passed through the second cable channel. Preferably the first cable channel, the second cable channel and the circumferential groove of the pulley all lie within substantially the same plane.

61 Claims, 5 Drawing Sheets



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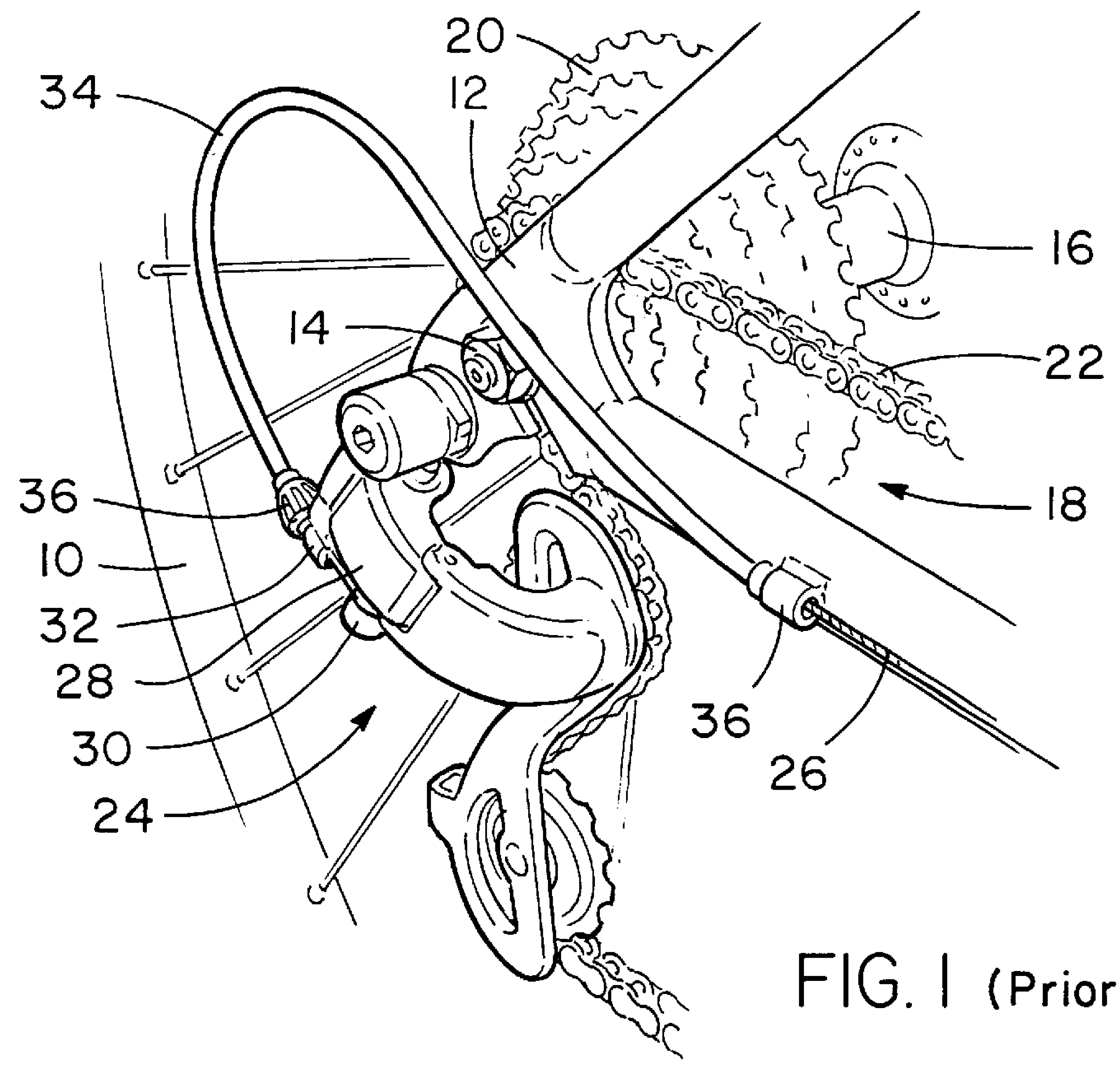


FIG. 1 (Prior Art)

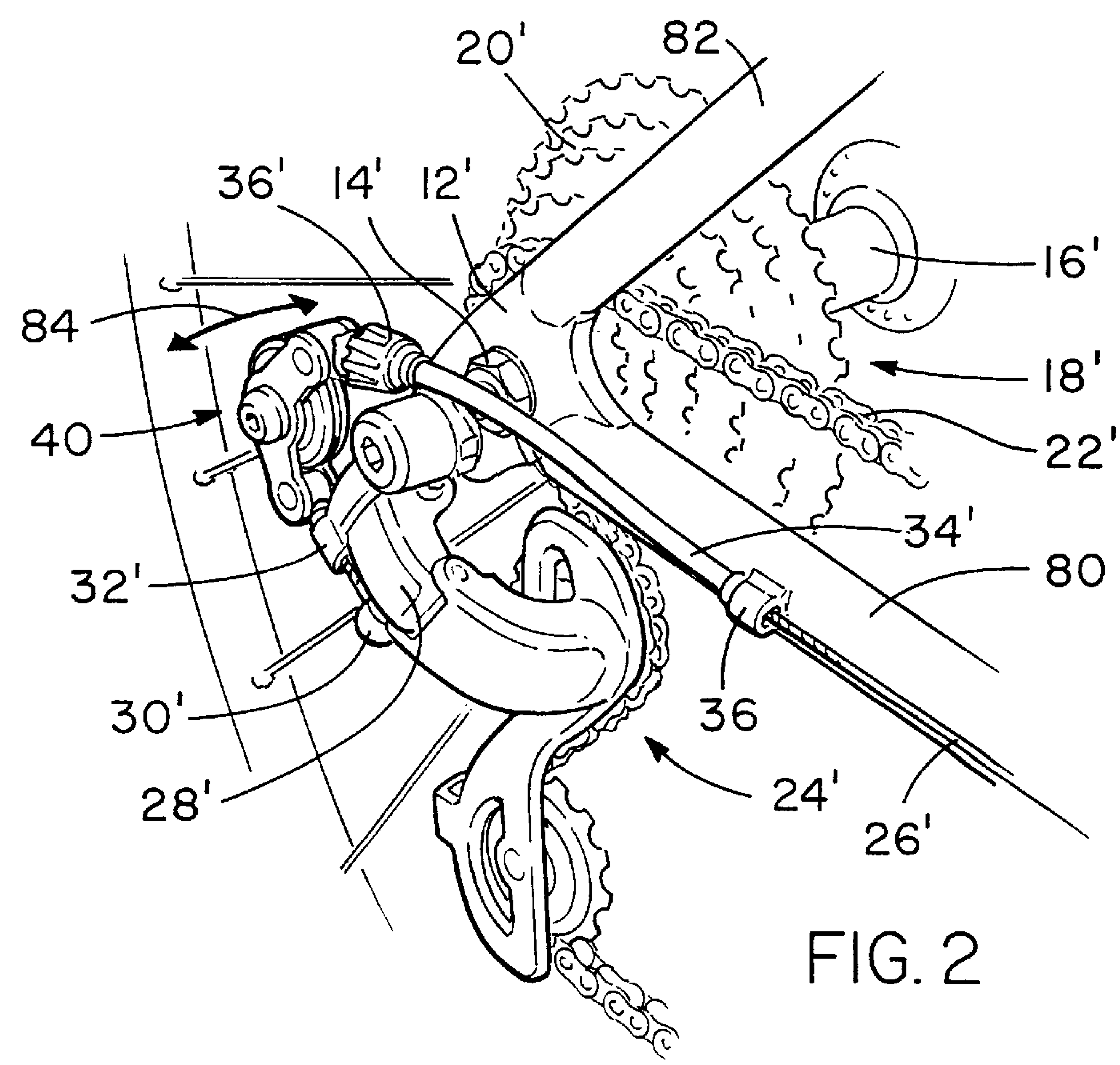


FIG. 2

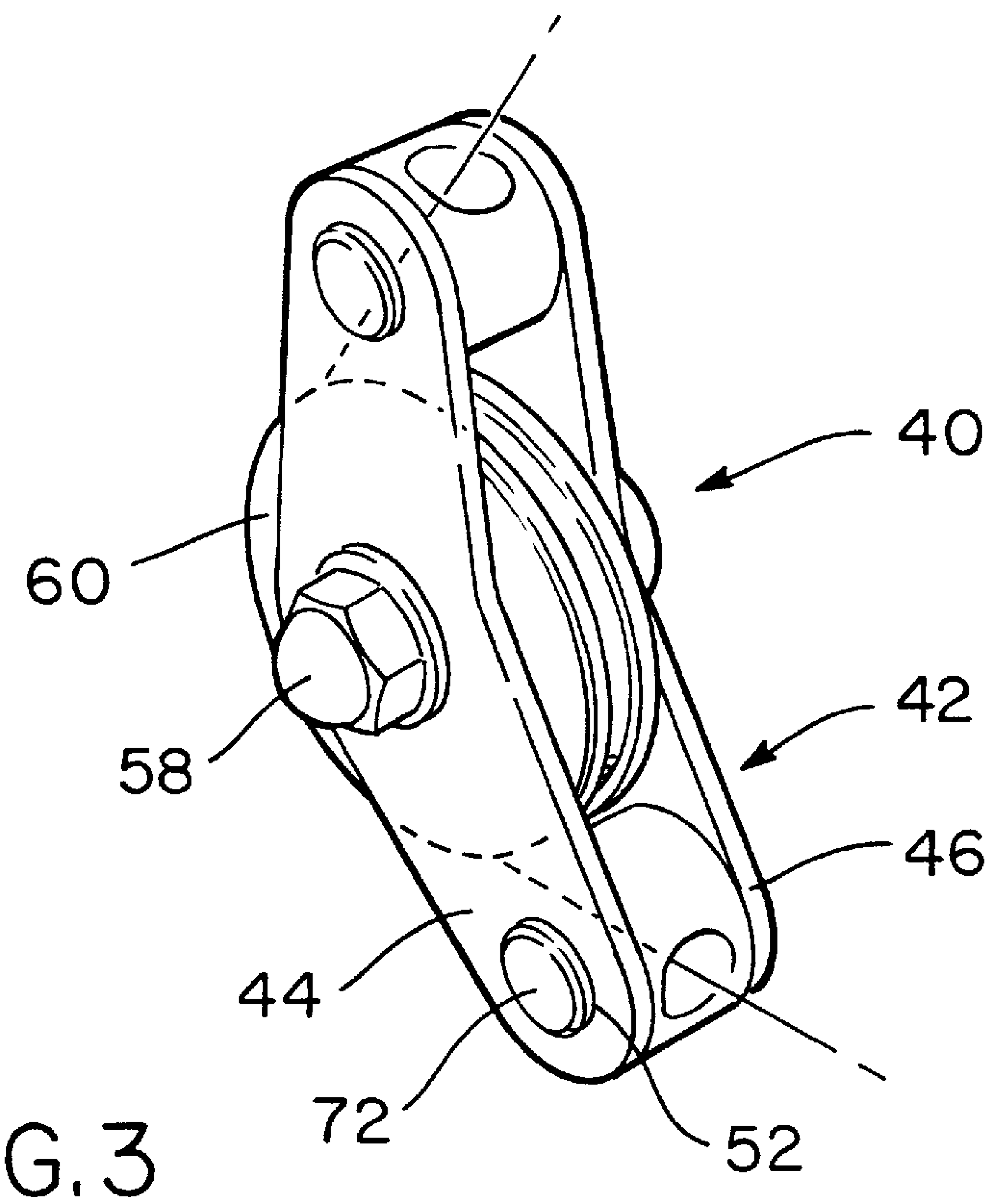

40
60
42
58
46
44
72
52

FIG. 3

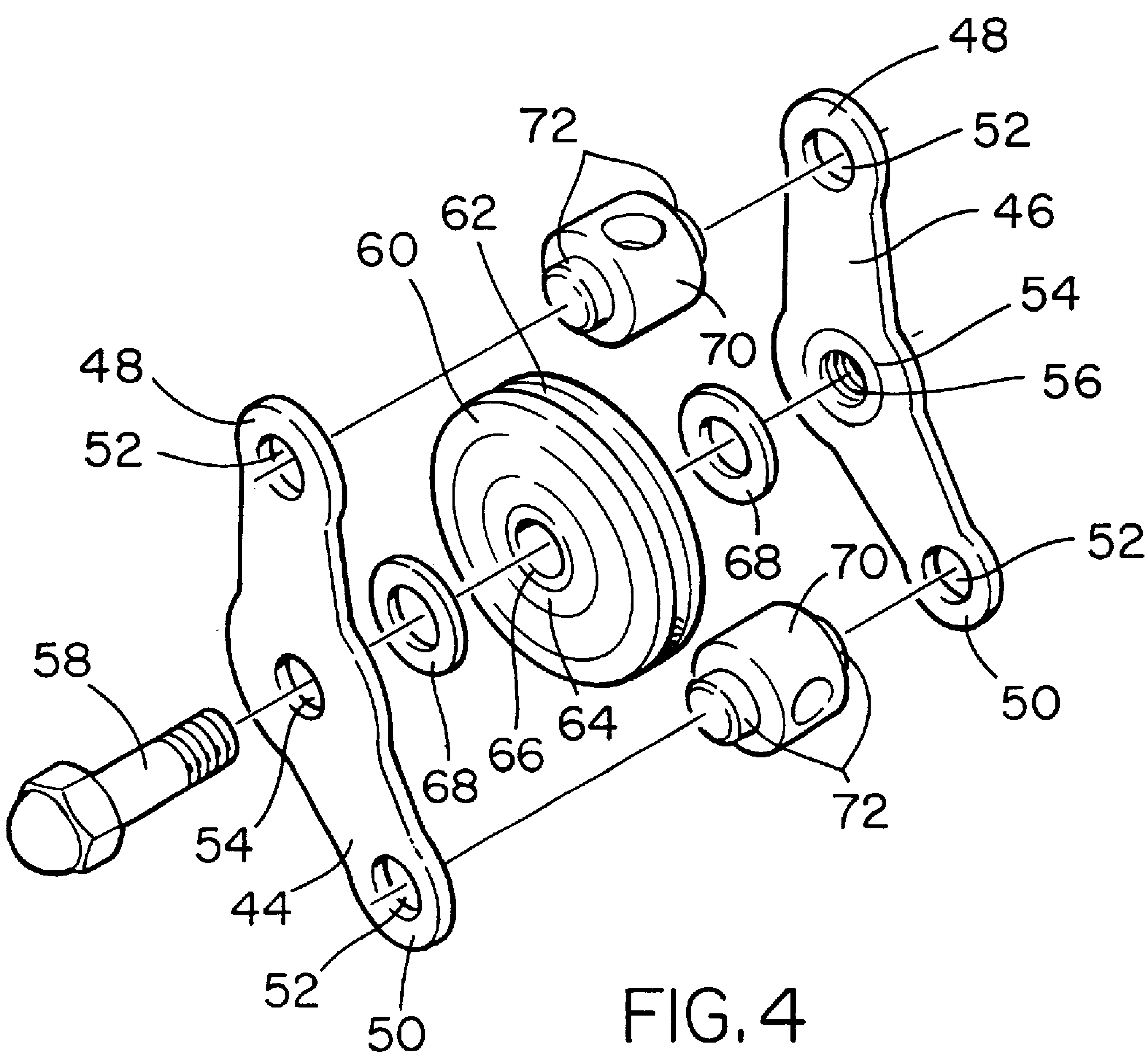
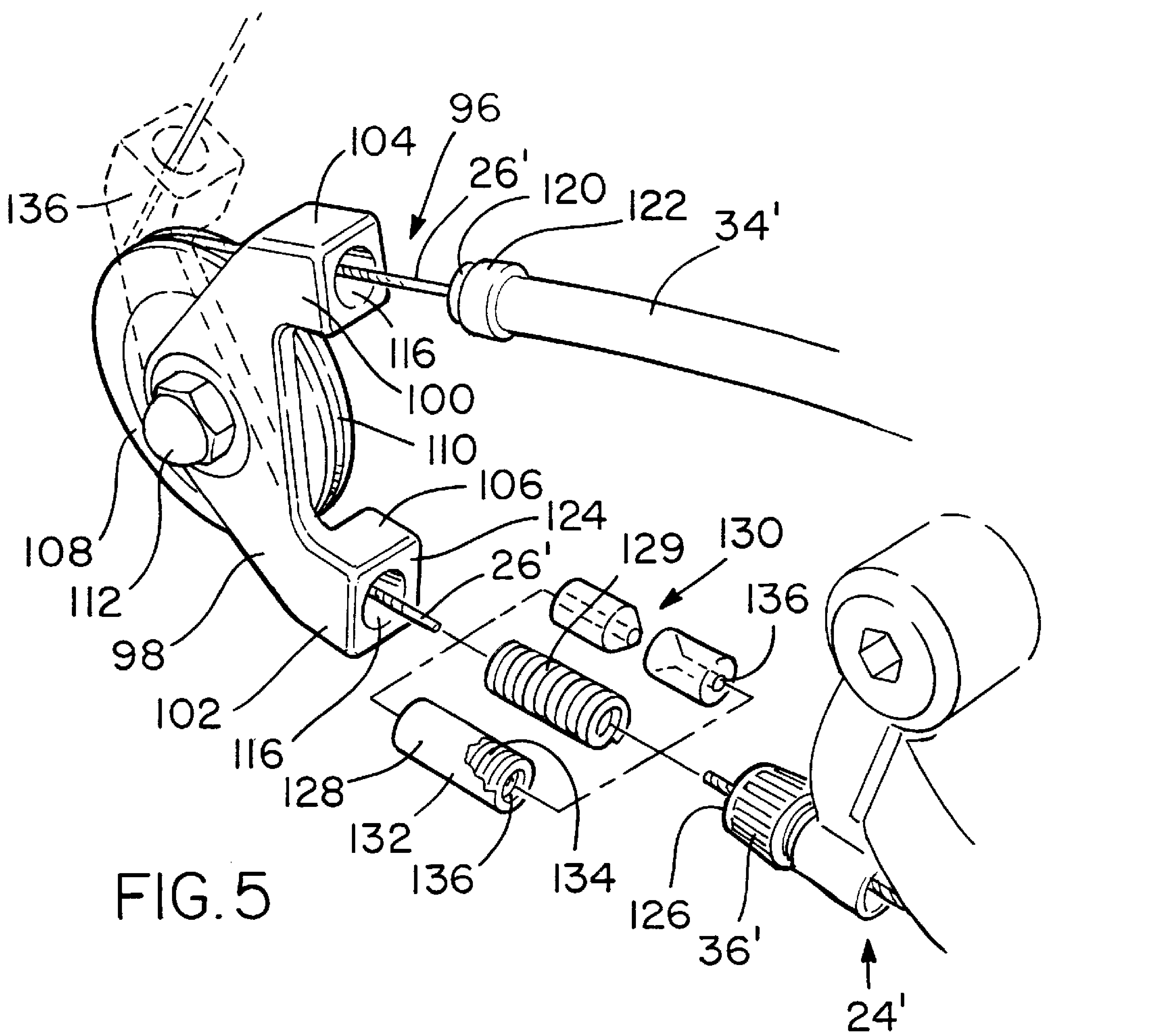
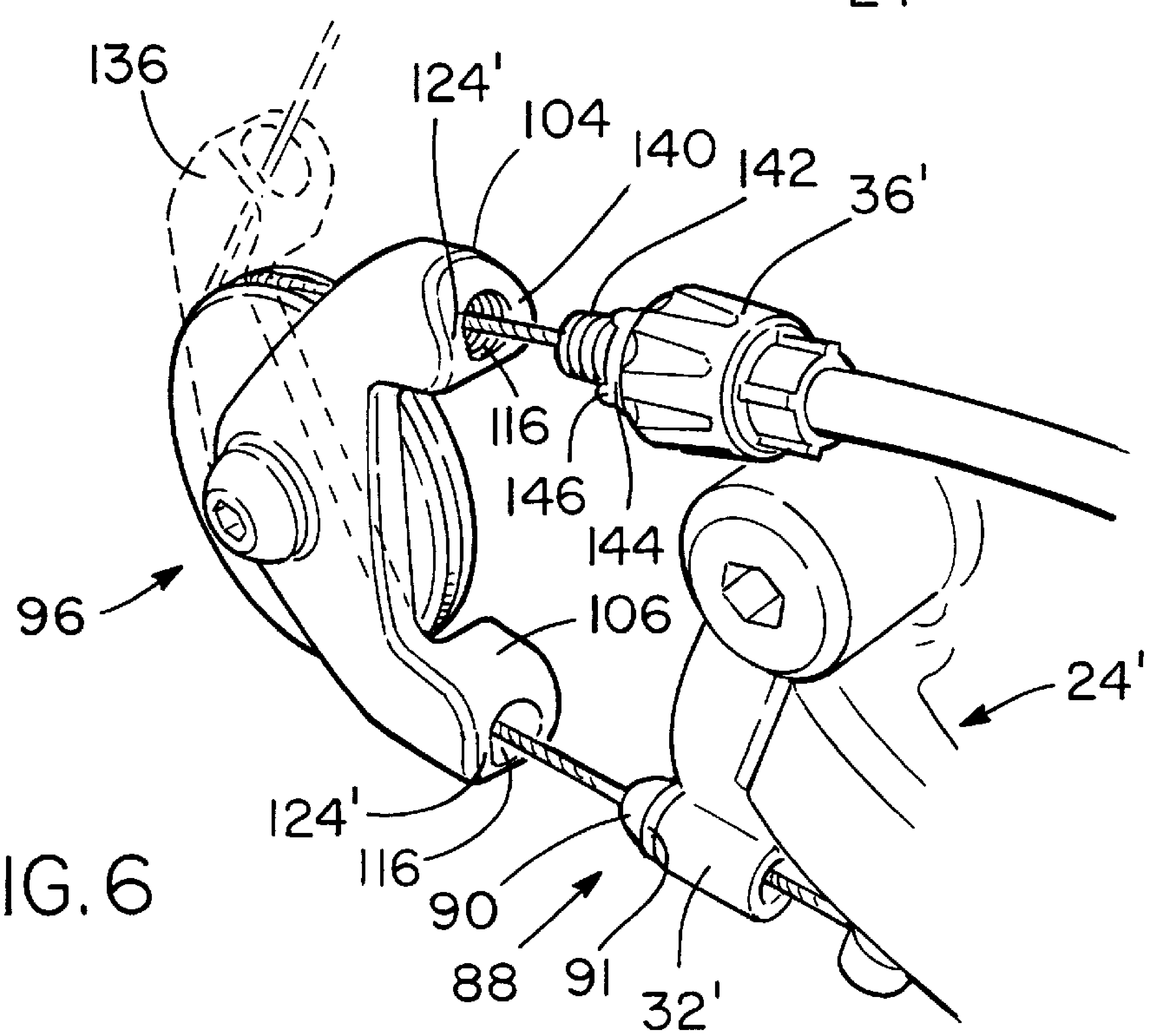

48
72
52
62
46
60
54
70
48
56
52
68
70
52
58
68
66
64
50
54
72
44
52
50

FIG. 4


96
104
26'
120
122
34'
136
116
100
110
106
124
129
130
108
112
26'
136
98
102
116
128
132
136
134
126
36'
24'
FIG. 5


136
124'
104
140
142
36'
116
146
144
96
106
24'
124'
116
90
88
91
32'
FIG. 6

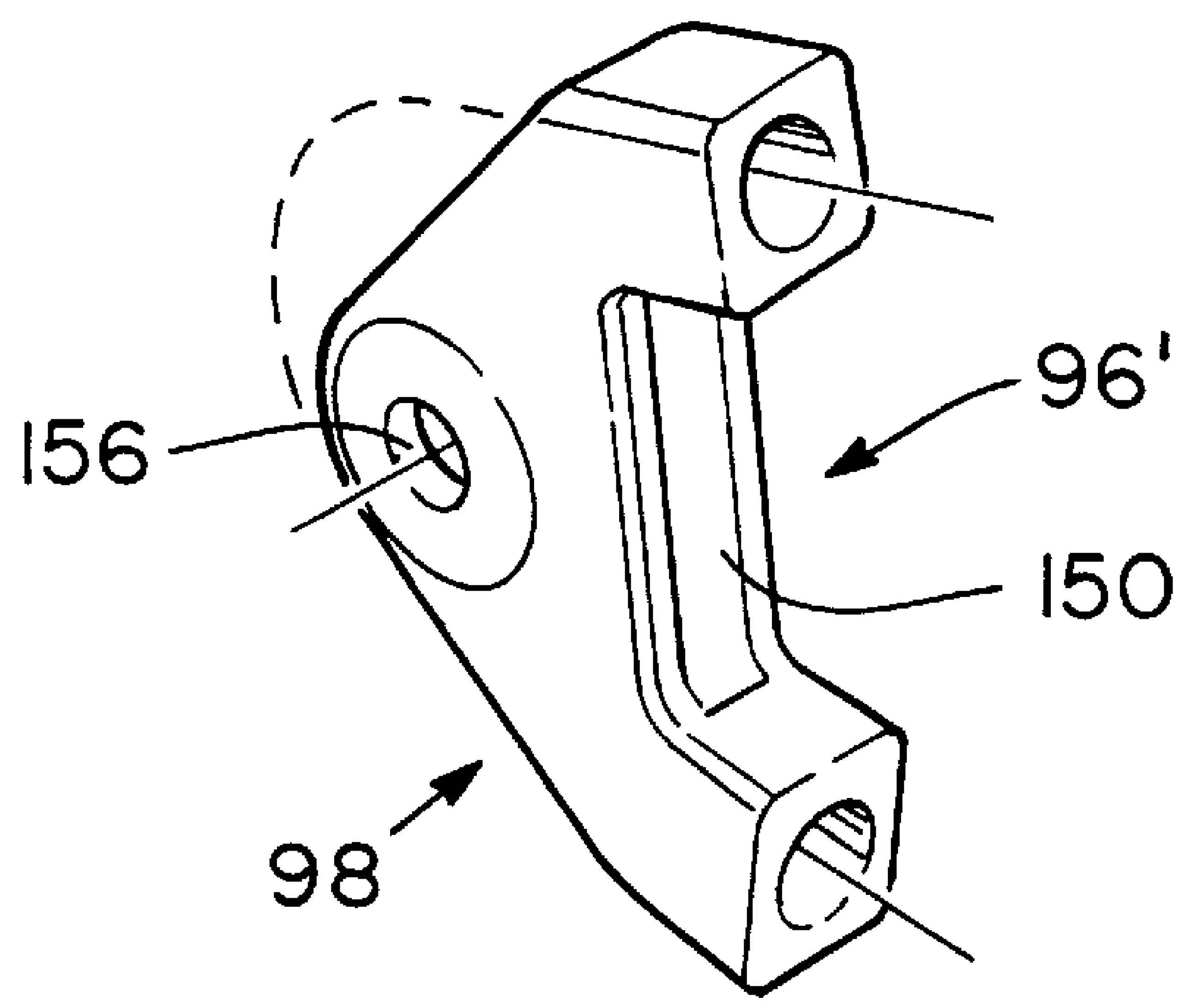


FIG. 7

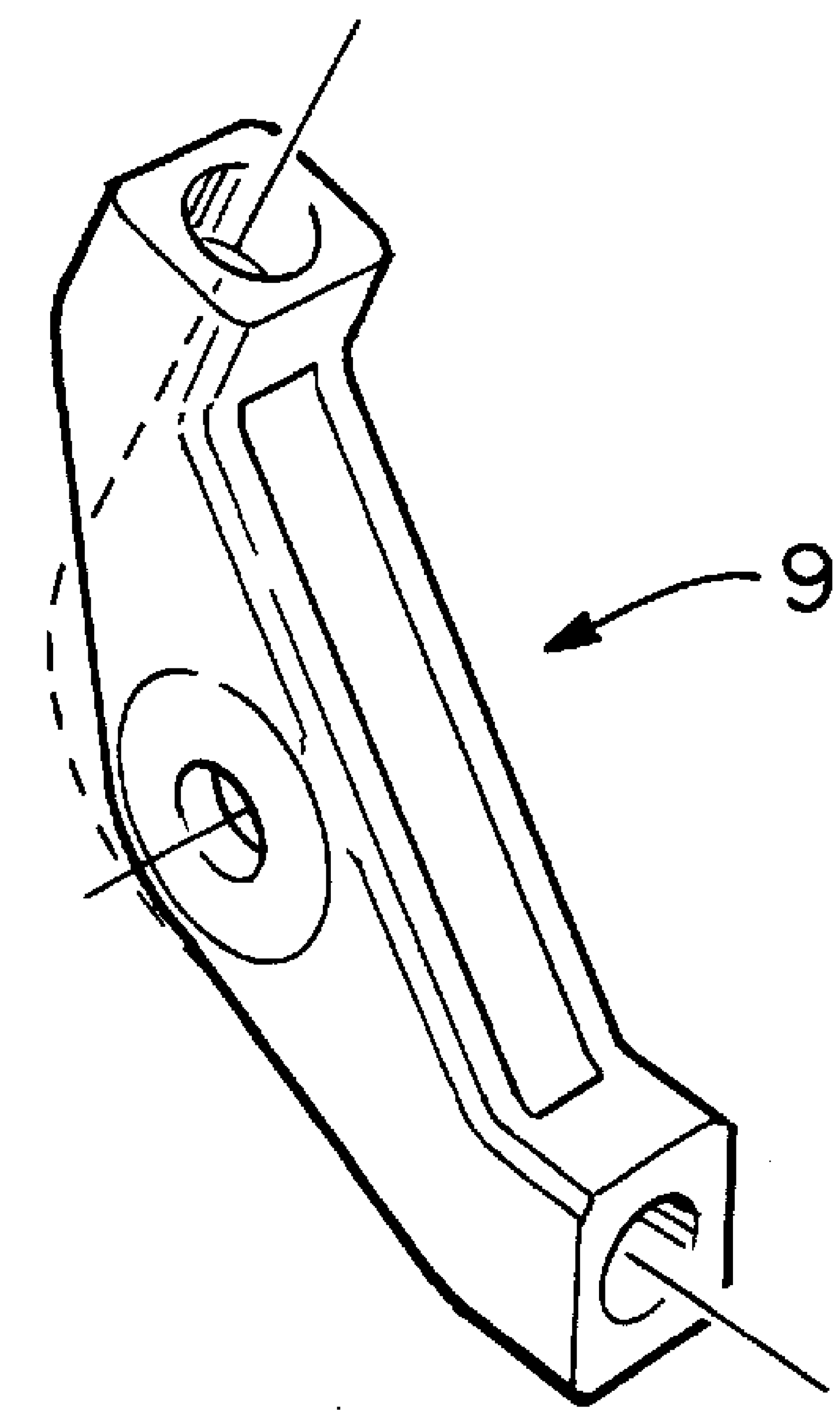


FIG. 8

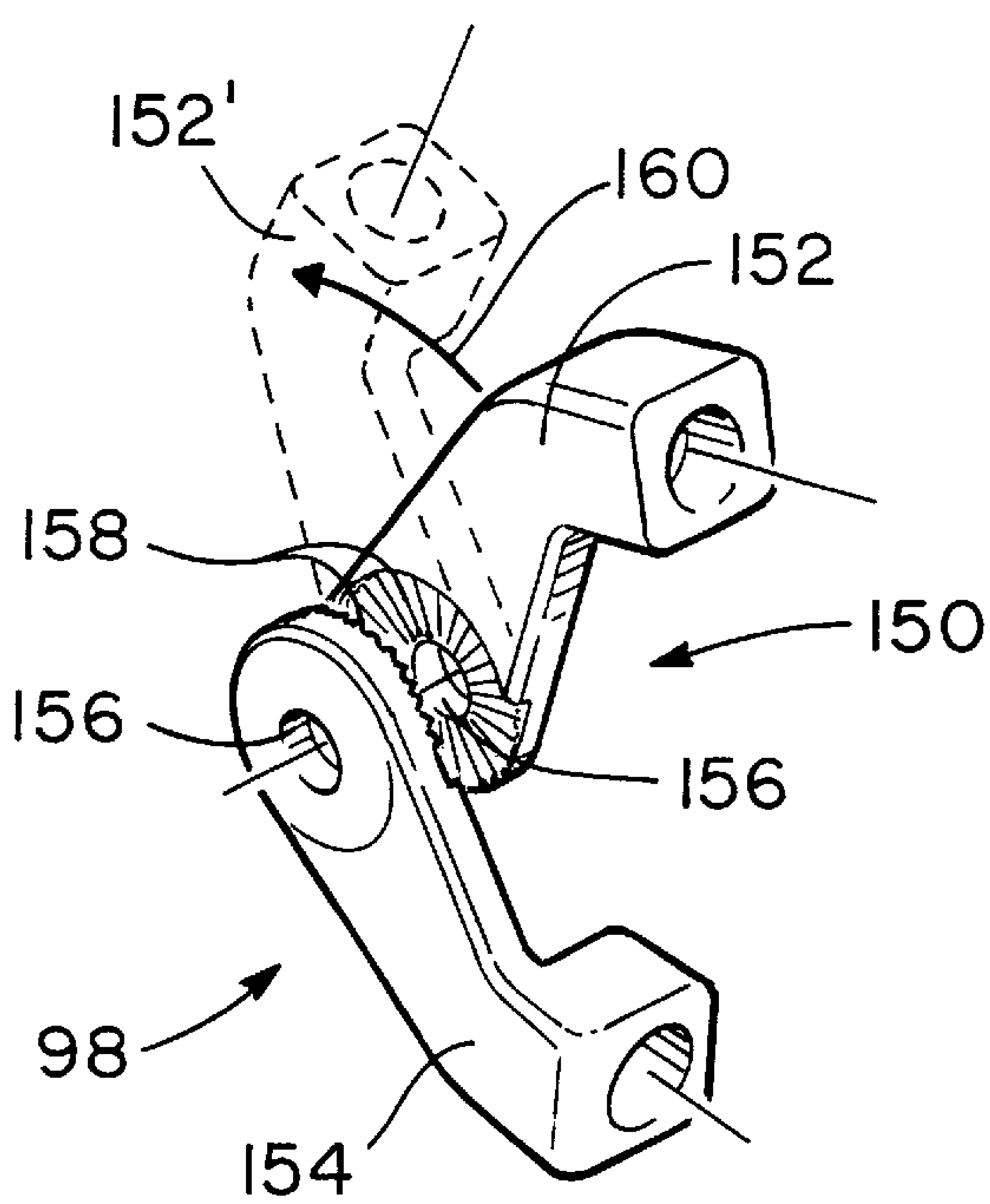


FIG. 9

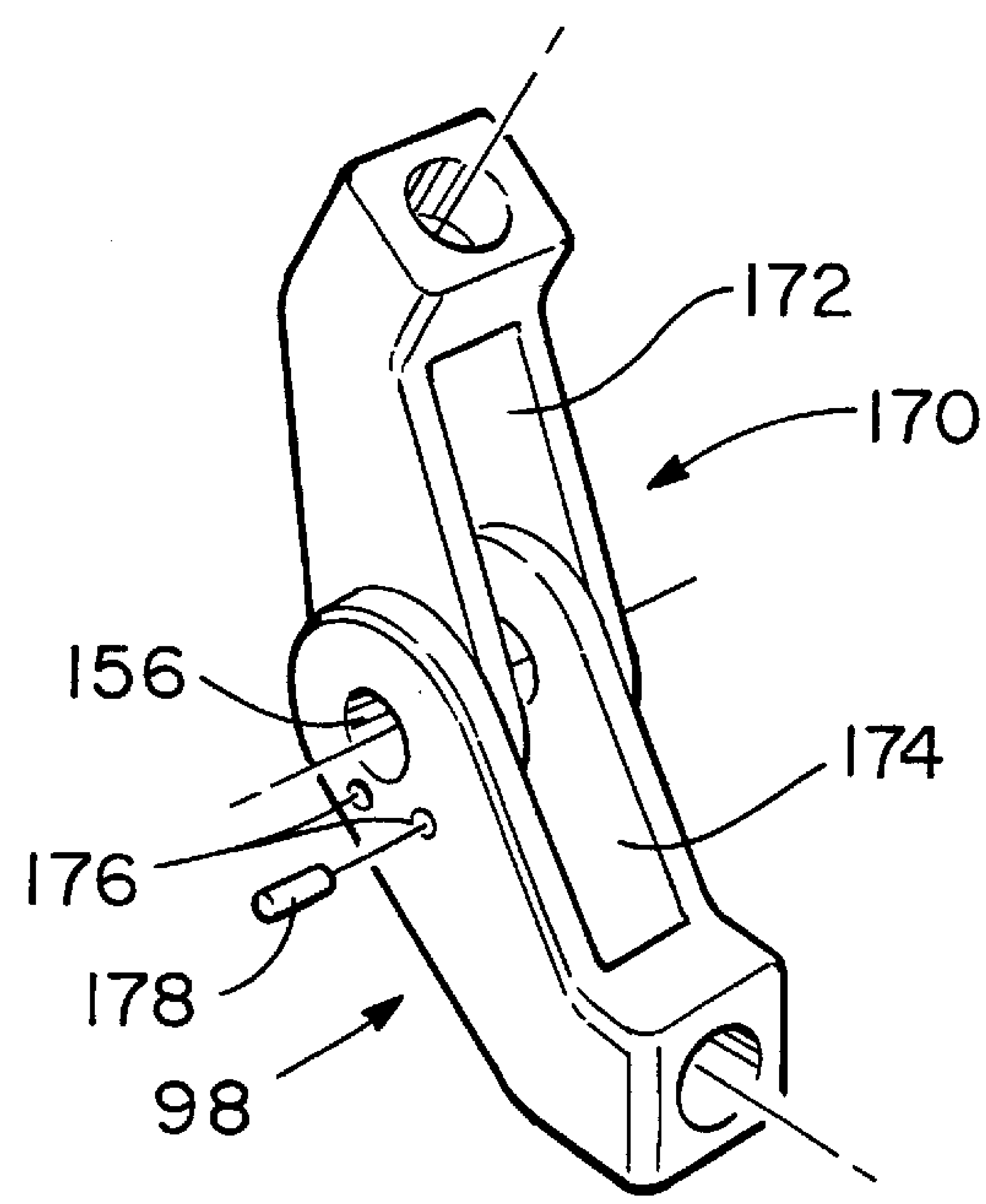


FIG. 10

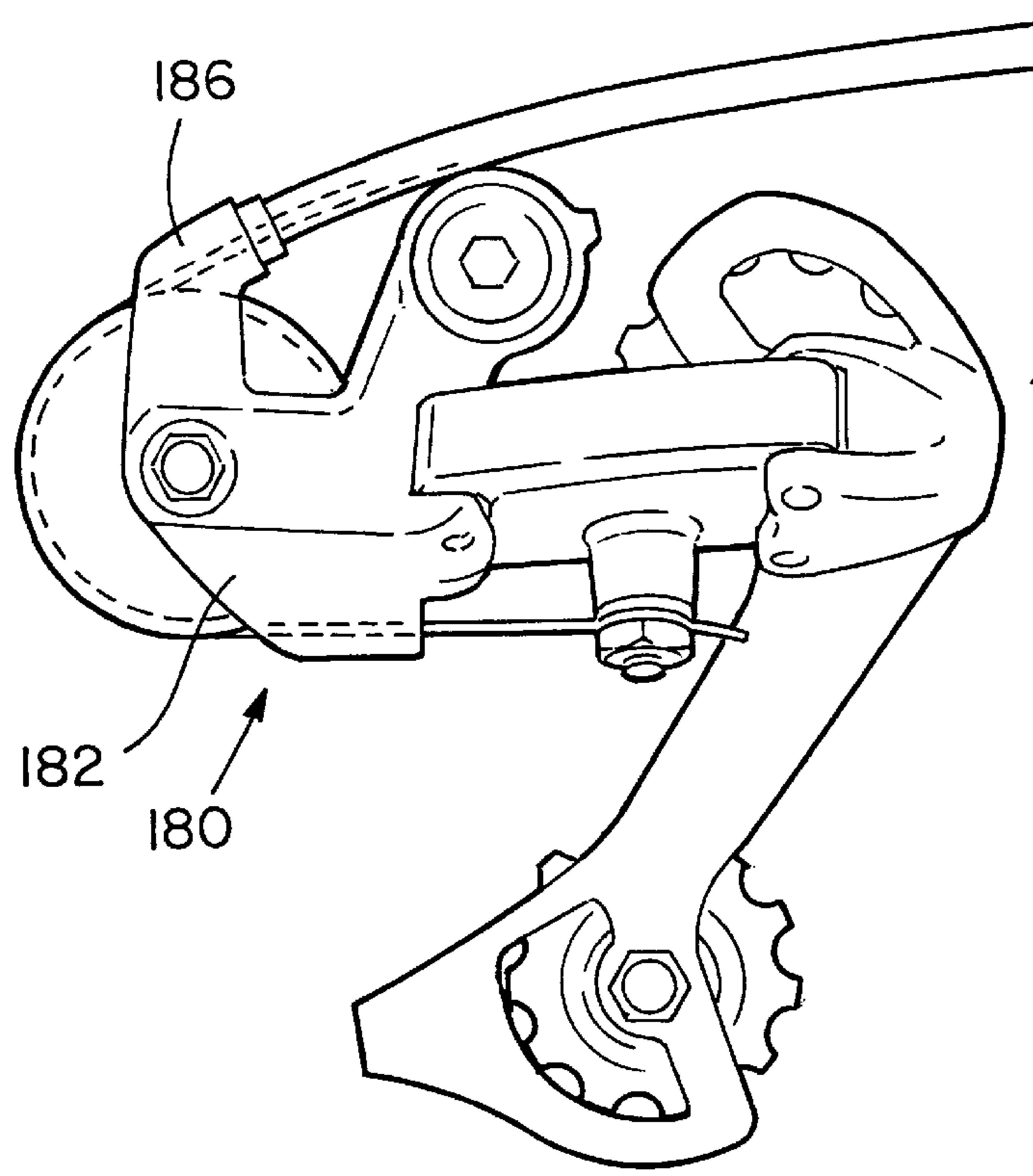


FIG. 11

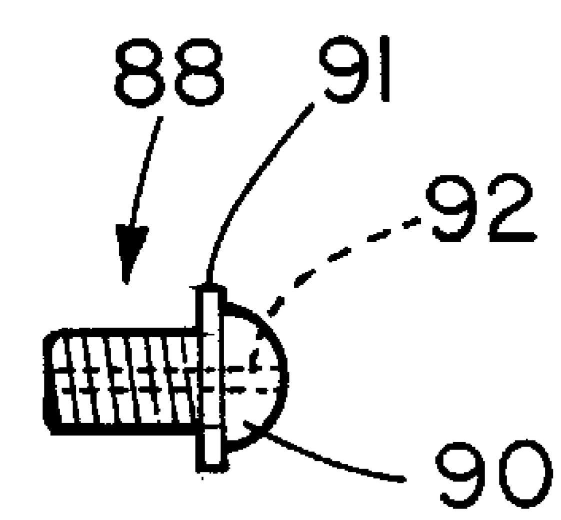


FIG. 16

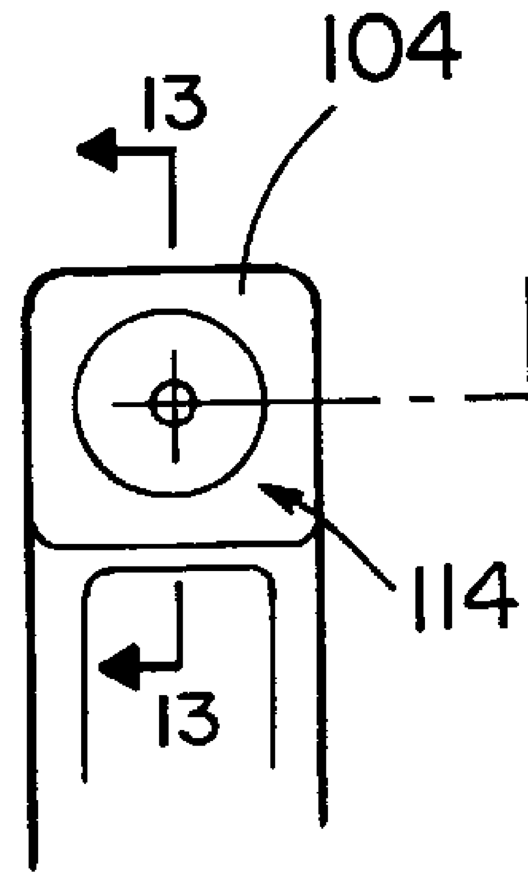


FIG. 12

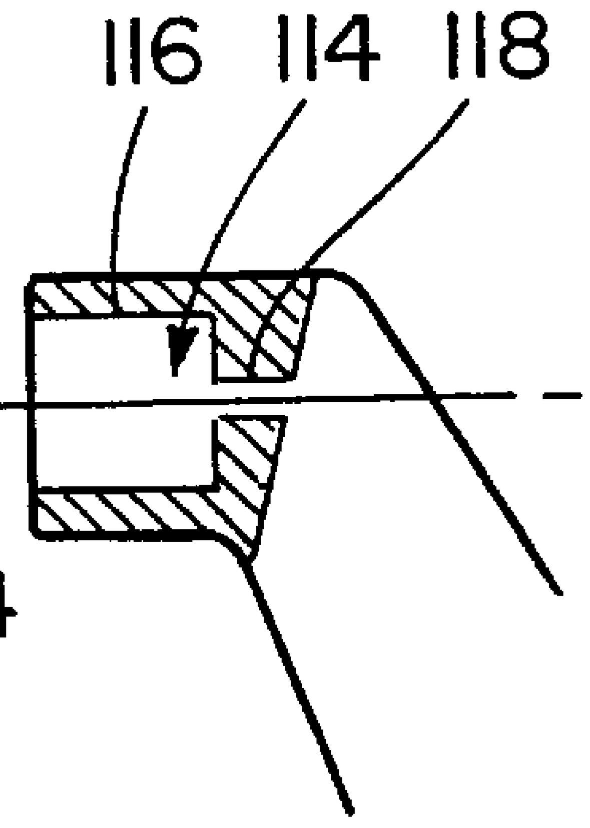


FIG. 13

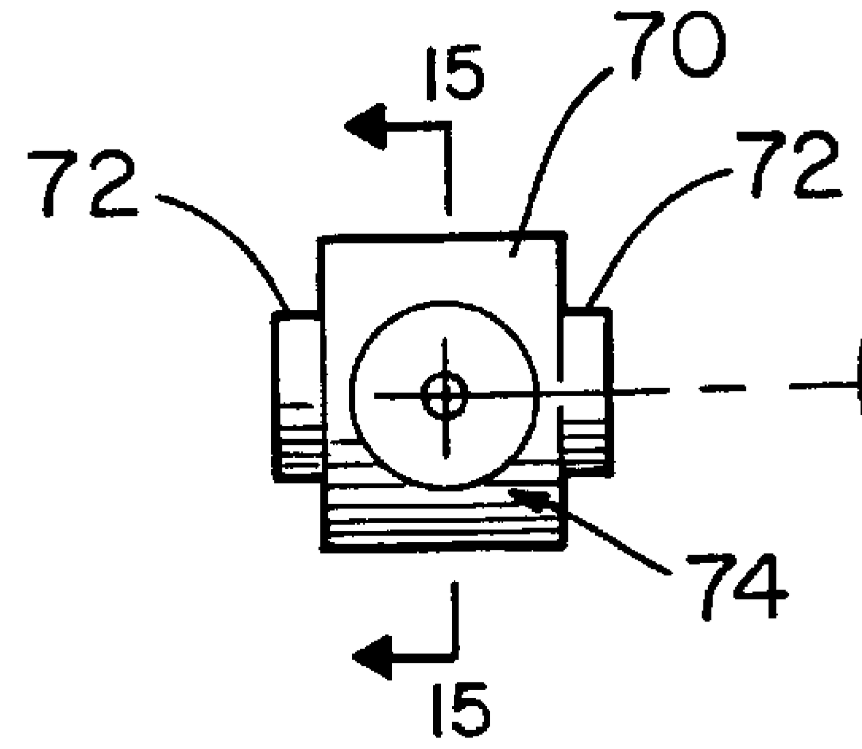


FIG. 14

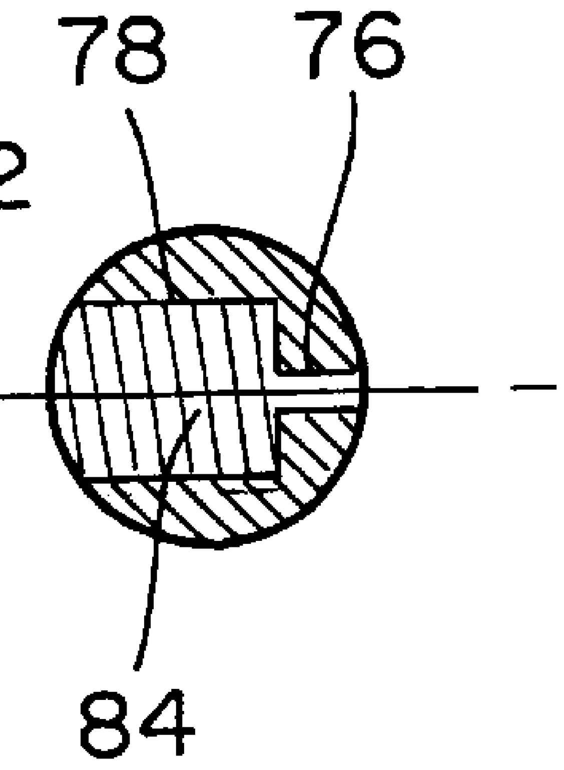


FIG. 15

LOW-FRICTION DERAILLEUR CABLE ROUTER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This application claims the benefit of U.S. Provisional application Ser. No. 60/008,167 filed Oct. 31, 1995.

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention is directed toward a guide for bicycle cables, and more particularly toward a low-friction derailleur cable router.

2. Background Art

Bicycle drive systems have been under constant redesign and refinement since bicycles were introduced over one hundred years ago. It is now common-place to have bicycles having between 1 and 24 "gears" or "speeds" allowing a bicyclist to select an appropriate gear as riding conditions change. A typical prior art rear wheel drive system is illustrated in FIG. **1**. A rear wheel **10** is mounted to a rear drop out **12** of a bicycle frame by means of an axle **14**. A hub **16** contains ball bearings or the like for providing smooth low-friction rotation of the wheel **10** about the axle **14**. Adjacent the hub **16** is a rear cluster **18** which contains a plurality of sprockets **20** of increasing diameter. A chain **22** engages a select sprocket **20** and the chain **22** can be moved between the sprockets by actuation of the rear derailleur **24**. The rear derailleur **24** is actuated by changing the tension in the derailleur cable **26** by movement of a shifter (not shown) mounted to the bicycle frame forward of the rear derailleur **24** connected to a distal end of the derailleur cable **26**. As is appreciated by almost all bicycle users, the smaller the sprockets **20** engaged by the chain **22**, the greater the amount of rotation of the wheel **10** for a given distance of chain movement.

A typical rear derailleur **24** as illustrated in FIG. **1** includes an actuator arm **28** to which the derailleur cable **26** is fixedly attached at its proximal end by means of a clamp **30** or other connecting structure. Most rear derailleurs in use today are "rear fed", meaning that the derailleur cable **26** is fed to a derailleur **24** from the rear, as is illustrated in FIG. **1**. Thus, a derailleur cable feed **32** receives the cable **26** from the rear of the derailleur. In order to facilitate the change of direction of the derailleur cable **26** from a forward portion of the bicycle to the rear of the bicycle, a flexible coupling or cable housing **34** is provided between the derailleur cable feed **32** and a stop **36** or other apparatus fixed to the bicycle frame. The cable housing **34** is flexible laterally but ridged axially. It therefore maintains the length of cable running inside of the cable housing **34**. A barrel tension adjuster **36** may be provided between one end of the cable housing **34** and the derailleur cable feed **32** for increasing or decreasing the effective length of the cable **26** to adjust the rear derailleur **24**.

Most rear derailleurs on the market and in use today are rear fed derailleurs. In addition, the use of the cable housing **34** to direct the derailleur cable **26** to the rear of the rear derailleur **24** is virtually exclusive. While the cable housing **34** has proven to be effective at routing the derailleur cable **26** in this manner, it is not without some serious drawbacks. First, as illustrated in FIG. **1** the cable housing **34** forms a rather large loop extending above and behind the rear derailleur **24**. This loop is unsightly and gives a bicycle a

decidedly "clunkly" or "low-tech" appearance. In addition, the loop formed by the cable housing **34** often becomes tangled with or snagged with obstructions during handling and riding of a bicycle. This problem is particularly acute where the bike is used for off-road applications such as mountain biking. Furthermore, even for non-off-road applications such as road racing the loop **34** provides undesirable wind drag. The cable housing **34** is also a source of considerable friction on the derailleur cable **26**. This friction increases markedly as the bike is ridden over time and dust and grit work their way inside the housing **34**. Also, as the loop is made larger increased force is required to move the cable **26**. This increased force is due to the longer friction causing surface and the fact that the resulting force applied by the derailleur cable **26** to the derailleur actuator arm **28** is dissipated by the derailleur cable **26** being directed over a wider arc.

The present invention is directed toward overcoming one or more of the problems stemming from the use of the cable housing to route a derailleur cable to a rear-fed rear derailleur.

SUMMARY OF THE INVENTION

The present invention is directed to a derailleur cable router for changing the direction of a derailleur cable operatively attached to a rear-fed rear derailleur mounted to a bicycle frame. The rear derailleur is actuated by variation of the tension applied to the derailleur cable from a direction rearward of the derailleur. The tension in the derailleur cable is controlled by a shifter attached to a distal end of the derailleur cable, the shifter being mounted to the bicycle frame forward of the derailleur. The derailleur cable includes a cable housing around at least a portion of the derailleur cable with the derailleur cable housing being fixed against lengthwise movement relative to the bicycle frame by attachment to the bicycle frame. The derailleur cable router includes a frame having a first and a second end. A housing is provided at the first end of the frame and the housing is attachable to a derailleur cable housing. A second housing is provided at the second end of the frame, the second housing being attachable to a derailleur cable feed of a rear derailleur. The first housing includes a first cable channel for receiving a derailleur cable from within a derailleur cable housing and the second housing includes a second cable channel for passing a derailleur cable to a rear derailleur cable feed. A pulley having an axis of rotation and a circumferential groove is mounted to the frame for rotation about its axis of rotation intermediate the first and second ends of the frame with the circumferential groove of the pulley aligned with the first and second cable channels so that a derailleur cable can be received in the first cable channel, engaged with a portion of the circumferential groove and passed through the second cable channel. Preferably the first cable channel, the second cable channel and the circumferential groove of the pulley all lie within substantially the same plane.

The first and second housings preferably extend the same direction normal of a plane formed by the body of the frame. The first housing may include a receiving bore coaxial with the first cable channel, the bore being sized to receive the leading end of a ferrule attached to an end of a cable housing. The second housing may have a leading surface through which the second cable channel passes, the leading surface being configured to abut a derailleur cable feed of a rear derailleur. This leading surface may be arcuate. Preferably a structure providing for brake away attachment is provided between the derailleur cable feed and the second housing. A preferred embodiment of the brake away attachment is a screw configured to be threadably received in a derailleur cable feed of a rear derailleur, the screw having a semi-spherical head received by a second bore coaxial with the second channel in the leading surface of the second housing, the screw further including an axial derailleur cable receiving passage. The brake away structure could alternatively be a spring or a length of cable housing.

Another aspect of the derailleur cable router described above has a two part frame consisting of a first leg having a proximal end and a distal end to which the first housing is attached and a second leg having a proximal end and a distal end to which the second housing is attached. The proximal ends of the first and second legs are connected by a structure providing for selective relative rotation between the first and second legs.

Another aspect of the present invention is a rear derailleur of a bicycle for mounting to a bicycle frame in operative association with a derailleur cable. The rear derailleur is actuated by variation in the amount of tension applied by a derailleur cable attached to an actuator arm of the derailleur from a direction rearward of the derailleur. The tension in the derailleur cable is controlled by a shifter attached to a distal end of the derailleur cable, the shifter being mounted to the bicycle frame forward of the derailleur. The derailleur cable includes a cable housing around at least a portion of the derailleur cable. The derailleur cable housing is attached to the frame to fix it against lengthwise movement relative to the bicycle frame. The rear derailleur comprises a frame having a first end and a housing for attachment to a derailleur cable housing and a second end integrally attached to the actuator arm of the derailleur. The housing includes a first cable channel for receiving a derailleur cable from within the derailleur cable housing from a forward direction relative to the rear derailleur and the second end of the frame includes a second cable channel for passing a derailleur cable to a cable clamp on the actuator arm of the rear derailleur. A pulley having an axis of rotation and a circumferential groove is rotatably mounted by its axis of rotation to the frame intermediate the first and second ends of the frame. The pulley is mounted so that a derailleur cable can be received in the first cable channel, engaged with a portion of the circumferential groove and passed out of the second cable channel for attachment to a cable clamp on the derailleur actuator arm.

The derailleur cable router of the present invention provides a compact structure for redirecting a derailleur cable coming from the front of a bicycle to rearwardly of a rear-feed rear derailleur. The router includes a pulley which engages the derailleur cable to provide the change of direction of the derailleur cable. The pulley provides a low friction bearing surface which all but eliminates friction forces which otherwise oppose movement of the derailleur cable. The cable router is always also very compact and rides behind the rear derailleur, virtually eliminating additional wind drag and further virtually eliminating a source of snagging with obstacles which plagued the prior art. The small turning radius of the derailleur cable router also optimizes force transmission between the derailleur cable and the derailleur, further diminishing the amount of force which must be applied to the derailleur cable in order to change the chain from engagement with a small rear sprockets to a larger rear sprockets. The cable router further includes a "break away feature" which allows the derailleur cable router to be pushed toward or away from the wheel by obstructions and the like while snapping back into the original position after the obstruction disengages the cable router. The cable router disclosed herein can also be manufactured from a small number of easily fabricated parts and requires a minimal amount of assembly. Thus, the many advantages discussed above can be provided simply and inexpensively. Moreover, the cable router can readily be attached to known rear feed rear derailleurs with a minimum of effort or could be integrally formed with a specially manufactured rear derailleur.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perpsective view which illustrates a prior art rear feed derailleur operatively attached to a bicycle frame with a derailleur cable directed to the rear of the rear feed derailleur by means of a cable housing;

FIG. **2** is a perspective view which shows the low-friction derailleur cable router of the present invention replacing the cable housing to route a derailleur cable to the rear of a conventional rear feed derailleur;

FIG. **3** is a perspective view of the low-friction derailleur cable router depicted in FIG. **2**;

FIG. **4** is an exploded perspective view of the second embodiment of the low-friction derailleur cable router depicted in FIG. **3**;

FIGS. **5–6** are partially exploded perspective views of a low-friction derailleur cable router of the present invention;

FIGS. **7–8** are perspective views of a third embodiment of the low-friction derailleur cable router of the present invention;

FIGS. **9–10** are perspective views of adjustable frames for low-friction derailleur cable routers of the present invention;

FIG. **11** is a side elevational view which illustrates the low-friction derailleur cable router of the present invention integrally formed with a rear derailleur;

FIG. **12** is a front elevational view of a cable housing attachment housing in accordance with the present invention;

FIG. **13** is a sectional view taken along line **13**—**13** of FIG. **12**;

FIG. **14** is a front elevational view of a linkage of FIGS. **3** and **4**;

FIG. **15** is a cross-sectional view of the linkage of FIG. **14** taken along line **15**—**15** of FIG. **14**; and

FIG. **16** is an elevational view of a bolt for break-away attachment of the low-friction derailleur cable router to a rear derailleur.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **2** is similar to FIG. **1**, differing only in that the low-friction derailleur cable router **40** has replaced the portion of the cable housing **34** which functions to redirect the derailleur cable **26** in rearward attachment to the actuator arm **28** of the derailleur **24**. Because of the otherwise identity in the drawings, like elements are indicated with the same reference numeral followed by a prime (') and can be understood with reference to the discussion of the prior art in FIG. **1** as set forth above in the Background Art section of this application.

As illustrated in FIG. **2**, the low-friction derailleur cable router **40** is positioned between a length of cable housing **34'** and a derailleur cable feed **32'** of the derailleur **24'**. The low-friction derailleur cable router **40** redirects the derailleur cable **26'** which extends from the forward portion of the bicycle so that the derailleur cable **26'** can be attached rearwardly of the rear derailleur **24'**.

The low-friction derailleur cable router **40** depicted in FIG. **2** is a first embodiment of the low-friction cable router described herein. This first embodiment is shown in greater detail in FIGS. **3** and **4**. The first embodiment of the low-friction derailleur cable router **40** consists of a frame **42** made up of first and second plates **44, 46**. Each of the plates **44, 46** include a first end **48** and a second end **50**, each of which has a through hole **52**. Between the first and second ends **48, 50** in the middle of each of the first and second frame plates **44, 46** is a connecting hole **54**. As seen in FIG. **4**, the connecting hole **54** in the second frame plate **46** receives a female threaded press fit nut **56** therein configured to threadably engage the threaded end of the bolt **58**. The first embodiment of the low-friction derailleur cable router **40** further includes a pulley **60** having a circumferential groove **62** in its radial edge. The circumferential groove **62** is sized to receive a standard derailleur cable **26'**. The pulley **60** includes a cartridge bearing **64** at its axis of rotation for minimizing friction as the pulley **60** is rotated. Of course, the cartridge bearing **64** could be replaced by a bushing made out of plastic or metal or some other structure which would also facilitate low-friction rotation of the pulley **60** about its axis somewhat less efficiently than a cartridge bearing, but at a lower cost than the cartridge bearing **64**. The cartridge bearing **64** includes an annular protrusion **66** on each side which extends beyond the width of the pulley **60** so that with the pulley **60** sandwiched between the first and second frame plates **44, 46** the annular protrusion **66** contacts the plates **42, 44** and the pulley **60** is free to rotate without interference from the plates **42, 44**. Sandwiched between the annular protrusions **66** of the cartridge bearing **64** on the side of the pulley **60** are washers **68**. The washers **68** function as spacers to further separate the plates **44, 46** from the pulley **60**. Also sandwiched between the plates **44, 46** are a pair of linkages **70**, each of which is identical in shape. Each linkage **70** includes an annular boss **72** on each side sized to be snugly received in the through holes **52**, as best seen in FIG. **3**.

FIG. **14** is a front elevational view of the linkages **70**. Each linkage has a counter sunk bore **74** which includes a smaller diameter cable channel **76** coaxial with a receiving bore **78**. The body of the linkage **70** is preferably cylindrical.

FIG. **4** illustrates the "sandwiched" assembly of the first embodiment of the low-friction cable derailleur **40**. Once assembled, the linkages **70** can be rotated about their axis to redirect the opening of the receiving bore **78** so as to fit a variety of directions of feed of the derailleur cable **26'**. More particularly, referring to FIG. **2**, as illustrated the derailleur cable **26'** runs along the chain stay **80**. Some bicycles run the derailleur cable **26'** along the seat stay **82**. Merely by rotating the linkage **70** associated with the first end **48** of the frame **42** the low-friction cable router **40** may be properly aligned, regardless of whether the derailleur cable is fed along the seat or chain stay.

The interior of the receiving bore **78** may be threaded as indicated at **84** of FIG. **15**. Internal threading of the receiving bore **78** allows for threaded engagement with the barrel tension adjuster **36'**. As understood by those skilled in the art, this allows for adjusting the tension in the cable **26'** to fine tune or adjust the rear derailleur **24'**.

The low-friction derailleur cable router is depicted mounted between a derailleur and a cable housing in FIG. **2**. The low-friction derailleur cable router **40** is attached to the rear derailleur by sizing the cable housing **34** lengthwise so that the end of the cable housing **34** is above but at approximately the same point as the derailleur cable feed **32'**. The barrel tension adjuster **36'** is threadably engaged in the receiving bore **78** of the upper linkage **70** and the cable **26** is fed through the tension adjuster **36'**, into the receiving bore **78** and cable channel **76** of the upper linkage **70**, into the circumferential groove **62** of the pulley **60**, around the pulley **60**, into the cable channel **76** of the lower linkage, out the receiving bore **78** of the lower linkage, through the derailleur cable feed **32'** of the rear derailleur **24'** and attached to the clamp **30'** on the actuator arm **28'** of the rear derailleur. The forward bias of the derailleur maintains tension in the cable **26'** which holds the low-friction derailleur cable router **40** in the position illustrated in FIG. **2**. Because there is no rigid connection between the lower linkage **70** and the derailleur, the low-friction derailleur cable router **40** can be deflected inward and outward as illustrated by the arrow **84** of FIG. **2**. Once the force causing the deflection is removed, the low-friction derailleur cable router **40** snaps back into its original position due to the tension in the derailleur cable **26'**.

Instead of merely having the lower linkage **70** abut the derailluer cable feed **32** as illustrated in FIG. **2**, it may be desirable to provide a structure for break-away attachment between the derailluer cable feed **32'** and the lower linkage **70**. In a preferred embodiment, this break-away attachment may be one of the embodiments illustrated in FIG. **5** discussed in greater detail below. Alternatively, the structure for break-away attachment may be the bolt **88** illustrated in FIG. **16**. The bolt **88** has a semi-spherical head **90** with an annular flange **90** at its base and an axial derailluer cable receiving passage **92**. The bolt **88** is threadably engaged in a threaded bore (not shown) of the derailluer cable feed **32'**. The semi-circle head **90** is received in the receiving bore **78** of the lower linkage **70**. This break-away attachment structure helps facilitate proper alignment of the low-friction cable router relative to the rear derailluer following displacement is indicated by the arrow **84** of FIG. **2**.

FIG. **5** illustrates a second embodiment of the low-friction derailluer cable router **96**. The second embodiment has an essentially C-shaped frame **98** having a first end **100** corresponding to the top of the C and a lower end **102** corresponding to the bottom end of the C. A first housing **104** extends a direction normal to the C-shaped frame at the top **100** of the frame and a second housing **106** extends the same direction normal to the frame **98** at the second end of the frame **102**. As with the first embodiment **40** discussed above, a pulley **108** having a circumferential groove **110** in its radial edge is mounted for rotation to the frame **98** intermediate the first and second ends **100, 102**. The pulley **108** may be identical in all respects to the pulley **60**. A bolt **112** secured by a nut (not shown) mounts the pulley. Washers and the like may be used as described with the first embodiment **40**. Referring to FIG. **12**, each of the upper and lower housings **104, 106** have a counter sunk bore **114** which includes a large diameter receiving bore **116** and a small diameter cable channel **118**.

The second embodiment **96** illustrated in FIG. **5** functions similarly to the first embodiment **40** in FIGS. **3** and **4**. The receiving bore **116** of the first housing **104** is sized to receive the leading edge **120** of a ferrule **112** at the end of a length of cable housing **34'**. The leading surface **124** of the second housing **106** may abut directly the barrel tension adjuster **36'** on a rear derailluer **24'**. In a preferred form of the second embodiment, a break-away attachment structure is provided which fits within the receiving bore **116** of the second housing **106** and within a similarly sized cavity in the leading surface **126** of the barrel adjuster **36'**. The break-away attachment structure may be one of a length of cable housing **128**, a coil spring **129** or male/female cone segments **130**. The length of cable housing **128** is shown with a piece of the casing **132** removed to reveal a coil **134** which underlies the casing **132**. Each of the length of cable housing, male/female cone segments and the coil spring include a passage **136** through which the derailluer cable **26'** passes. The break-away attachment structures help keep the low-friction cable router **96** properly aligned following deflection of the low-friction cable router should it be struck by an obstruction or the like in the same manner described above with respect to the first embodiment of the low-friction derailluer cable router **40**. The second embodiment **96** is also held in position by tension in the derailleur cable **26'** created by the derailluer **24'** and the cable **26'** is fed through the second embodiment **96** in the same manner as discussed above with respect to the first embodiment **40**.

The second embodiment **96** illustrated in solid lines in intended for use where the derailluer cable **26'** is run along the chain stay **80** as seen in FIG. **2**. The angle between the legs of the frame **98** is approximately 15°. For those cycles where the derailluer cable **26'** runs along the seat stay **82**, a more open frame, illustrated by the ghost lines **136** is contemplated, where the angle between the legs is about 60°. Except for the wider angle, this embodiment is identical to the second embodiment **96**. The present invention contemplates an angle between the legs ranging between 0° of 90°.

FIG. **6** illustrates a modified and preferred version of the second embodiment of the low-friction cable router **96**. This version includes internal female threads **140** in the receiving bore **116** of the first housing **104**. In addition, the break-away structure in this embodiment is the bolt **88** illustrated in FIG. **16** featuring the semi-spherical head **90**. The semi-spherical head **90** is received within the receiving bore **116** of the second housing **106**. The embodiment in FIG. **6** further differs in that the leading surface **124'** of both first and second housings **104, 106** is arcuate. The female threads **140** are configured to threadably engage the threaded conduit **142** which is part of the barrel tension adjuster **36'**. The barrel adjuster **36'** shown in FIG. **6** includes an alignment ring **144** having four 90° radially spaced projections **146**. As appreciated by those skilled in the art, these projections are intended to be received in grooves in the abutting surface of the derailluer cable feed **32'** of the rear derailluer **24'** to index adjustment of the barrel tension adjuster. However, with the tension adjuster **36'** moved from threaded engagement with the derailluer cable feed **32'** to threaded engagement with the first housing **104** as depicted in FIG. **6**, the spaces between the projections **146** receive the arcuate leading surface **124** of the second embodiment of the low-friction cable router **96** depicted in FIG. **6** to provide the same indexing as was provided by engagement of the projections **146** with the grooves of the derailluer cable feed **32'**. An advantage of the arcuate leading surface **124'** of the second housing **106** is that because the angle between the derailluer cable feed **32'** and the chain stay **80** of various bicycles may change, the arcuate surface as opposed to a flat surface will provide a more constant cable length between the derailleur and the pulley. That is, the arcuate surface will "roll" up or down with the semi-spherical head **90** of the bolt **88** received in the receiving bore **116**, providing a smooth, continuous, connection as opposed to a space that would result if the leading surface **124'** was flat as illustrated in FIG. **5**. In addition, this connection is more aesthetically pleasing to observers.

FIGS. **7** and **8** illustrate an alternative embodiment **96'** of the second embodiment of the low-friction cable router **96** illustrated in FIGS. **5** and **6**. This embodiment provides a second wall **150** as part of the C-shaped frame **98**. In all other respects, this embodiment is identical to that shown in FIG. **5** and may include the modifications illustrated in and discussed with respect to FIG. **6**. FIG. **8** merely shows the "open C" configuration of the frame **98** illustrated by the ghost lines **136** of FIG. **5**.

FIG. **9** illustrates a third alternative embodiment of the low-friction cable router **150**. This third embodiment is similar to the embodiment shown in FIG. **5**, only the frame **98** is broken into separate first and second legs **152, 154**. Each of the legs **152, 154** includes a connection hole **156** with annular knurling **158** surrounding the connecting hole **156**. The bolt **112** (not shown in FIG. **9**) fits through the connection holes **156** and holds the first and second legs **152, 154** juxtaposed with the knurled surfaces in engagement. The knurled surfaces help hold the first and second legs at a selected rotative position. By loosening the bolt **112** the knurling can be disengaged and the first and second legs rotated relative to one another as indicated by the arrow **160** to assume a different relative orientation as illustrated by the phantom first leg **152'**. In all other manners the third embodiment **150** is identical to the second embodiment **94** illustrated in FIGS. **5** and **6** and may include the various modifications discussed above.

FIG. **10** is a fourth embodiment of the low-friction cable router **170**. This embodiment is similar to the second embodiment **96'** illustrated in FIGS. **7** and **8** with the frame **98** divided into first and second legs **172, 174**. Each of the legs **172, 174** includes a connecting hole **156** for receiving a bolt **112** (not shown in FIG. **10**). The second leg includes a pair of locking holes **176** radially spaced from the connecting hole **156**. The first leg **172** includes a receptor hole (not shown) which can be brought into and out of alignment with the various locking holes **156** to change the relative position of the first and second legs to accommodate different bicycles where the derailluer cable **26'** may be fed along either the stay **80** or the seat stay **82**. A pin **178** is received in one of the locking hole **156** or a receptor hole when aligned to maintain the legs in the select position.

FIG. **11** illustrates a fifth embodiment of the low-friction cable router **180** wherein it is integrally formed with the rear derailluer **24'**. In this embodiment the router frame **182** is formed as part of the rear derailluer **24'** frame and the derailluer cable feed is combined with the second housing of the cable router. Although not shown in FIG. **11**, a barrel tension adjuster could be provided in operative association with the first cable housing **186** in the manner illustrated in FIGS. **2** and **6**.

What is claimed is:

1. A derailleur cable router for changing the direction of a derailleur cable operatively attached to a rear derailleur mounted to a bicycle frame, the rear derailleur being actuated by variation in tension applied by the derailleur cable from a direction rearward of the derailleur, the tension in the derailleur cable being controlled by a shifter attached to a distal end of the derailleur cable, the shifter being mounted to the bicycle frame forward of the derailleur, the derailleur cable including a cable housing around at least a portion of the derailleur cable, the derailleur cable housing being attached to the bicycle frame to fix the cable housing against lengthwise movement relative to the bicycle frame, the derailleur cable router comprising:

a frame having at a first end means for attachment to a derailleur cable housing and at a second end means for attachment to a derailleur cable feed of a rear derailleur, the means for attachment to a derailleur cable housing including a first cable channel for receiving a derailleur cable from within a derailleur cable housing and the means for attachment to a rear derailleur cable feed including a second cable channel for passing a derailleur cable to a rear derailleur cable feed;

a pulley wheel having an axis of rotation and a circumferencial groove; and

means for mounting the pulley wheel by its axis of rotation to the frame for rotation relative to the frame intermediate the first and second ends of the frame with the circumferencial groove of the pulley aligned with the first and second cable channels so that a derailleur cable can be received in the first cable channel, engaged with a portion of the circumferencial groove and passed through the second cable channel.

2. The derailleur cable router of claim **1** wherein the first cable channel, the second cable channel and the circumferencial groove of the pulley lie in substantially the same plane.

3. The derailleur cable router of claim **1** wherein the frame comprises a C shaped plate with the first end at the top of the C and the second end at the bottom of the C.

4. The derailleur cable router of claim **1** wherein the means for attachment to a derailleur cable housing comprises a first housing extending from the first end of the plate a direction normal to the plate, the first housing containing the first cable channel and having a bore coaxial with the first cable channel, the bore being sized to receive a leading end of a ferrule attached to an end of a cable housing and the means for attachment to a derailleur cable feed of a rear derailleur comprises a second housing extending from the second end of the plate the direction normal to the plate, the second housing containing the second cable channel and having a leading surface through which the second cable channel passes, the leading surface being configured to abut a derailleur cable feed of a rear derailleur.

5. The derailleur cable router of claim **4** wherein the means for attachment to a derailleur cable feed of a rear derailleur further comprises a second bore coaxial with the second cable channel, the second bore being sized to receive a means for break-away attachment between a derailleur cable feed and the second housing.

6. The derailleur cable router of claim **5** wherein the means for break-away attachment comprises a screw configured to be threadably engaged with a derailleur cable feed of a rear derailleur, the screw having a semispherical head received by the second bore, the screw further including an axial derailleur cable receiving passage.

7. The derailleur cable router of claim **5** wherein the means for break-away attachment comprises a coil spring.

8. The derailleur cable router of claim **5** wherein the means for break-away attachment comprises a length of cable housing.

9. The derailleur cable router of claim **4** wherein the bore of the means for attachment to a derailleur cable housing is internally threaded in a manner to threadably engage male threads of a barrel cable length adjuster attached to an end of a cable housing.

10. The derailleur cable router of claim **1** wherein the frame further comprises a first leg having a proximal end and a distal end to which the means for attachment to a derailleur cable housing is attached and a second leg having a proximal end and a distal end to which the means for attachment to a derailleur cable feed of a rear derailleur is attached, the proximal ends of the first and second legs being connected by connection means for selectively allowing relative rotation between the first and second legs.

11. The derailleur cable router of claim **10** wherein the proximal ends of the first and second legs each have a knurled portion around a connecting hole and the proximal ends are juxtaposed with the knurled portions in abutment.

12. The derailleur cable router of claim **10** wherein the connection means comprises a bolt through the connecting holes threadably engaging a nut.

13. The derailleur cable router of claim **10** wherein the proximal ends of the first and second legs each have a connecting hole coaxial with the axis of rotation of the pulley, the proximal ends of the first and second legs being juxtaposed with their respective connecting holes aligned and the connection means comprises means holding the legs together for rotation about their connection holes and one of the first and second legs having at least two locking holes radially spaced from the connecting holes and the other of the first and second legs having a receptor hole radially spaced a like distance, the legs being rotatable about the connection holes to selectively bring each locking hole into alignment with the receptor hole, and a pin axially received in an aligned locking hole and receptor hole, the pin being removable to allow another locking hole to be brought into alignment with the receptor hole whereupon the pin can be reinserted to hold the legs in a new select relative position.

14. A rear derailleur of a bicycle for mounting to a bicycle frame in operative association with a derailleur cable, the rear derailleur being actuated by variation in tension applied by the derailleur cable attached to an actuator arm of the derailleur from a direction rearward of the derailleur, the tension in the derailleur cable being controlled by a shifter attached to a distal end of the derailleur cable, the shifter being mounted to the bicycle frame forward of the derailleur, the derailleur cable including a cable housing around at least a portion of the derailleur cable, the derailleur cable housing being attached to the frame to fix it against lengthwise movement relative to the bicycle frame, the rear derailleur comprising:

a frame having at a first end means for attachment to a derailleur cable housing and a second end integrally attached to the actuator arm of the derailleur, the means for attachment to a derailleur cable housing including a first cable channel for receiving a derailleur cable from within the derailleur cable housing and the second end of the frame including a second cable channel for passing a derailleur cable to a means for securing a derailleur cable on the actuator arm of the rear derailleur;

a pulley wheel having an axis of rotation and a circumferencial groove; and

means for mounting the pulley wheel by its axis of rotation to the frame rotation relative to the frame intermediate the first and second ends of the frame with the circumferencial groove of the pulley aligned with the first and second cable channels so that a derailleur cable can be received in the first cable channel, engaged with a portion of the circumferencial groove and passed out of the second cable channel for attachment to the means for securing a derailleur cable.

15. The rear derailleur of claim **14** wherein the means for attachment to a derailleur cable housing comprises a first housing extending from the first end of the plate a direction normal to a plane within which the plate lies, the first housing containing the first cable channel and having a bore coaxial with the first cable channel, the bore being sized to receive a leading end of a ferrule attached to an end of a cable housing.

16. The rear derailleur of claim **15** wherein the bore contains internal threads sized to receive male threads of a barrel cable tension adjuster at an end of a cable housing.

17. The rear derailleur of claim **14** wherein the first cable channel, the second cable channel and the circumferencial groove of the pulley lie in substantially the same plane.

18. A derailleur cable router for changing a direction of a derailleur cable having a cable housing surrounding at least a portion of the derailleur cable, wherein the derailleur cable router comprises:

a frame;

a pulley mounted on the frame for rotation around a pulley axis; and

a housing support pivotably supported on the frame for supporting the cable housing relative to the pulley so that the housing support pivots around a housing support axis spaced apart from the pulley axis.

19. The derailleur cable router according to claim 18 wherein the housing support axis is disposed radially outwardly from an outer peripheral surface of the pulley.

20. The derailleur cable router according to claim 18 wherein the housing support pivots around an axis generally parallel to the pulley axis.

21. The derailleur cable router according to claim 18 wherein the housing support includes a receiving bore for supporting the cable housing and a cable channel for receiving the derailleur cable therethrough.

22. The derailleur cable router according to claim 21 wherein the receiving bore has a threaded inner peripheral surface.

23. The derailleur cable router according to claim 21 further comprising a tension adjuster disposed on the housing support.

24. The derailleur cable router according to claim 21 wherein a diameter of the receiving bore is greater than a diameter of the cable channel.

25. The derailleur cable router according to claim 24 wherein the housing support has a substantially cylindrical shape.

26. The derailleur cable router according to claim 18 wherein the frame includes a first frame member extending radially outwardly from the pulley axis and terminating at a first frame member first end, and wherein the housing support is pivotably mounted at the first frame member first end.

27. The derailleur cable router according to claim 26 wherein the frame includes a second frame member extending radially outwardly from the pulley axis generally parallel to the first frame member and terminating at a second frame member first end, and wherein the housing support is pivotably mounted at the second frame member first end.

28. The derailleur cable router according to claim 26 wherein the first frame member extends radially outwardly from the pulley axis and terminates at a first frame member second end.

29. The derailleur cable router according to claim 28 further comprising a derailleur interfacing member disposed on the first frame member second end.

30. The derailleur cable router according to claim 29 wherein the derailleur interfacing member includes a cable channel for receiving the derailleur cable therethrough.

31. The derailleur cable router according to claim 30 wherein the derailleur interfacing member is pivotably mounted to the first frame member second end.

32. The derailleur cable router according to claim 31 wherein the derailleur interfacing member has a substantially cylindrical shape.

33. The derailleur cable router according to claim 28 wherein the frame includes a second frame member extending radially outwardly from the pulley axis generally parallel to the first frame member and terminating at a second frame member first end, and wherein the housing support is pivotable mounted at the second frame member first end.

34. The derailleur cable router according to claim 33 further comprising a derailleur interfacing member disposed on the first frame member second end.

35. The derailleur cable router according to claim 34 wherein the derailleur interfacing member includes a cable channel for receiving the derailleur cable therethrough.

36. The derailleur cable router according to claim 35 wherein the derailleur interfacing member is pivotably mounted to the first frame member second end.

37. The derailleur cable router according to claim 36 wherein the derailleur interfacing member has a substantially cylindrical shape.

38. The derailleur cable router according to claim 35 wherein the second frame member extends radially outwardly from the pulley axis and terminates at a second frame member second end.

39. The derailleur cable router according to claim 38 wherein the derailleur interfacing member is disposed between the first frame member second end and the second frame member second end.

40. The derailleur cable router according to claim 39 wherein the derailleur interfacing member is pivotably mounted between the first frame member second end and the second frame member second end.

41. A derailleur cable router for changing a direction of a derailleur cable having a first cable housing surrounding at least a portion of the derailleur cable, wherein the derailleur cable router comprises:

a pulley support;

a pulley mounted on the pulley support for rotation around a pulley axis;

wherein the pulley support includes:

a first portion extending radially outwardly from the pulley axis for supporting the first cable housing;

a second portion extending radially outwardly from the pulley axis; and

a movable derailleur interfacing mechanism disposed at the second portion, wherein the derailleur interfacing mechanism includes a convex member slidably engaging a concave member; and

wherein the pulley includes a cable receiving groove for receiving the derailleur cable from the first portion and for outputting the derailleur cable to the second portion.

42. A derailleur cable router for changing a direction of a derailleur cable having a first cable housing surrounding at least a portion of the derailleur cable, wherein the derailleur cable router comprises:

a pulley support;

a pulley mounted on the pulley support for rotation around a pulley axis;

wherein the pulley support includes:

a first portion extending radially outwardly from the pulley axis for supporting the first cable housing;

a second portion extending radially outwardly from the pulley axis; and

a movable derailleur interfacing mechanism including a coil spring disposed at the second portion; and

wherein the pulley includes a cable receiving groove for receiving the derailleur cable from the first portion and for outputting the derailleur cable to the second portion.

43. A derailleur cable router for changing a direction of a derailleur cable having a first cable housing surrounding at least a portion of the derailleur cable, wherein the derailleur cable router comprises:

a pulley support;

a pulley mounted on the pulley support for rotation around a pulley axis;

wherein the pulley support includes:

a first portion extending radially outwardly from the pulley axis for supporting the first cable housing;

a second portion extending radially outwardly from the pulley axis; and

a derailleur interfacing mechanism pivotably mounted to the second portion of the pulley support; and

wherein the pulley includes a cable receiving groove for receiving the derailleur cable from the first portion and for outputting the derailleur cable to the second portion.

44. The derailleur cable router according to claim 43 wherein the derailleur interfacing mechanism has a substantially cylindrical shape.

45. A derailleur operated by a derailleur cable having a cable housing surrounding at least a portion of the derailleur cable, the derailleur comprising:

a base member including:

a mounting portion for mounting the derailleur to a bicycle frame, the mounting portion having a laterally extending mounting axis; and

a cable feed portion defining a cable feed opening having a longitudinal cable feed axis oriented differently from the mounting axis;

a movable member supporting a chain guide;

an actuating arm coupled between the base member and the movable member so that the movable member moves relative to the base member;

a cable housing support supported on the base member and spaced apart from the cable feed portion for supporting an end of the cable housing;

a pulley rotatably mounted to the base member, wherein the pulley includes:

a rotational axis oriented generally parallel to the mounting axis; and

a cable receiving groove for receiving the derailleur cable from the cable housing support and for outputting the derailleur cable to the cable feed opening.

46. The derailleur according to claim 45 wherein the cable feed portion is one-piece with the mounting portion.

47. The derailleur according to claim 45 wherein the cable housing support includes a threaded bore for receiving a tension adjuster.

48. The derailleur according to claim 45 wherein the cable housing support includes a first cable channel, wherein the cable feed portion includes a second cable channel defining the cable feed opening, and wherein first cable channel, the second cable channel and the cable receiving groove of the pulley lie in substantially the same place.

49. A derailleur operated by a derailleur cable having a cable housing surrounding at least a portion of the derailleur cable, the derailleur comprising:

a base member;

a movable member supporting a chain guide;

an actuating arm coupled between the base member and the movable member so that the movable member moves relative to the base member;

a derailleur cable router coupled to the base member including:

a cable router frame;

a pulley mounted to the cable router frame for rotation around a pulley axis;

a cable housing support coupled to the cable router frame for supporting the cable housing relative to the pulley; and

wherein the cable router frame is movably coupled to the base member so that the pulley deflects relative to the derailleur in response to a force applied to the cable router frame.

50. The derailleur according to claim 49 wherein the base member includes a cable feed defining a cable feed opening, and wherein the derailleur cable router is coupled to the cable feed.

51. The derailleur according to claim 50 wherein the cable router frame includes:

a first portion extending radially outwardly from the pulley axis and supporting the cable housing support; and

a second portion extending radially outwardly from the pulley axis for coupling to the cable feed.

52. The derailleur according to claim 51 further comprising a derailleur interfacing mechanism disposed between the second portion of the cable router frame and the cable feed.

53. The derailleur according to claim 52 wherein the derailleur interfacing mechanism includes a cable channel communicating with the cable feed opening for receiving the derailleur cable therethrough.

54. The derailleur according to claim 53 wherein the derailleur interfacing mechanism is pivotably mounted to the second portion of the cable router frame.

55. The derailleur according to claim 54 wherein the derailleur interfacing mechanism has a substantially cylindrical shape.

56. The derailleur according to claim 52 wherein the derailleur interfacing mechanism includes a length of cable housing disposed between the second portion of the cable router frame and the cable feed.

57. The derailleur according to claim 52 wherein the derailleur interfacing mechanism includes a convex member disposed between the second portion of the cable router frame and the cable feed.

58. The derailleur according to claim 52 wherein the derailleur interfacing mechanism includes a concave member disposed between the second portion of the cable router frame and the cable feed.

59. The derailleur according to claim 52 wherein the derailleur interfacing mechanism includes:

a convex member disposed between the second portion of the cable router frame and the cable feed;

a concave member disposed between the second portion of the cable router frame and the cable feed; and

wherein the convex member slidingly engages the concave member.

60. The derailleur according to claim 52 wherein the derailleur interfacing mechanism includes a coil spring disposed between the second portion of the cable router frame and the cable feed.

61. The derailleur according to claim 49 wherein the base member includes a cable feed defining a cable feed opening for receiving the derailleur cable therethrough.

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