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Huang et al.

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(54) **ONE-WAY WRENCH SWITCHABLE BETWEEN TWO MODES**

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B25B 13/48 (2006.01)

(52) **U.S. Cl.**
CPC ***B25B 13/467*** (2013.01); ***B25B 13/466*** (2013.01); ***B25B 13/481*** (2013.01)

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USPC 81/58.1, 58, 58.3, 60, 61, 63.2, 57.39
See application file for complete search history.

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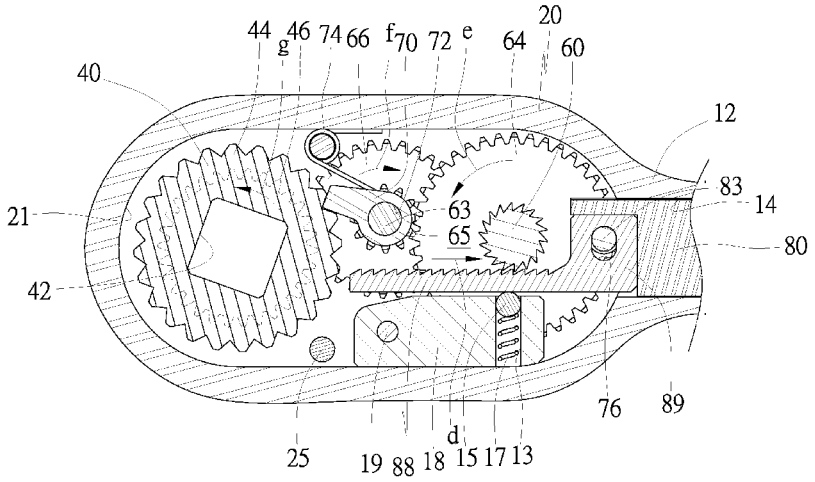
Primary Examiner — Hadi Shakeri

(57) **ABSTRACT**

A one-way wrench includes a handle, a toothed wheel, a detent, a rod and a gear train. The handle includes a shank and a head. The head is formed at an end of the shank and includes a chamber in communication with the tunnel. The toothed wheel is rotationally inserted in the chamber of the head. The detent is pivotally connected to the head and elastically engaged with the toothed wheel so that the head rotates the toothed wheel in a one-way manner. The rod is movable in the tunnel of the shank in a reciprocated manner. The gear train is arranged between the rod and the toothed wheel to convert the reciprocating of the rod to on-and-off rotation of the toothed wheel.

15 Claims, 17 Drawing Sheets



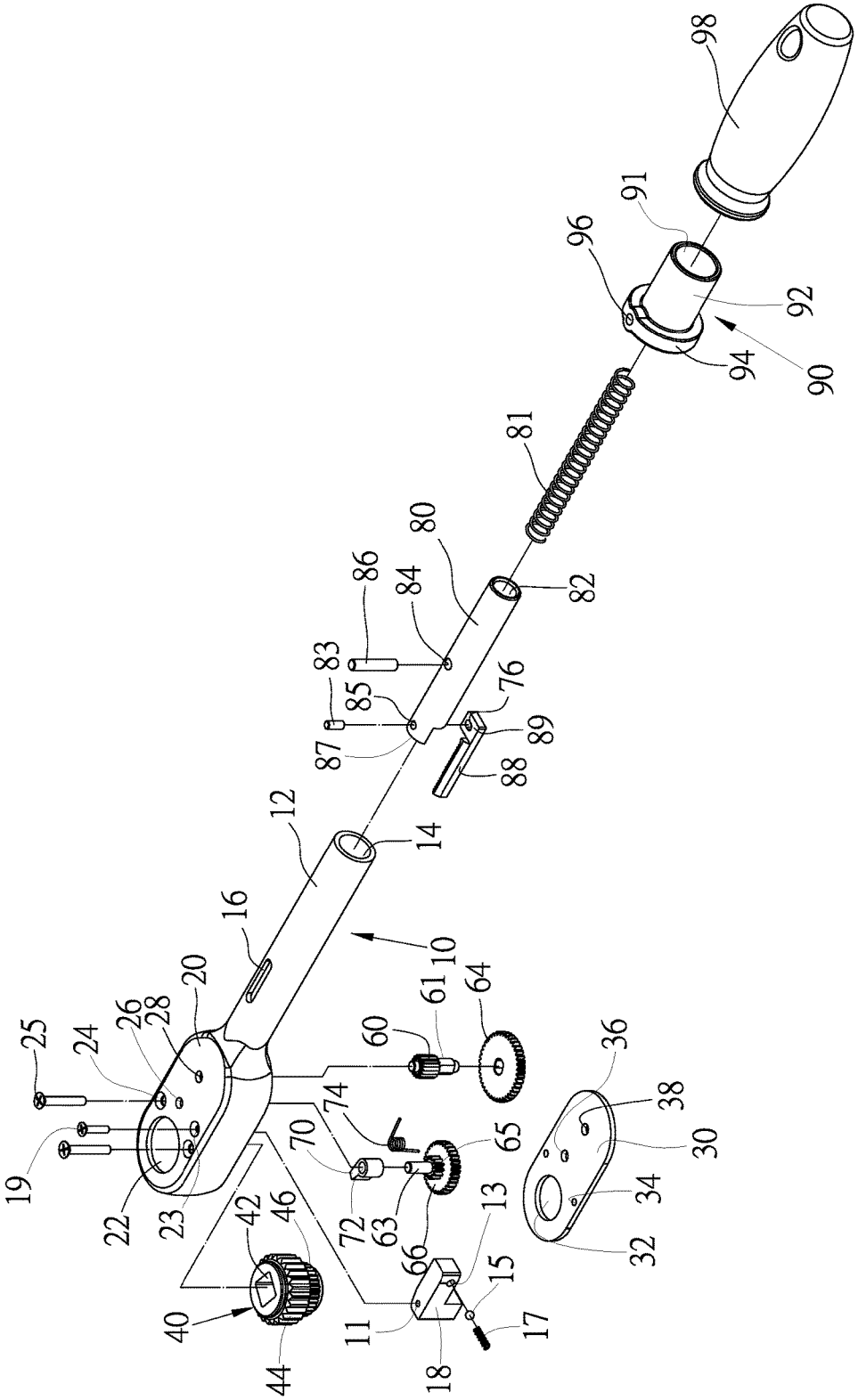

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FIG.1

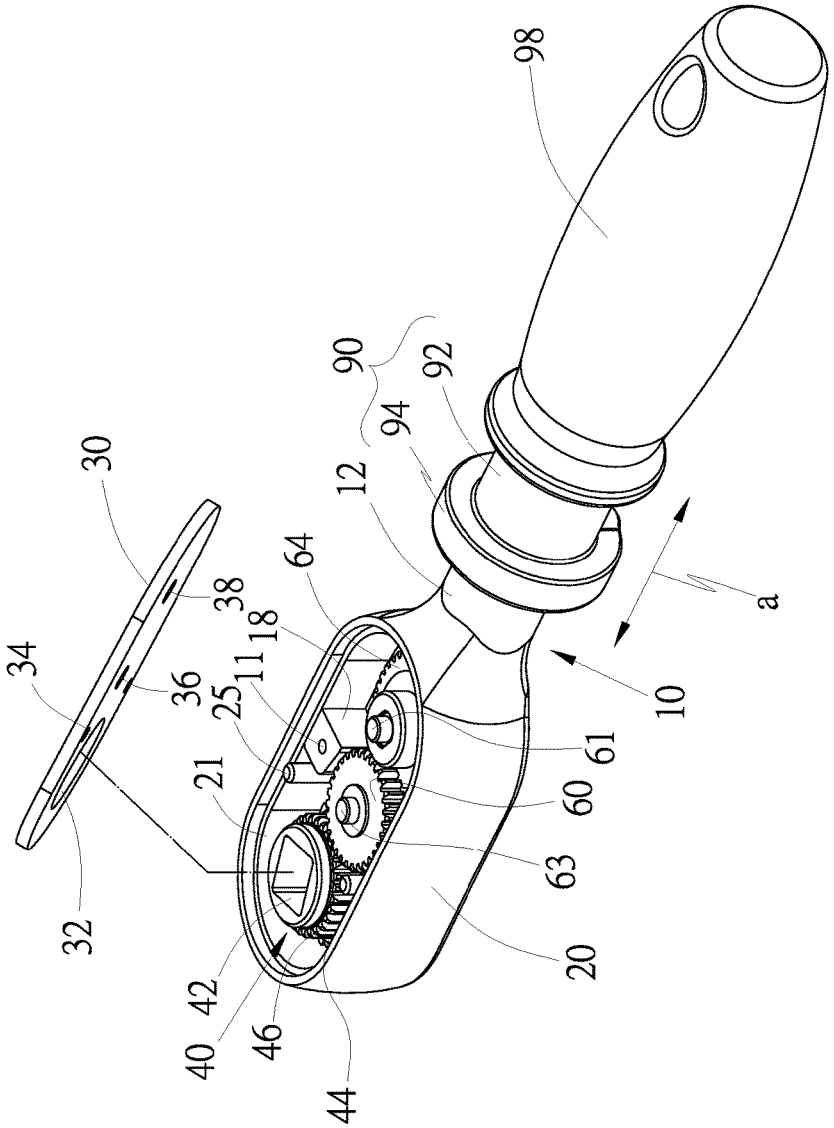


FIG.2

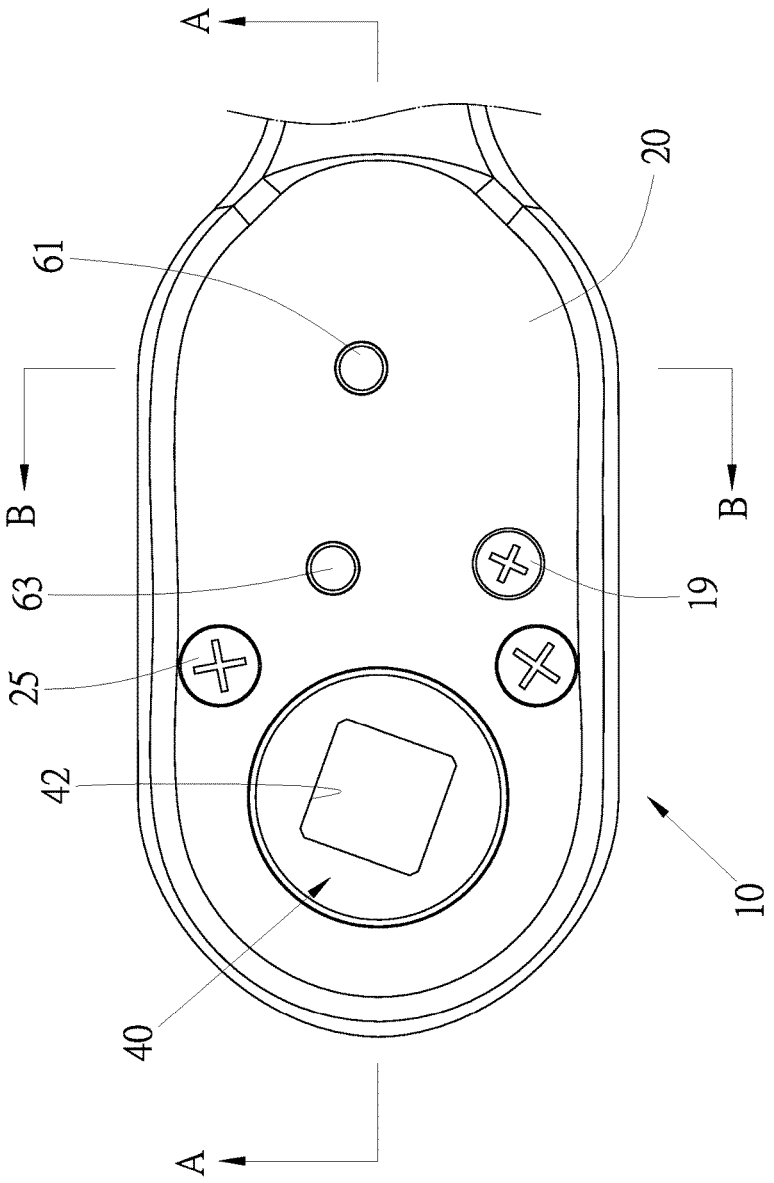


FIG.3

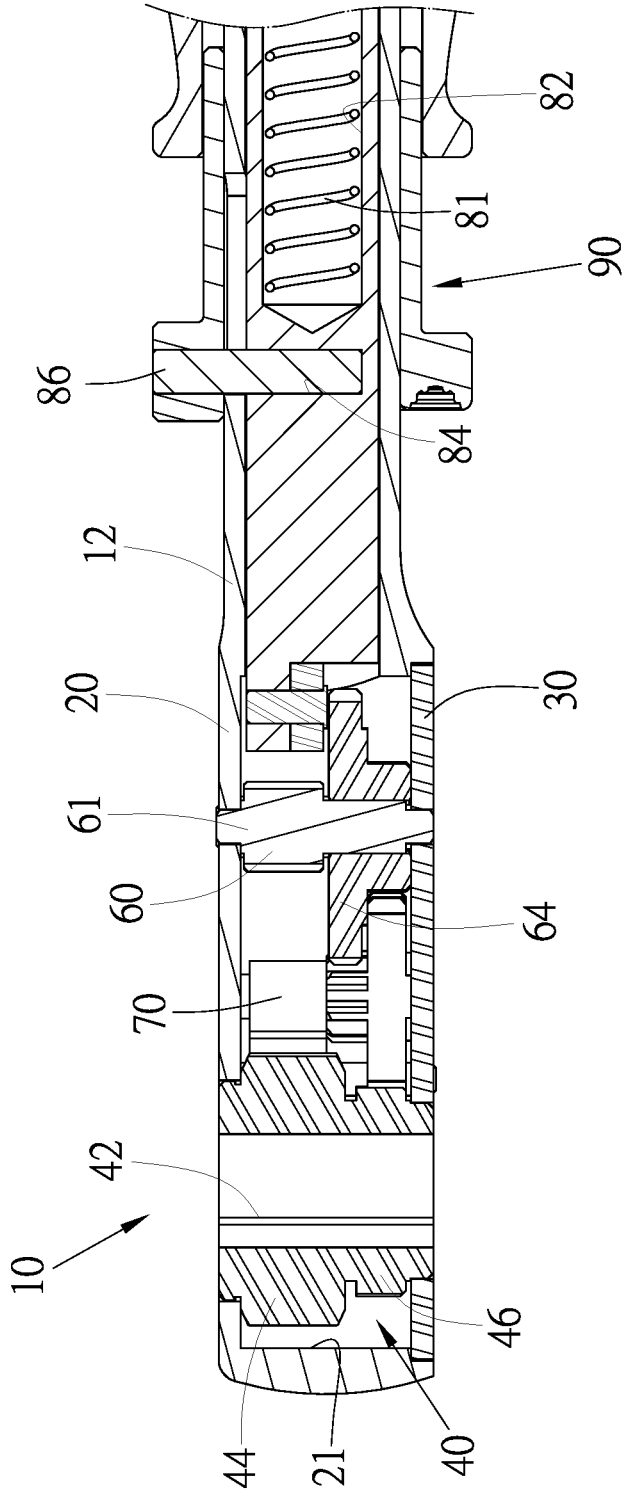


FIG.4

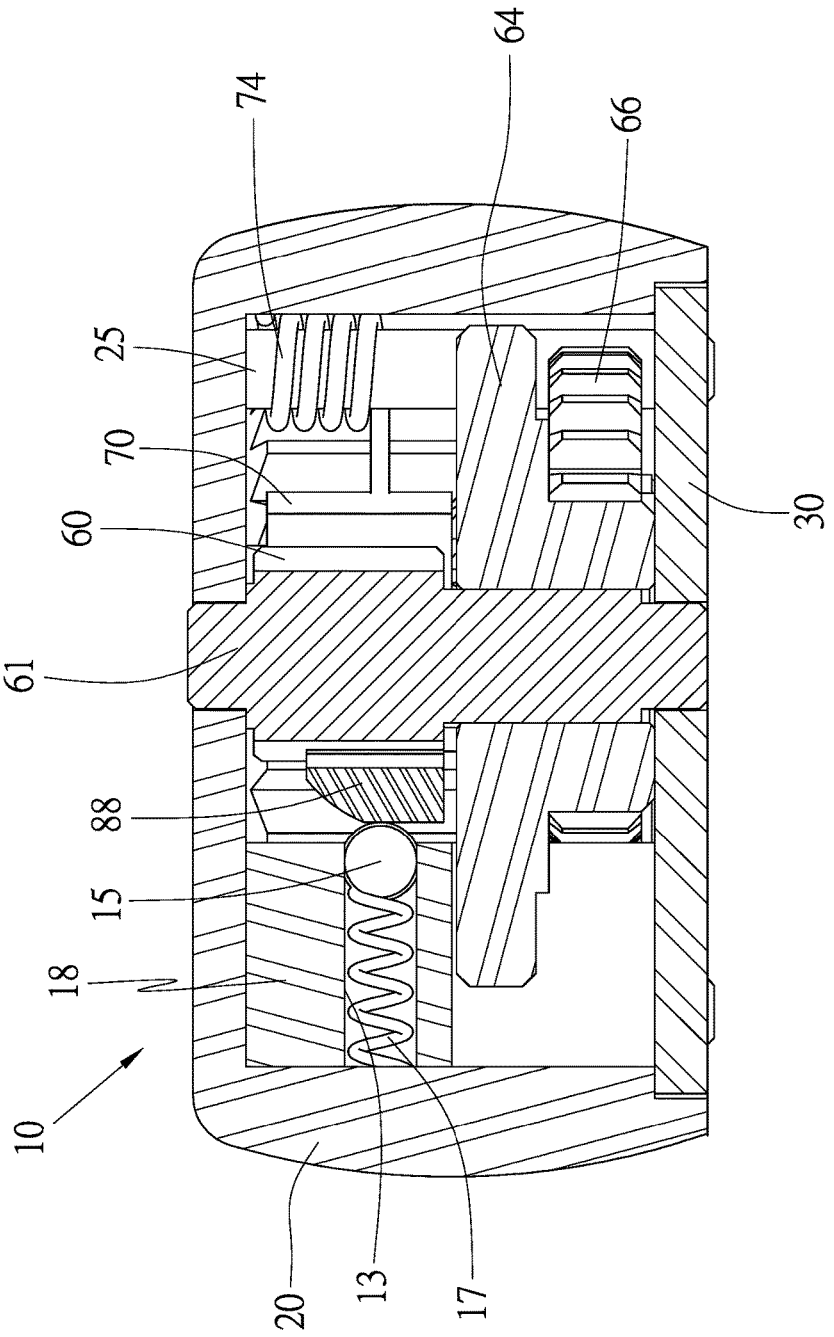


FIG.5

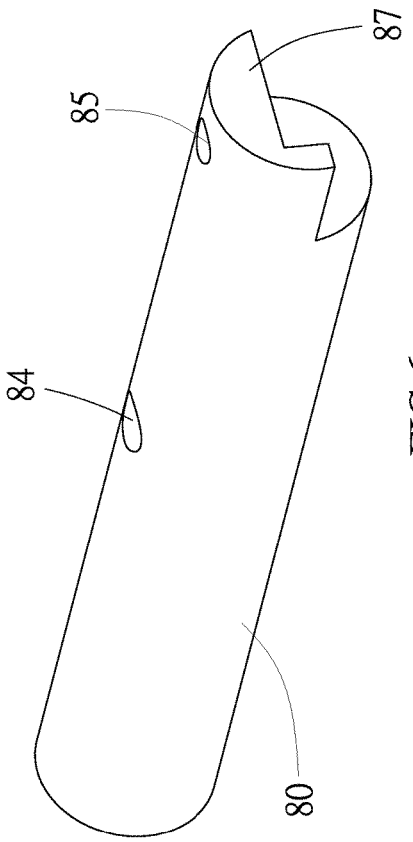


FIG.6

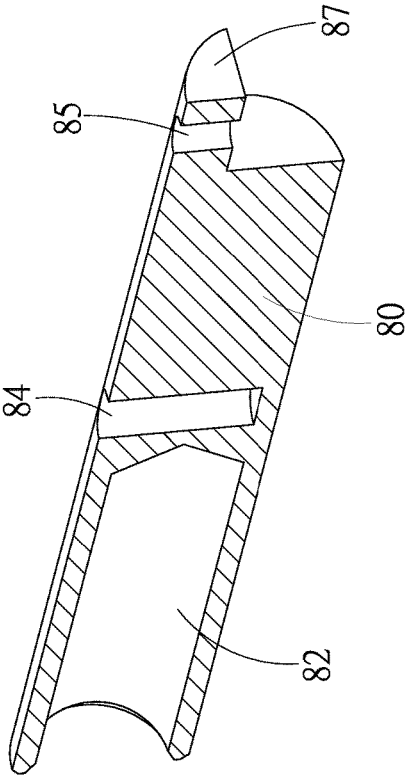
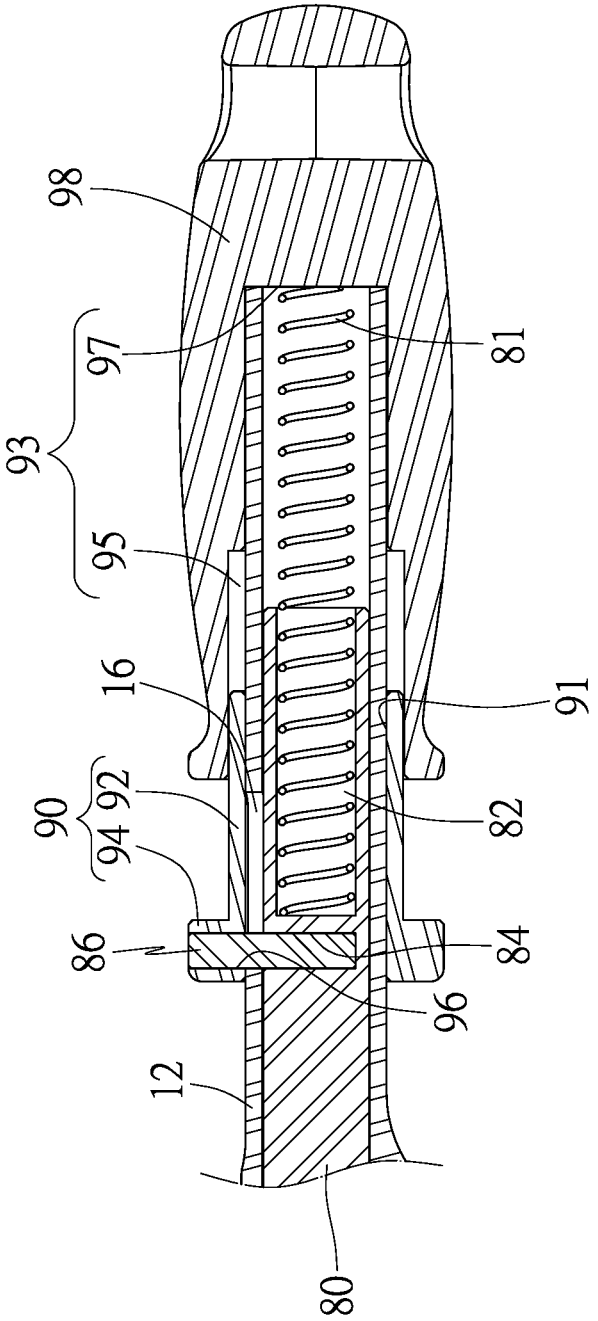


FIG.7



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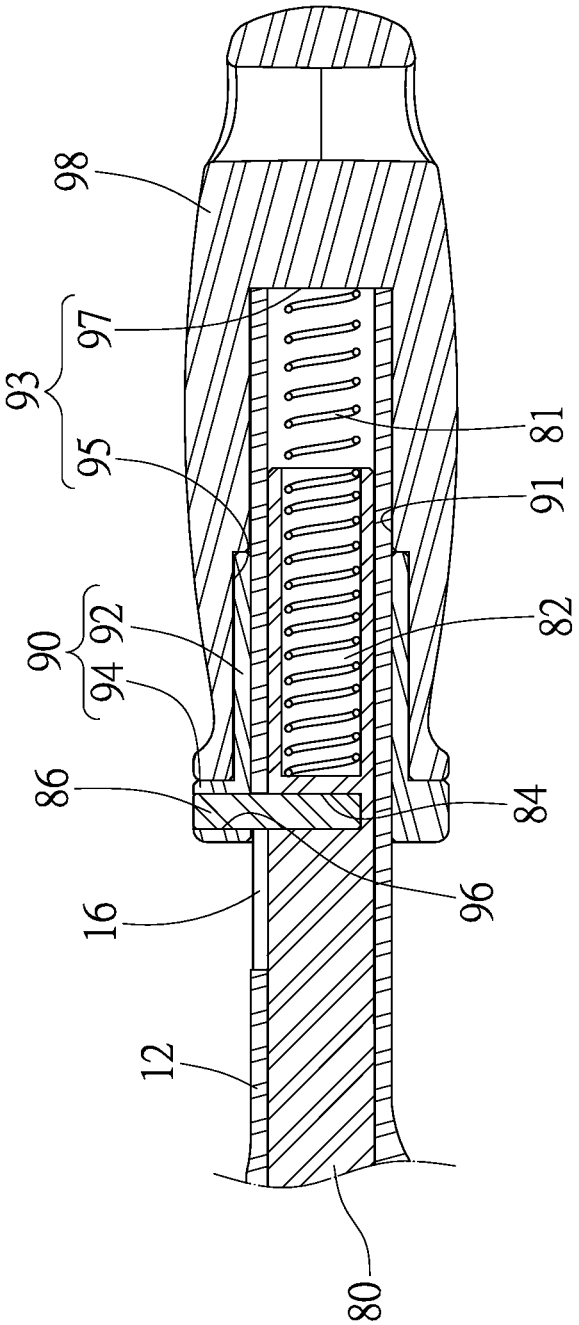

FIG.9

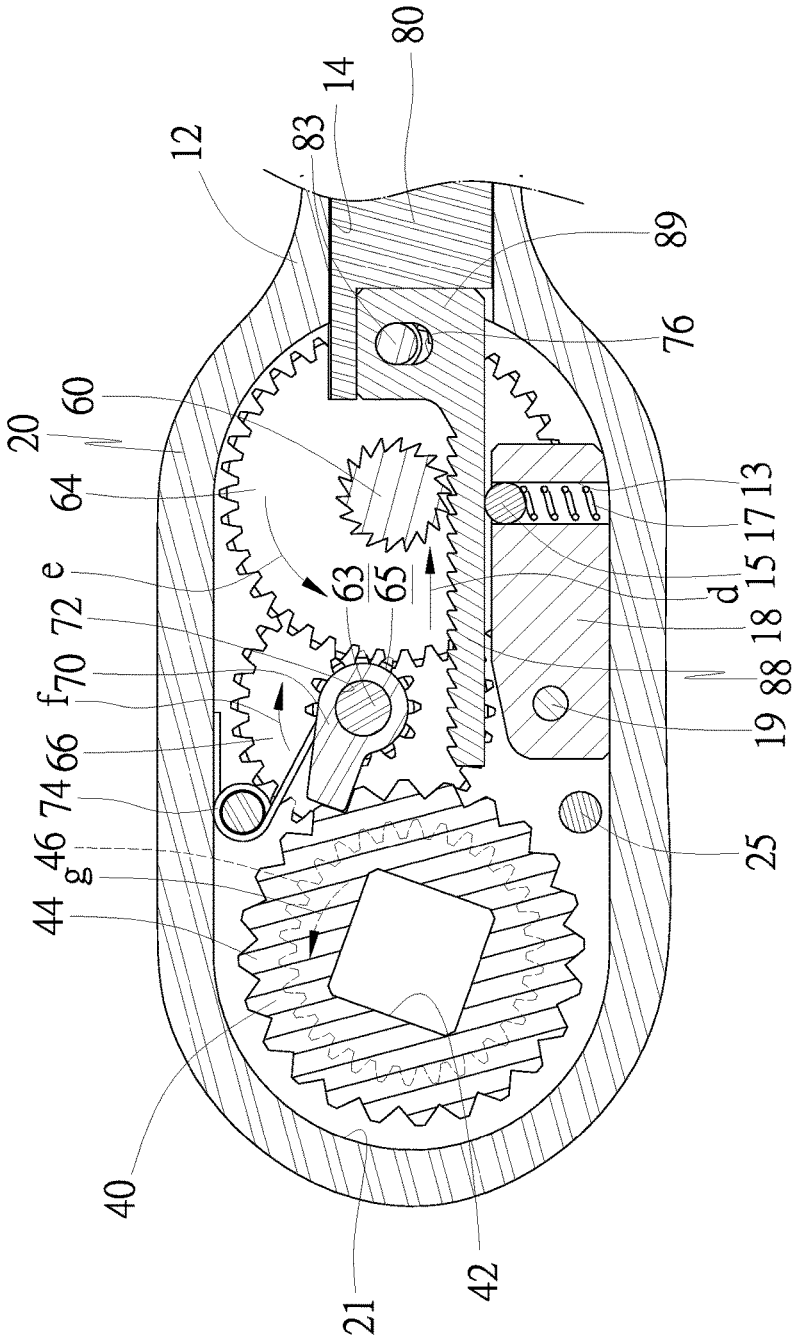
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FIG.10

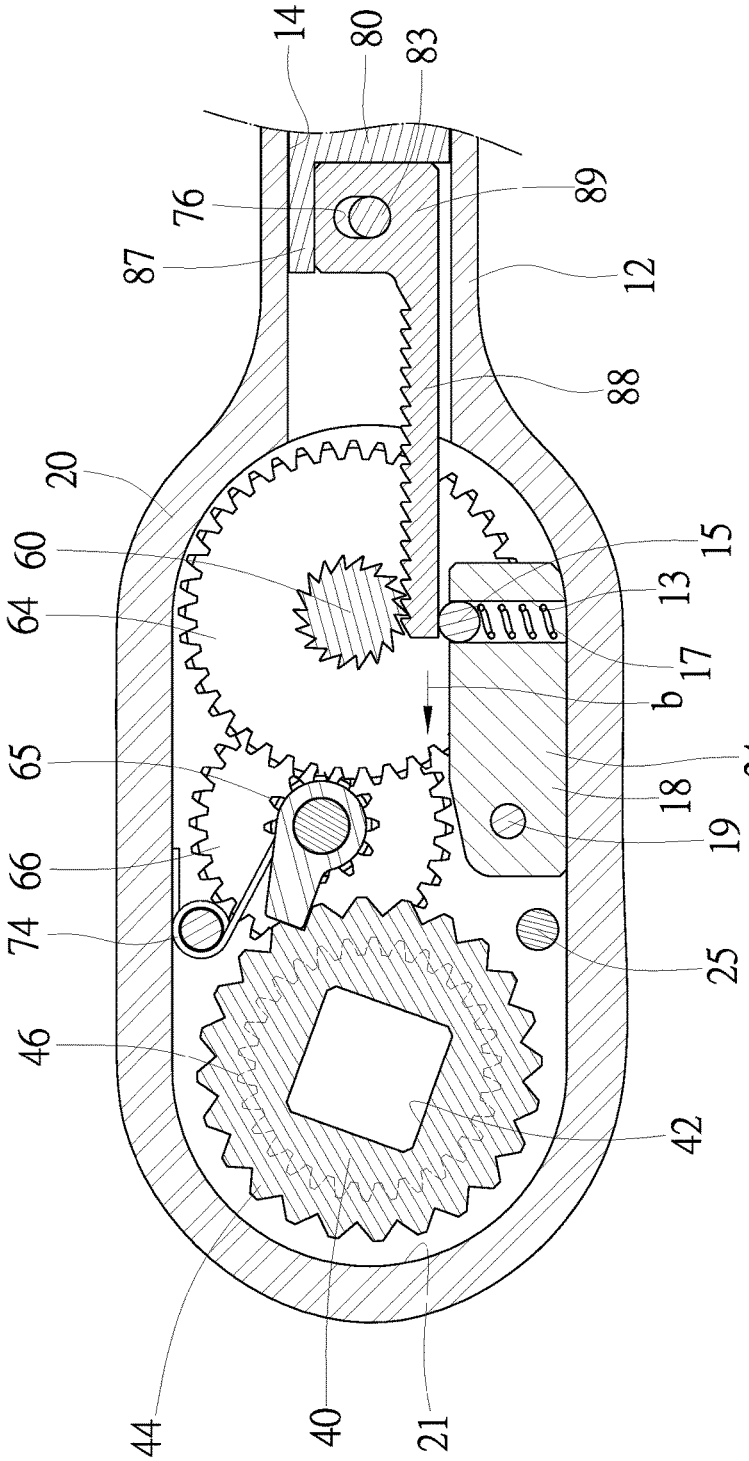
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FIG.11

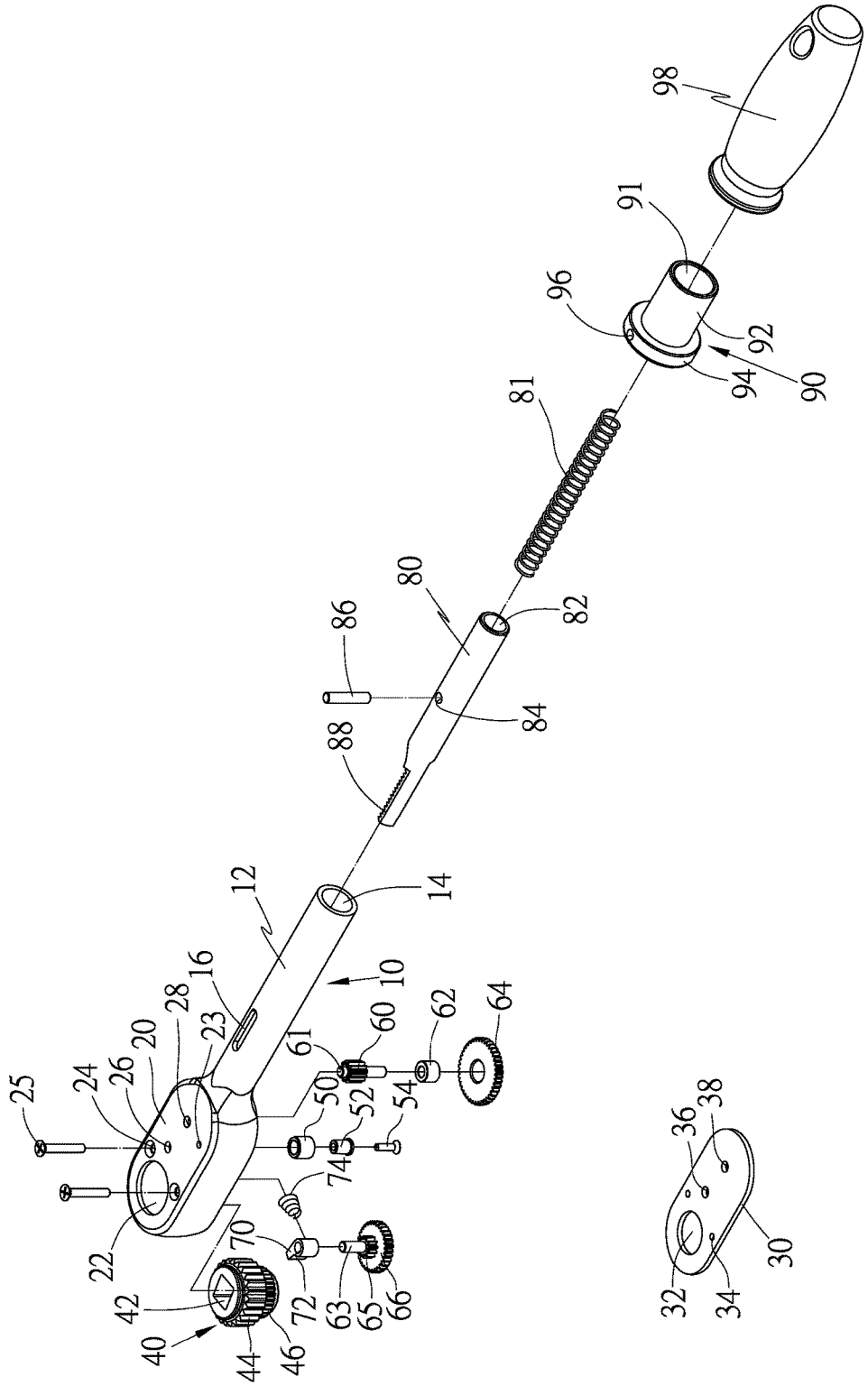
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FIG.12

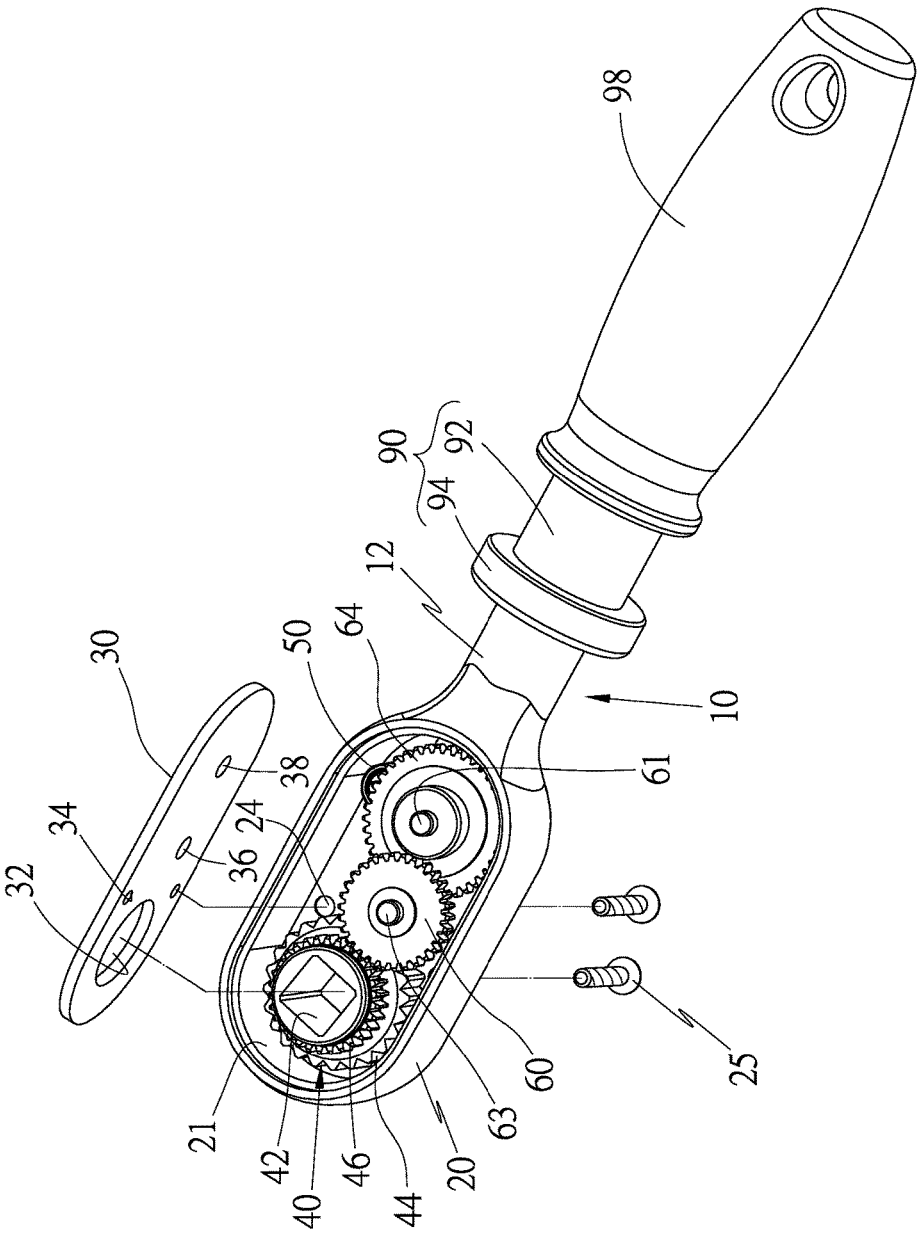


FIG.13

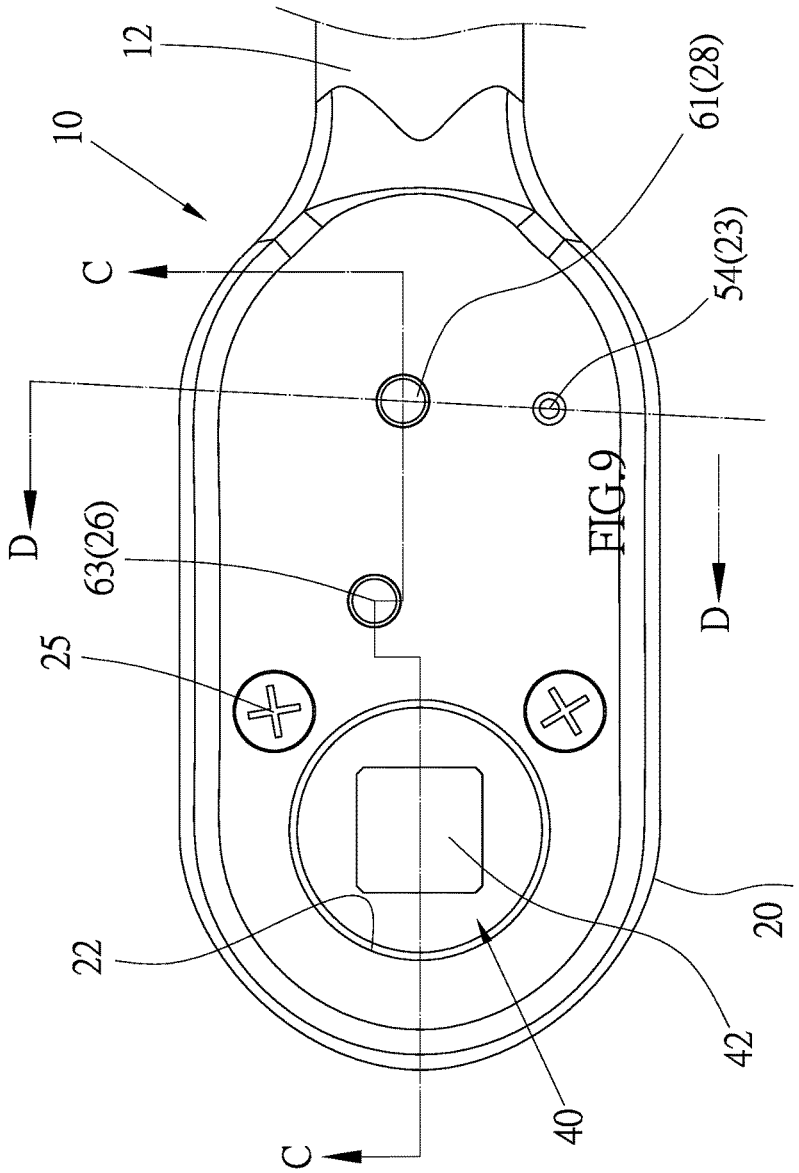
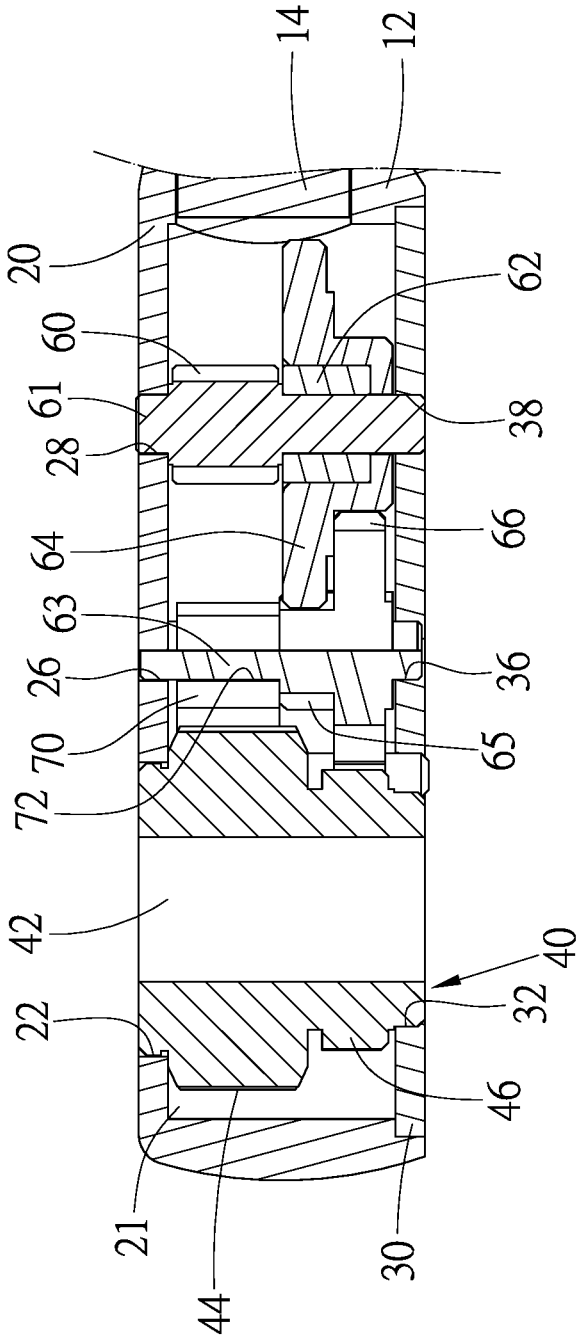


FIG.9

FIG.14



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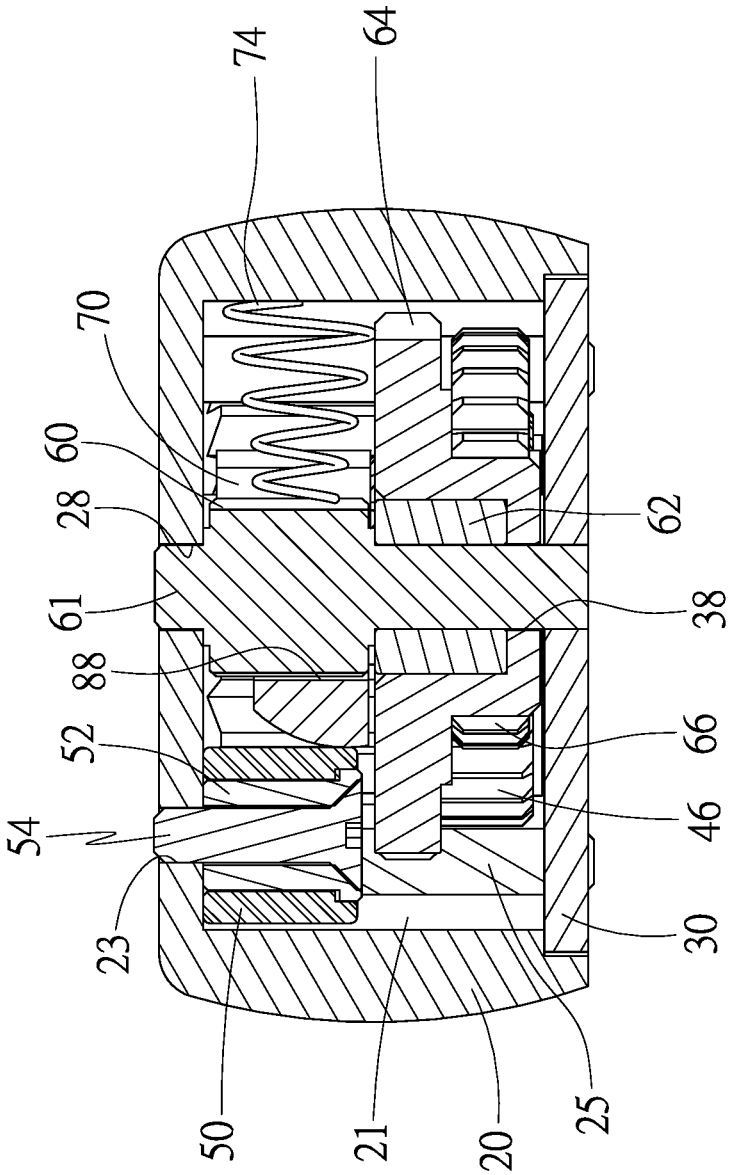

FIG.16

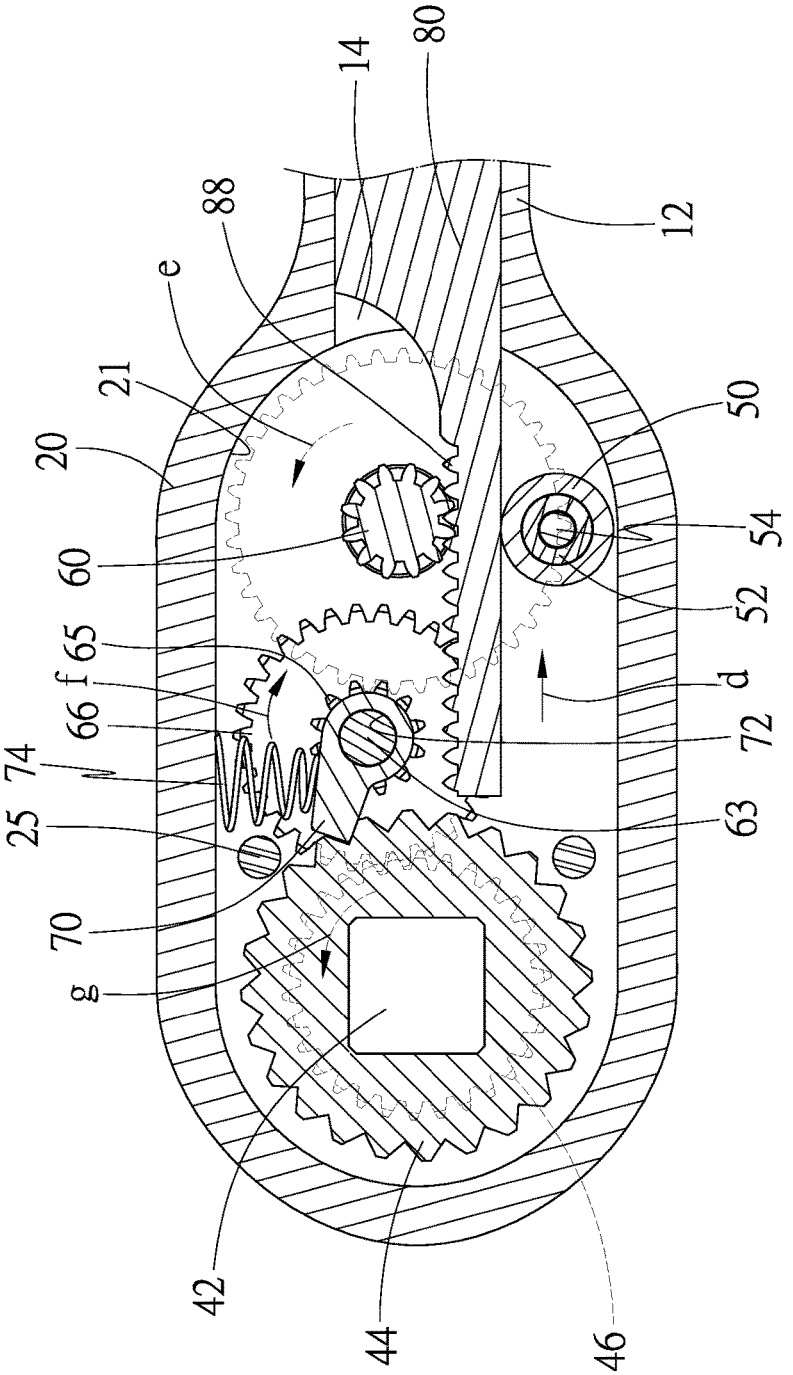

FIG.17

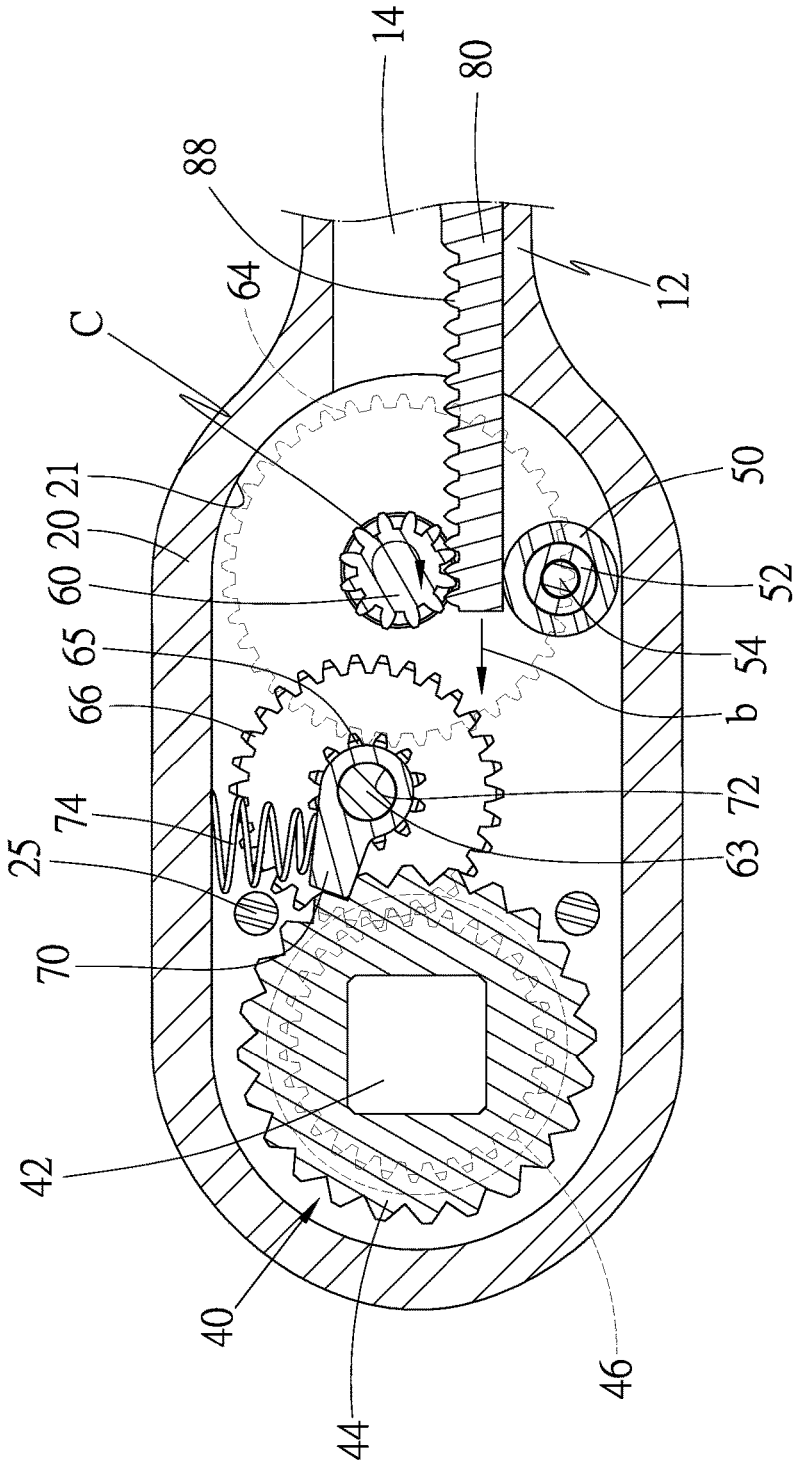

FIG.18

ONE-WAY WRENCH SWITCHABLE BETWEEN TWO MODES

BACKGROUND OF INVENTION

1. Field of Invention

The present invention relates to a one-way wrench and, more particularly, to a one-way wrench switchable between two modes.

2. Related Prior Art

U.S. Pat. No. 6,070,499 discloses a one-way wrench switchable between two modes, one for transmitting high torque and the other for transmitting low torque. The one-way wrench includes a handle 11, a rotary member 27, a drive member 13, two pawls 42 and 43, a selector switch 45 and a drive ring 21. A knurled sleeve 12 is provided on a section of the handle 11. The handle 11 includes a fixed arm 14 formed on another section and a driving housing 15 formed at an end. The driving housing 15 includes teeth 17 formed on an internal face. The fixed arm 14 includes a tunnel in communication with the interior of the driving housing 15. The drive member 13 is a stepped element with two slots 39 and 40 for receiving the pawls 42 and 43. A pin 44 is inserted in the drive member 13 and the pawls 42 and 43 to render the pawls 42 and 43 rotatable relative to the drive member 13. The selector switch 45 includes a plate 52 formed at an end of a spindle 46. The spindle 46 includes two holes 55 and 56. The hole 55 receives a spring 49 and a bearing pin 47. The hole 56 receives a spring 50 and a bearing pin 48. As the selector switch 45 is inserted in the drive member 13, the holes 55 and 56 are in communication with the slots 39 and 40, respectively. The spring 49 pushes the bearing pin 47 to bias the pawl 42. The spring 50 pushes the bearing pin 48 to bias the pawl 43. A substantial portion of the drive member 13 is inserted in the driving housing 15 and the drive ring 21 while a portion of the drive member 13 that extends out of the drive ring 21 is engaged with a clip 36. Thus, the drive member 13 and the drive ring 21 are kept on the handle 11 while the drive ring 21 is allowed to spin around the drive member 13. The pawl 42 is engaged with the driving housing 15 while the pawl 43 is engaged with the drive ring 21.

The shaft 24 includes a bevel pinion 25 at an end and a spline projection 27 at another end. A substantial portion of the shaft 24 is inserted in the tunnel of the handle 11 while the bevel pinion 25 is engaged with the drive ring 21 in the driving housing 15 and the spline projection 27 is engaged with the knurled sleeve 12.

The knurled sleeve 12 is maneuvered to spin the shaft 24 relative to the handle 11 in two senses of direction. In the first sense of direction, the bevel pinion 25 spins the drive ring 21 relative to the pawl 43 without spinning the drive member 13 in a direction. The bevel pinion 25 spins the drive ring 21 that in turn spins the drive member 13 via the pawl 43. Thus, the one-way wrench transmits low torque at high speed.

When the handle 11 is pivoted to spin the driving housing 15 while the shaft 24 is not spun relative to the handle 11, the driving housing 15 spins the drive member 13 via the pawl 42. Thus, the one-way wrench transmits high torque at low speed.

Taiwanese Patent Nos. 494828 and 1468261 disclose similar one-way wrenches. However, problems are encountered in the use of these one-way wrenches. Firstly, in the mode for transmitting low torque at high speed, the actual speed for spinning the drive member 13 is low since a user cannot use his or her hand to spin the knurled sleeve 12 for more than 180° without having to stop and turn his or her hand back to the normal position. Secondly, the user could easily injure his or her wrist if he or she twists the knurled sleeve 12 very often.

The present invention is therefore intended to obviate or at least alleviate the problems encountered in prior art.

SUMMARY OF INVENTION

It is the primary objective of the present invention to provide a one-way wrench switchable between a high-torque mode and a high-speed mode which imposes relatively little stress in a user's wrist.

To achieve the foregoing objective, the one-way wrench includes a handle, a toothed wheel, a detent, a rod and a gear train. The handle includes a head formed at an end of a shank. The shank includes a chamber in communication with the tunnel. The toothed wheel is rotationally inserted in the chamber of the head. The detent is pivotally connected to the head and elastically engaged with the toothed wheel so that the head rotates the toothed wheel in a one-way manner. The rod is movable in the tunnel of the shank in a reciprocated manner. The gear train is arranged between the rod and the toothed wheel to convert the reciprocating of the rod to on-and-off rotation of the toothed wheel.

Other objectives, advantages and features of the present invention will be apparent from the following description referring to the attached drawings.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described via detailed illustration of two embodiments referring to the drawings wherein:

FIG. **1** is an exploded view of a one-way wrench according to the first embodiment of the present invention;

FIG. **2** is a partial view of the one-way wrench shown in FIG. **1**;

FIG. **3** is a top view of a head of the one-way wrench illustrated in FIG. **1**;

FIG. **4** is a cross-sectional view of the one-way wrench taken along a line A-A shown in FIG. **3**;

FIG. **5** is a cross-sectional view of the one-way wrench taken along a line B-B shown in FIG. **3**;

FIG. **6** is a perspective view of a rod of the one-way wrench shown in FIG. **1**;

FIG. **7** is a cut-away view of the rod shown in FIG. **6**;

FIG. **8** is a cross-sectional and partial view of the one-way wrench shown in FIG. **1**;

FIG. **9** is a cross-sectional and partial view of the one-way wrench in another position than shown in FIG. **8**;

FIG. **10** is another cross-sectional and partial view of the one-way wrench shown in FIG. **1**;

FIG. **11** is a cross-sectional and partial view of the one-way wrench in another position than shown in FIG. **10**;

FIG. **12** is an exploded view of a one-way wrench according to the second embodiment of the present invention;

FIG. **13** is a partial view of the one-way wrench shown in FIG. **12**;

FIG. **14** is a top view of a head of the one-way wrench illustrated in FIG. **12**;

FIG. **15** is a cross-sectional view of the one-way wrench taken along a line C-C shown in FIG. **14**;

FIG. **16** is a cross-sectional view of the one-way wrench taken along a line D-D shown in FIG. **14**;

FIG. **17** is a cross-sectional and partial view of the one-way wrench shown in FIG. **12**; and

FIG. **18** is a cross-sectional and partial view of the one-way wrench in another position than shown in FIG. **17**.

DETAILED DESCRIPTION OF EMBODIMENTS

Referring to FIGS. **1** to **11**, a one-way wrench includes a handle **10**, a cover **30**, a toothed wheel **40**, a gear train, a detent **70**, a rod **80**, a spring **81**, a driving element **90** and a grip **98** according to a first embodiment of the present invention. The gear train includes elements that will be described later.

Referring to FIGS. **1** through **2**, the handle **10** includes a head **20** formed at an end of a shank **12**. The shank **12** and the head **20** are made in one piece. The shank **12** is a circular tube that includes an axial tunnel **14** in communication with a longitudinal slot **16**. The slot **16** extends much shorter than the tunnel **14**.

The head **20** includes a chamber **21**, an opening **22** and apertures **23**, **24**, **26** and **28**. The chamber **21** is in communication with the tunnel **14**. The opening **22** and the apertures **23**, **24**, **26** and **28** are in communication with the chamber **21**. There are two apertures **24**.

The cover **30** is shaped in compliance with the chamber **21**. The cover **30** includes an opening **32** corresponding to the apertures **24**, two screw holes **34** corresponding to the apertures **24**, and apertures **36** and **38** corresponding to the apertures **26** and **28**.

The toothed wheel **40** includes teeth **44**. A gear **46** is connected to the toothed wheel **40** in a coaxial manner. The gear **46** and the toothed wheel **40** are preferably made in one piece. The toothed wheel **40** is made with a diameter larger than that of the gear **46**. A square receptacle **42** axially extends throughout the toothed wheel **40** and the gear **46**. The toothed wheel **40** can include a square insert instead of the square receptacle **42** in another embodiment.

The gear train includes four gears **60**, **64**, **65** and **66** and a rack **88**. The gear **60** is made with a diameter smaller than that that of the gear **64**. The gears **60** and **64** are provided on a shaft **61** so that they can spin together. The gears **60** and **64** and the shaft **61** are individual elements in this embodiment. The gears **60** and **64** and the shaft **61** can be made in one piece in another embodiment. The gear **65** is made with a diameter smaller than that of the gear **66**. The gears **65** and **66** are provided on a shaft **63** so that they can spin together. The gears **65** and **66** and the shaft **63** can be individual elements or made in one piece.

The rack **88** is formed with a flat portion **89**. A slot **76** is made in the flat portion **89** of the rack **88**.

The rod **80** includes an axial bore **82** in an end, a transverse bore **84** made in the periphery, a tongue **87** extending from another end, and an aperture **85** made in the tongue **87**. The tongue **87** is made with a planar face.

The driving element **90** includes an annular flange **94** formed on a tube **92**. The tube **92** is made with an axial aperture **91**. The annular flange **94** includes a radial aperture **96** in communication with the axial aperture **91**.

The grip **98** includes an axial bore **93**. The bore **93** includes a large portion **95** and a small portion **97**. The large portion **95** of the bore **93** is made with a diameter larger than that of the small portion **97**. The small portion **97** of the bore **93** is located deeper in the grip **98** than the large portion **95**.

A detent **70** includes a tip (not numbered) and an aperture **72**.

A spring **74** includes two rectilinear terminal portions extending from a helical middle portion. The spring **74** is a torque spring.

A positioning element **18** includes two portions extending perpendicular to each other. That is, the positioning element is a bent element. The positioning element includes a screw hole **11** and an aperture **13**. The screw hole **11** extends perpendicular to the aperture **13**.

In assembly, the rack **88** is movably inserted in the chamber **21** of the head **20** and the tunnel **14** of the shank **12**. A portion of the rack **88** is inserted in the chamber **21** of the head **20** while another portion of the rack **88** is inserted in the tunnel **14** of the shank **12**. The rack **88** is engaged with the gear **60**.

The rod **80** is movably inserted in the tunnel **14** of the shank **12** so that the rod **80** can be reciprocated along the shank **12**. The rack **88** is connected to and hence movable with the rod **80** by fitting a pin **83** in the aperture **85** of the rod **80** and inserting the pin **83** in the transverse slot **76** of the rack **88**. The width of the transverse slot **76** is larger than the diameter of the pin **83** to allow the rack **88** to pivot relative to the rod **80**. The transverse slot **76** extends perpendicular to the rod **80**. The pin **83** can be replaced with a screw and the aperture **85** can be replaced with a screw hole in another embodiment.

The driving element **90** is movably provided on the shank **12**. The driving element **90** is connected to the rod by inserting a pin **86** in the radial aperture **96** of the driving element **90** and the transverse bore **84** of the rod **80**. The pin **86** extends through the slot **16**. The diameter of the pin **86** is marginally smaller than the width of the slot **16** to render the pin **86** smoothly movable in the slot **16** without pivoting.

The grip **98** is fitted on the shank **12**, i.e., the shank **12** is fitted in the small portion **97** of the bore **93** so that the grip **98** is not movable relative to the shank **12**. The tube **92** is movable in the large portion **95** of the bore **93**.

The spring **81** is a compression spring formed with an end inserted in the bore **82** of the rod **80** and another end inserted in the small portion **97** of the bore **93** of the grip **98**. The spring **81** is compressed between the rod **80** and the grip **98**. Thus, the spring **81** tends to bias the rod **80** toward the head **20**.

The spring **81** is compressed when the driving element **90** is operated to move the rod **80** toward the grip **98**. Accordingly, the tube **92** of the driving element **90** is moved in the large portion **95** of the bore **93** of the grip **98**. The spring **81** pushes the rod **80** toward the head **20** when the driving element **90** is released.

The positioning element **18**, the toothed wheel **40**, the gears **60**, **64**, **65** and **66**, the detent **70** and the spring **74** are inserted in the chamber **21** of the head **20** that is closed by the cover **30**. The cover **30** is secured to the head **20** by inserting two screws **25** in the screw holes **34** via the apertures **24**. Thus, the positioning element **18**, the toothed wheel **40**, the gears **60**, **64**, **65** and **66**, the detent **70** and the spring **74** are retained in the chamber **21** of the head **20** by the cover **30**.

The shaft **61** includes an end inserted in the second aperture **28** and another end inserted in the second aperture **38** to render the gears **60** and **64** smoothly rotatable in the head **20**.

The gear **60** is engaged with the rack **88**.

The shaft **63** includes an end inserted in the aperture **26** and another end inserted in the aperture **36** to render the gears **65** and **66** smoothly rotatable in the head **20**. The gear **65** is engaged with the gear **64**.

The toothed wheel **40** includes an end inserted in the opening **22** of the head **20** and another end inserted in the opening **32** of the cover **30** to render the toothed wheel **40** smoothly rotatable in the head **20**. The gear **46** is engaged with the gear **66**.

The shaft **63** is inserted in the aperture **72** of the detent **70** to allow the detent **70** to pivot to and fro. The spring **74** is located between the detent **70** and the head **20** to bias the detent **70** toward the toothed wheel **40** and hence keep the tip of the detent **70** in engagement with one of the teeth **44** of the toothed wheel **40**. With the toothed wheel **40** and the detent **70**, the head **20** rotates the toothed wheel **40** in a sense of direction, but the head **20** does not rotate the toothed wheel **40** in an opposite sense of direction. The spring **74** is kept in position by inserting one of the screws **25** in the helical portion thereof.

A ball **15** and a spring **17** are inserted in the aperture **13** of the positioning element **18**. A portion of the ball **15** is located out of the aperture **13**. A screw **19** is inserted in the screw hole **11** via the aperture **23** to retain the positioning element **18** in position in the chamber **21** of the head **20**. Now, the aperture **13** includes an open end facing the rack **88** and another open end facing the head **20**. An end of the spring **17** is placed against the head **20** while the portion of the ball **15** is placed against the rack **88**. Thus, the spring **17** tends to keep the rack **88** engaged with the gear **60**.

In use, an end of an extensive rod is inserted in the receptacle **42** of the toothed wheel **40** and another end of the extensive rod is inserted in a socket. The socket is provided on a nut or a head of a screw. In a first mode of operation, the driving element **90** is operated while the grip **98** is held in position.

Referring to FIG. **10**, the gear **60** is rotated as the rack **88** is moved away from the head **20** as indicated by an arrow head d. The ratchets of the rack **88** are engaged with the ratchets of the gear **60** so that the rack **88** spins the gear **60** as indicated by an arrow head e. The gear **64** spins the gear **65** as indicated by an arrow head f. The gear **66** spins the gear **46** as indicated by an arrow head g.

Referring to FIG. **9**, the translation of the driving element **90** away from the head **20** is stopped when the pin **86** reaches a closed end of the slot **16**. Then, the driving element **90** is released to allow the spring **81** to push the driving element **90** toward the head **20**. Referring to FIG. **8**, the translation of the driving element **90** toward the head is stopped when the pin **86** reaches another closed end of the slot **16**.

Referring to FIG. **11**, the gear **60** is not rotated when the rack **88** is moved toward the head **20** as indicated by an arrow head b. This is for two reasons. Firstly, the gear **60** is formed with ratchets, and so is the rack **88**. Secondly, the pin **83** is movable in and along the transverse slot **76** to allow the rack **88** and the flat portion **89** of the rod **80** to be pushed away from the gear **60**. That is, the rack **88** is disengaged from the gear **60**. At the same time, the rack **88** pushes the entire ball **15** in the aperture **13** and hence compresses the spring **17**. The spring **17** can return the rack **88** to engagement with the gear **60** via the ball **15**.

The translation of the driving element **90** is reciprocated. The reciprocating of the driving element **90** is converted to the on-and-off rotation of the toothed wheel **40**. The reciprocating of the driving element **90** imposes less stress in a user's wrist than rotation of a knob.

As described above, the rectilinear movement of the rack **88** is converted to the rotation of the toothed wheel **40**. The numbers of the teeth of the rack **88** and the gears **60**, **64**, **65**, **66** and **46** are chosen so that a stroke of the rectilinear movement of the rack **88** is converted to a revolve (360°) of the rotation of the toothed wheel **40**. Hence, low torque is transmitted at high speed in the first mode.

In a second mode, referring to FIG. **10**, the handle **10** is pivoted counterclockwise, and so are the head **20** and the detent **70**. The tip of the detent **70** is engaged with one of the teeth **44** of the toothed wheel **40** so that the detent **70** and the head **20** rotate the toothed wheel **40** counterclockwise.

Referring to FIG. **11**, the handle **10** is pivoted clockwise, and so are the head **20** and the detent **70**. A screw or a nut engaged with a socket engaged with the toothed wheel **40** holds the toothed wheel **40** in position. The toothed wheel **40** does not rotate clockwise with the detent **70** and the head **20** because the tip of the detent **70** can be disengaged from the teeth **44** of the toothed wheel **40**. Therefore, high torque is transmitted at low speed.

The one-way wrench can be inverted before the socket is engaged with the toothed wheel **40**. Thus, the one-way wrench can be operated to rotate the screw or the nut clockwise but not counterclockwise.

Referring to FIGS. **12** to **18**, there is a one-way wrench according to a second embodiment of the present invention. The second embodiment is identical to the first embodiment except for several things. Firstly, the rack **88** and the rod **80** are made in one piece. Hence, the tongue **87**, the aperture **85**, the flat portion **89** of the rack **88**, the transverse slot **76** and the pin **83** are omitted.

Secondly, the rack **88** is placed against a roller **50** instead of the ball **15**, the spring **17** and the positioning element **18**. The roller **50** is provided on a shaft **54** via a bushing **52**. The shaft **54** can be in the form of a screw inserted in the aperture **23** of the head **20**. The rack **88** extends between the gear **60** and the roller **50**. The roller **50** tends to keep the rack **88** engaged with the gear **60**, but allows disengagement of the rack **88** to be from the gear **60**.

Thirdly, the spring **74** is a compression spring instead of a torque spring. An end of the spring **74** can be secured to the head **20** by welding for example. Alternatively, the end of the spring **74** can be inserted in a dovetail groove made in the head **20** so that the spring **74** can be detached from the head **20**.

Fourthly, the gear **64** is provided on the shaft **61** via a one-way bearing **62**. Accordingly, the teeth of the rack **88** and the teeth of the gear **60** are ordinary teeth instead of ratchets. The one-way bearing **62** includes an internal portion provided on the shaft **61** and an external portion fitted in the gear **64**. The gear **64** and the gear **60** are located side by side. Thus, the gear **60** rotates the gear **64** is a sense of direction but not in an opposite sense of direction.

Referring to FIG. **17**, the rack **88** is moved away from the head **20** as indicated by an arrow head d. Hence, the rack **88** rotates the gear **60** as indicated by an arrow head e. Due to the use of the one-way bearing **62** (FIG. **15**), the gear **60** rotates the gear **64**. The gear **64** rotates the gear **65** as indicated by an arrow head f. The gear **66** rotates the gear **46** as indicated by an arrow head g.

Referring to FIG. **18**, the rack **88** is moved toward the head **20** as indicated by an arrow head b. Hence, the rack **88** rotates the gear **60** as indicated by an arrow head c. Due to the use of the one-way bearing **62** (FIG. **15**), the gear **60** does not rotate the gear **64**. Accordingly, the toothed wheel **40** is not rotated.

As described above, the reciprocating of the rack **88** is converted to the on-and-off rotation of the toothed wheel **40**. Low torque is transmitted at high speed.

In another embodiment, the gear **46** can be directly engaged with the rack **88**. Accordingly, the gears **60**, **64**, **65** and **66** are omitted.

The present invention has been described via the detailed illustration of the embodiments. Those skilled in the art can derive variations from the embodiments without departing from the scope of the present invention. Therefore, the embodiments shall not limit the scope of the present invention defined in the claims.

The invention claimed is:

1. A one-way wrench comprising:

a handle comprising:

a shank comprising a tunnel extending in a longitudinal direction thereof; and

a head formed at an end of the shank and made with a chamber in communication with the tunnel;

a toothed wheel rotationally inserted in the chamber of the head;

a detent pivotally connected to the head and elastically engaged with the toothed wheel so that the head rotates the toothed wheel in a one-way manner;

a rod movable in the tunnel of the shank in a reciprocated manner; and

a gear train arranged between the rod and the toothed wheel to convert the reciprocating of the rod to on-and-off rotation of the toothed wheel, wherein the gear train comprises:

a rack longitudinally connected to the rod and formed with ratchets and a transverse slot;

a pin connected to the rod and inserted in the transverse slot of the rack;

a first gear coaxially connected to the toothed wheel;

a last gear connected to the first gear and formed with ratchets engaged with the ratchets of the rack;

a spring for biasing the rack toward the last gear; and

a ball provided between the spring and the rack to reduce friction between the spring and the rack.

2. The one-way wrench according to claim **1**, wherein the gear train further comprises:

a second gear engaged with the first gear;

a third gear coaxially connected to the second gear; and

a fourth gear engaged with the third gear;

wherein the last gear is coaxially connected to the fourth gear at an end and engaged with the rack at another end.

3. The one-way wrench according to claim **2**, wherein the gear train further comprises a shaft coaxially connected to the last gear and a one-way bearing provided between the shaft and the fourth gear.

4. The one-way wrench according to claim **3**, wherein the gear train further comprises a roller for pressing the rack against the last gear.

5. The one-way wrench according to claim **1**, wherein the gear train further comprises a positioning element for keeping the ball and the spring in position.

6. The one-way wrench according to claim **5**, wherein the positioning element comprises an aperture for receiving the ball and the spring.

7. The one-way wrench according to claim **1**, wherein the detent comprises an aperture for receiving a shaft that is connected to the head.

8. The one-way wrench according to claim **1**, further comprising a spring for biasing the detent toward the toothed wheel.

9. The one-way wrench according to claim **8**, wherein the spring is a torque spring.

10. The one-way wrench according to claim **8**, wherein the spring is a compression spring.

11. The one-way wrench according to claim **1**, wherein the shank further comprises a slot in communication with the tunnel, wherein the rod comprises a transverse bore and a pin inserted in the transverse bore via the slot, wherein the movement of the rod is restrained as movement of the pin is limited by two closed ends of the slot.

12. The one-way wrench according to claim **11**, further comprising a driving element movably provided on the shank and made with a radial aperture for receiving the pin so that the driving element is connected to the rod by the pin.

13. The one-way wrench according to claim **12**, further comprising a grip connected to the shank and a spring compressed between the grip and the rod.

14. The one-way wrench according to claim **13**, wherein the rod comprises a bore for receiving an end of the spring, wherein the grip comprises a bore for receiving another end of the spring.

15. The one-way wrench according to claim **14**, wherein the bore of the grip comprises a small portion for tightly receiving the shank and a large portion for movably receiving the driving element.

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