US008109181B2

(12) **United States Patent**
Gao

(10) **Patent No.: US 8,109,181 B2**
(45) **Date of Patent: Feb. 7, 2012**

(54) **RATCHET SCREWDRIVER AND CONSTRUCTION METHOD**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 637 days.

(21) Appl. No.: **11/795,963**

(22) PCT Filed: **May 19, 2006**

(86) PCT No.: **PCT/US2006/019269**

§ 371 (c)(1),
(2), (4) Date: **Jul. 25, 2007**

(87) PCT Pub. No.: **WO2007/136365**

PCT Pub. Date: **Nov. 29, 2007**

(65) **Prior Publication Data**

US 2009/0301267 A1 Dec. 10, 2009

(51) **Int. Cl.**
B25B 13/46 (2006.01)

(52) **U.S. Cl.** **81/62**; 81/63

(58) **Field of Classification Search** 81/61–63.2
See application file for complete search history.

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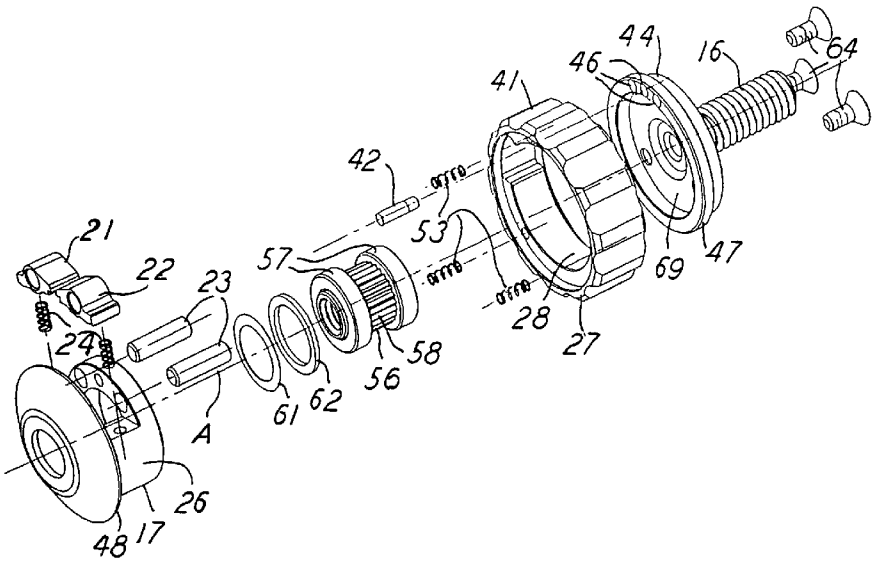
(57) **ABSTRACT**

A ratchet screwdriver with an assembly of a handle (**10**), a body (**17**), a gear (**56**), a pawl (**21**, **22**, **71**), and a selector (**27**) movable on the assembly. The selector carries a pawl actuator (**38**, **81**) for pivoting the pawl, and there is a rotation lock (**42**, **92**) on the selector for releasably holding the rotated selector. The selector can be axially, and also rotationally, movable on the body for controlling the lock. The assembly is along an axis (A), and there are a member (**44**) and axial force appliers (**62**, **64**) effective between the body and the member, thus restricting axial movement in the assembly. There is provision for assembly along the axis from adjacent the handle. There are modifications and an assembly method.

10 Claims, 5 Drawing Sheets



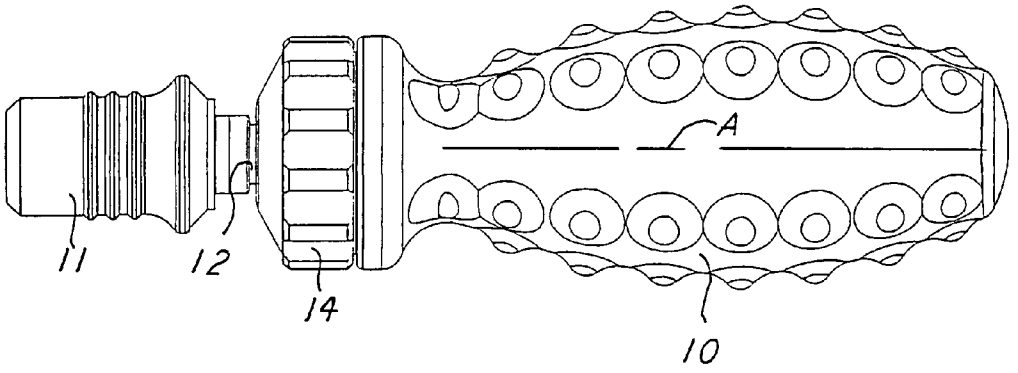


FIG. 1

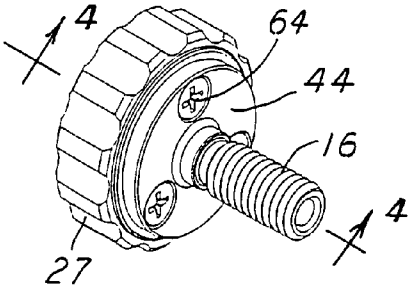


FIG. 2

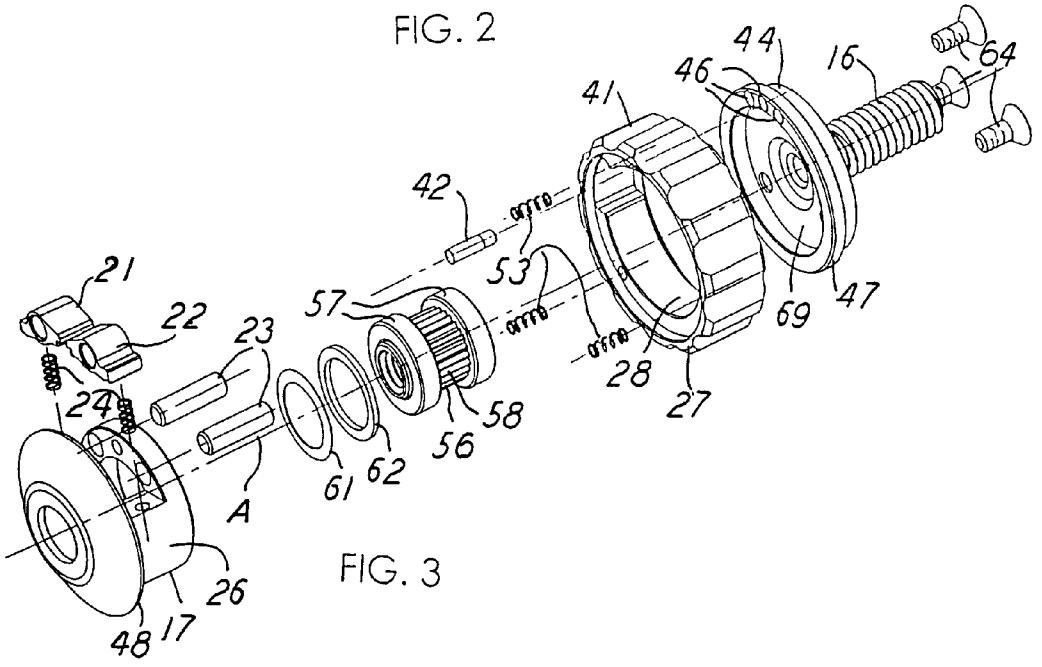


FIG. 3

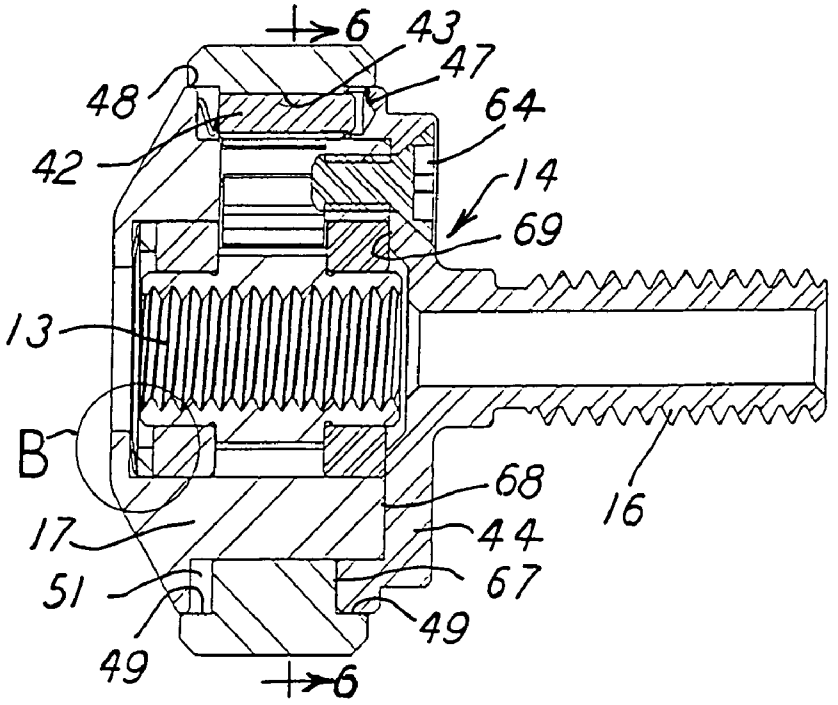


FIG. 4

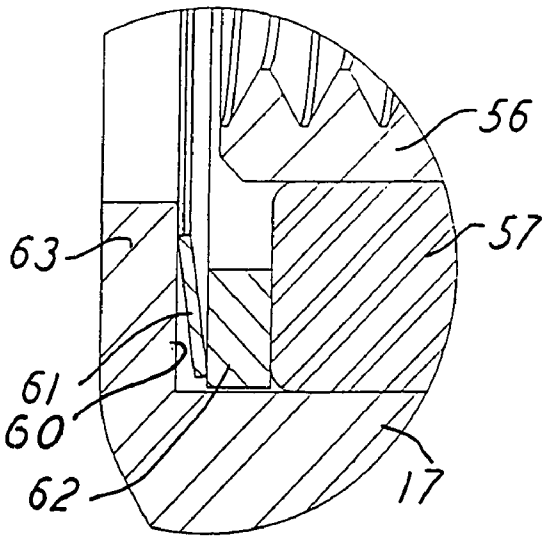


FIG. 5

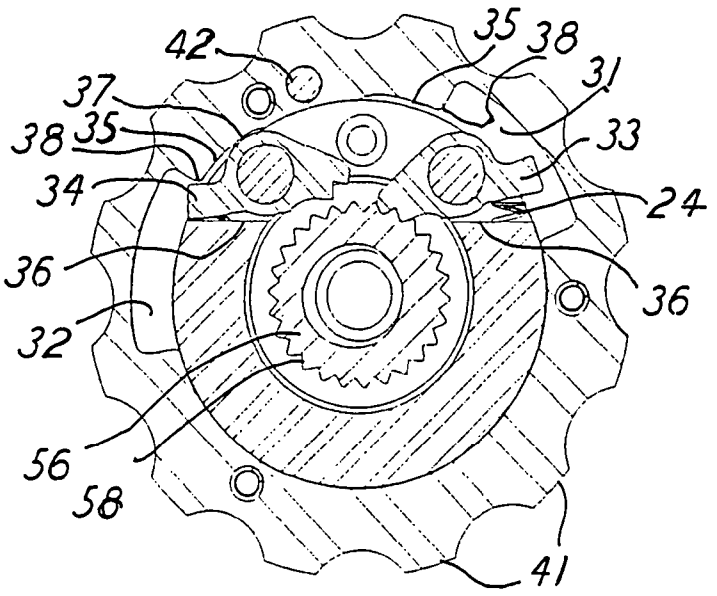


FIG. 6

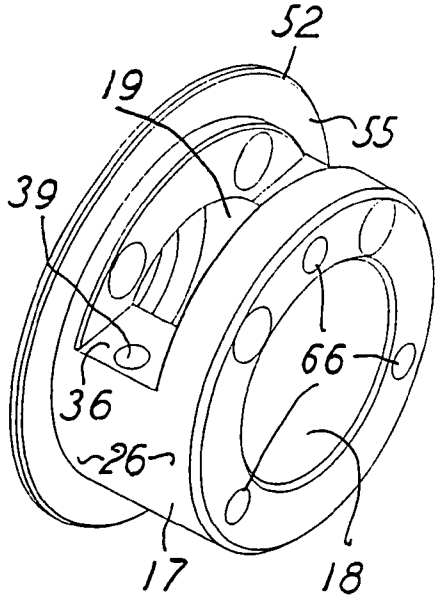


FIG. 7

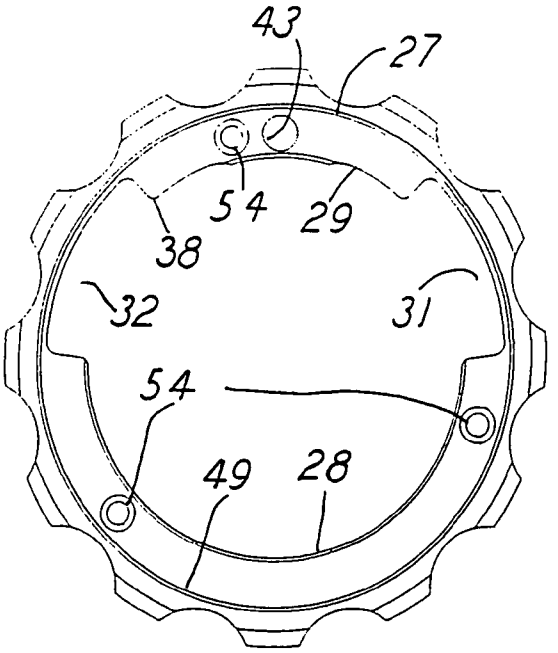


FIG. 8

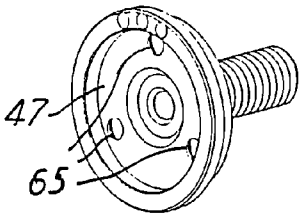


FIG. 9

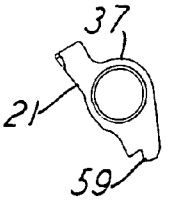


FIG. 10

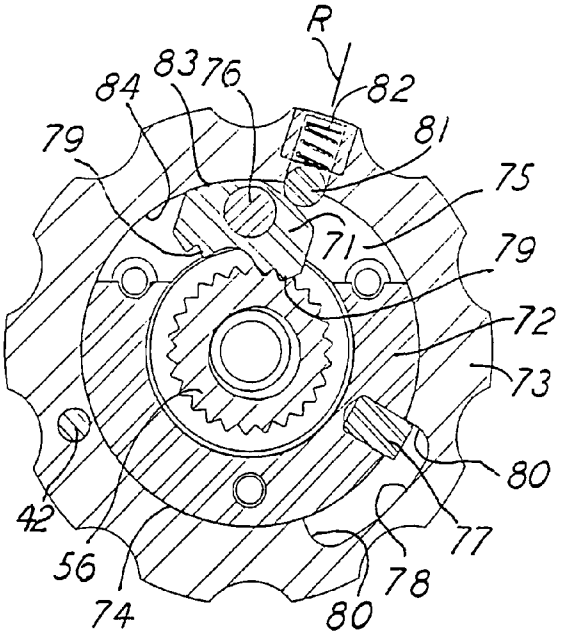


FIG. 11

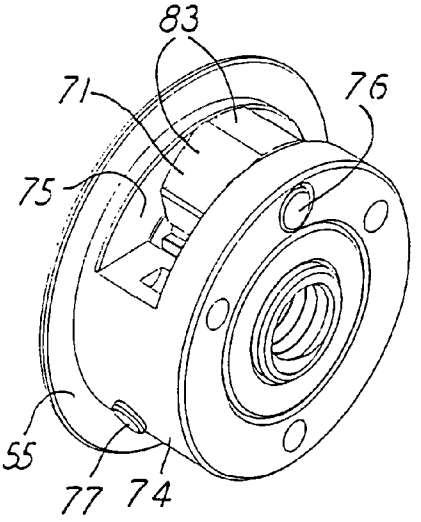


FIG. 12

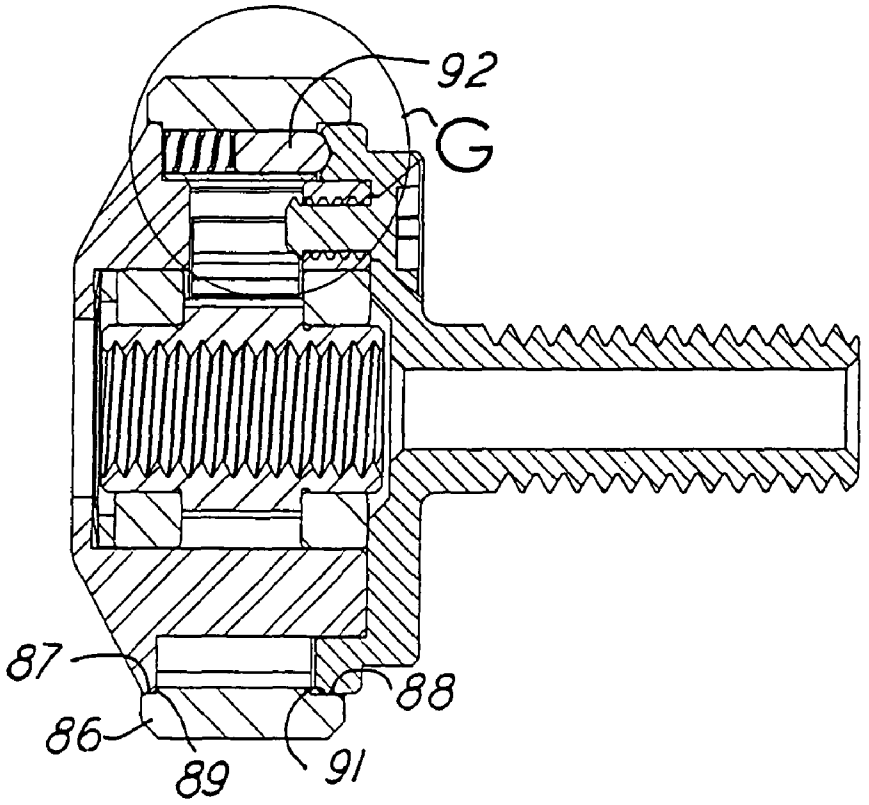


FIG. 13

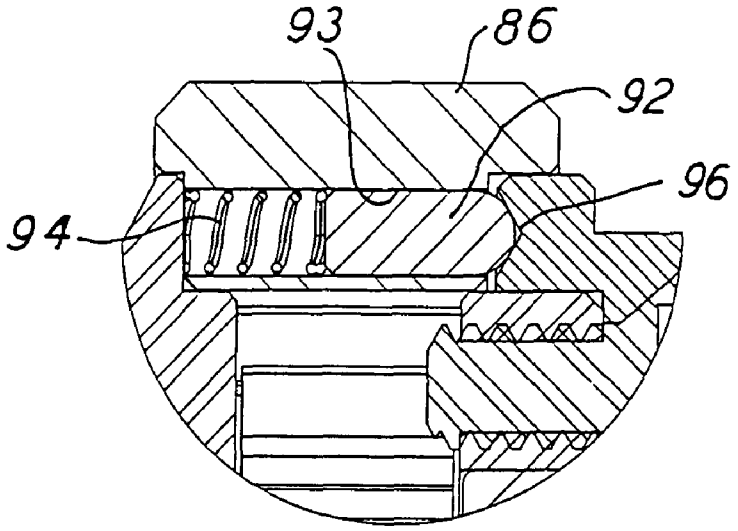


FIG. 14

RATCHET SCREWDRIVER AND CONSTRUCTION METHOD

This invention relates to ratchet screwdrivers and their construction methods.

BACKGROUND OF THE INVENTION

Ratchet screwdrivers are already known in the art of applying a ratchet tool for rotating a threaded fastener such as a screw. Those prior tools can be applied in both the tightening and removing processes of the threaded fastener, including use in the medical arts.

The present invention improves upon the prior screwdrivers in that it provides a ratchet screwdriver that has pivotal pawls and that provides for optimum control and operating confinement of the pawl or pawls, and the drive direction selector, and the driven gear. That produces greater precision in operation.

The pivotal pawl or pawls are snugly mounted and cooperate with the adjacent parts of the screwdriver to be accurate and secure in both the operative and inoperative positions. The selector, which operates the pawl or pawls, cooperates to lend support in both the pawl operative and inoperative positions, and it is releasably lockable in all its two or three selectable positions of operations, and it thereby secures the pawls in their selected operative and inoperative positions.

In achieving the foregoing, the screwdriver is structured and made in a manner that provides for the aforementioned features. It is constructed such that it can be assembled from its back end, rather then from the front end as with the prior art structures. The assembly imposes an axial force on the mechanism for snug containment of the ratchet. Also, it is secured by an axially movable rotation locking member and by fasteners. In that arrangement, the fasteners apply axial force on the assembly and on the drive gear for stabilizing the gear and avoiding the play of the prior art assemblies.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation view of a screwdriver of this invention.

FIG. **2** is a front end perspective view of a fragment of FIG. **1**.

FIG. **3** is a back end exploded perspective view of a fragment of FIG. **1**.

FIG. **4** is an enlarged section view taken on a plane designated by the line **4-4** of FIG. **2**.

FIG. **5** is an enlarged view of the circled portion designated "B" in FIG. **4**.

FIG. **6** is a section view taken on a plane designated by the line **6-6** of FIG. **4**.

FIG. **7** is an enlarged perspective view of a part shown in FIG. **3**.

FIG. **8** is an enlarged end elevation view of a part shown in FIG. **3**.

FIG. **9** is a perspective of a part shown in FIG. **3**.

FIG. **10** is a slightly enlarged end elevation view of a part shown in FIG. **3**.

FIG. **11** is a section view similar to FIG. **6** but showing another embodiment of this invention.

FIG. **12** is a perspective view similar to FIG. **7** but with parts added thereto.

FIG. **13** is a section view similar to FIG. **4** but with a different part, namely, the selector lock.

FIG. **14** is an enlarged view of the portion of FIG. **13** in the circle designated G on FIG. **13**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS AND METHOD

FIG. **1** shows a screwdriver of this invention, and it is rotatable about the longitudinal axis A. There is a handle **10** for gripping by the operator, and there is and adapter **11** rotatable by the handle, and it will be understood that the adapter attaches with the handle by having a suitable adapter shank **12** securely threaded into a threaded opening **13** in a ratchet mechanism at **14** which is supported by the handle **10**. Likewise, the ratchet **14** has a threaded shank **16** which is suitably conventionally secured in the handle **10**. The adapter is conventional in that it receives and drives replaceable tools which are interchangeably releasably held in the adapter. The ratchet **14** determines the direction of rotation of the adapter and its tool about the axis A.

The ratchet mechanism **14** in FIG. **3** is viewed from its front end, that is, from opposite the handle end which is the end from which it is assembled, and the assembly achieves a desired no-play axial condition.

A mechanism body, in the form of a pawl cylindrical cage member **17**, has a central opening **18** and a cutout **19** which extends to the opening **18** and which pivotally receives two pawls **21** and **22**. Pivot posts **23** are secured in the cage **17** and pivotally support the pawls **21** and **22**. The cage **17** rotates with the handle rotation and thusly carries the two pawls with it for orbiting about the axis A. A compression spring **24** abuts each pawl **21** and **22** for pivotally positioning the respective pawl.

The cage **17** has a circular exterior **26**, and an annulus or ring **27** is rotatably supported on the surface **26**. The annulus **27** is in a complete circle extending around the cage surface **26** and is rotatable thereon. Thus the annulus **27** has interior arcuate surfaces **28** and **29** snug on and guided by the cage surface **26**. The annulus also has two radially facing cutouts **31** and **32** which constantly receive the respective projecting pawl ends **33** and **34**. It will be understood that the rotation of the annulus will cause engagement of the retilinear. or planar projecting pawl end **33** or **34** and thus pivot the pawl for ratchet selection. The springs **24** can sit in holes **39** on respective tangentially facing surfaces **36** of the cage **17**, and the springs **24** urge the pawls into the ratchet engaged mode. It will also be seen in FIG. **6** that the surfaces **36** serve as abutments or stops for the pawls in their disengaged or non-ratcheting mode. Additionally, the annulus **27** has two pockets **35** on its arcuate surface **29** and they can be mated with a matching arcuate surface **37** on the pawls, and the released pawl is thusly confined between the surfaces defining the pockets **35** and the pawl surface **37** in the disengaged mode. Still further, the disengaged pawl is further trapped by the corner **38** of the ring **27**, and that can serve as a stop for the rotation of the ring **27** in that direction.

The ring **27** has user-grippable projections **41** for both rotation and axial movement of the ring on the cage **17**. In the rotation, the ring **27** can be selectively set in either right hand or left hand, or both, drive direction positions, as with ratchets. In all three positions, the ring **27** can be locked in the selected position and will remain locked until it is axially moved on the cage **17** for unlocking and then moved to another selected position. There is a releasable lock pin **42** that is pressed into the ring hole **43**, so the pin **42** moves with the ring **27**. Without retraction of the ring **27** and its pin **42**, the

ring **27** cannot rotate on the cage **17**, thus it is locked in one of three selectable positions for the respective ratchet action mentioned. In doing so, the ring is adjacent to and surrounds a circular member **44** which presents three holes **46** for sequential reception of the pin **42**.

The member **44** serves as an end locking and axial compression plate for enclosing the rear end of the ratchet mechanism **14** and it presents a circular surface **47** which, along with a circular surface **48** on the cage **17**, provides further rotation and axial sliding support, as well as foreign matter rejection, for the ring **27** at two interior circular surfaces **49** on the ring. There is axial space at **51** for the ring **17** to slide axially between the cage **17** and the member **44**. The cage **17** is also flanged at **52** for closing off the front end of the ratchet mechanism **14** and providing axial support for three springs **53** which respectively sit in three blind holes **54** in the ring **27** for axially urging the ring **27** into the described pin-locked positions. In operation, the springs **53** slide on the surface **55** of the flange **52** and they extend from the three openings **54** in the ring **27** for axially urging the ring **27**, such as rightward as viewed in FIG. **4**, and into the selected locked position by pin **42**.

A saw tooth gear **56** is rotatably supported, as part of the mechanism **14**, on two bearings **57** supported in cage opening **18**, and there are radially extending teeth **58** for engagment with the pawls **21** and **22** through the teeth **59** on the pawls. A wave washer **61**, along with a plain washer **62**, axially presses between a circular wall **60**, on an interior flange **63** on the cage **17**, and the bearing **57**. With a further arrangement, axial movement of the gear **56** in the assembly is eliminated. The annulus **27** has an axial extent along axis A, and the gear **56** and bearings **57** lie within that extent, as seen in FIG. **4**.

In the desired assembly from the rear, the parts are brought together along the axis A to the FIG. **4** assembly, and the screws **64** are tightened through the holes **65** in the member **47** and into the cage threaded holes **66**. The ring **27** is positioned over the member **17**, and the two circular surfaces at **67** and the two at **68** abut each other to achieve snug axial positioning. Likewise, the gear **56** is confined axially through its bearings **57** by the wall **69** on the member **44** and, as mentioned, by the wave washer **61**, all by the tightening of the screws **64**.

FIGS. **11** and **12** show another embodiment of this invention, and here only one pivotal pawl **71** is employed. The gear **56** is the same, but the body is now a cage **72**, and the ring is different from the previous embodiment, and it is now ring or selector **73**. Otherwise, the arrangement and the assembly, including the assembly method, are basically unchanged.

The cage **72** has its exterior circular surface **74** for rotational and axial sliding support of the ring **73**, and the cage supports a single pivot pin **76** for support of the pawl **71** which extends through the shown cage radial opening **75**. Also, there is a rotation stop **77** protruding from the surface **74** for engagement with the ring **73** such as in the recess **78** on the ring where two circularly spaced-apart stop walls **80** are presented to the pin **77**.

The pawl **71** has two spaced-apart sets of pawl teeth **79** for alternate engagement with the gear **56**. The ring **73** carries a pawl contractor in the form of a ball **81**, and a back-up spring **82** is in outer radial restriction on the ring **73** and provides radial inward force on the ball and thus on the pawl. There is sliding engagement of the pawl **71** by the ball for pivoting the pawl between right and left drive engagement with the gear **56** upon rotation of the ring **73**. Left hand engagement is shown, and the ring **73** was rotated counterclockwise from that rear handle end to achieve that mode. The pawl **71** has two arcuate and contiguous exterior surfaces **83** which have the same curvature as that of the circular surface **84** of the ring, thus they have the same radius from axis A. Thus the ring lends support for the pawl in both its engaged positions. Also, the ball **81** precisely and easily slides on the arcuate pawl surfaces **83** for its radial movement in and out upon rotation of the ring. Again, the lock pin **42** could be employed and be carried by the ring **73** for the purposes previously mentioned.

FIG. **11** shows that the ball **81** and spring **82** are disposed on a radial line R, and the location of the engaged pawl teeth and the engaged gear teeth is also on that line. That feature occurs in both driving directional modes for the pawl **71**, thus there is secure teeth driving arrangement.

FIGS. **13** and **14** show a modification with regard to the locking of the selectors **27** and **73**, and the selector is now slightly changed in its axial length to be selector **86**. Thus, the selector **86**, which is also termed annulus **86**, can be as seen in FIGS. **13** and **14** and has circular surfaces **87** and **88** which are axially guided by and which can be in rotation contact with the adjacent circular surfaces **89** and **91** respectively on the body **17** and the member **44**. That is, the selector **86** need not move axially in the assembly. Still, the selector **86** presents a lock pin **92** to the member **44**, but the pin **92** itself is axially movably in its mounting hole **93** on the selector **86** for releasable rotation locking with the member **44**. A spring **94** urges the pin **92** into the selected one of three holds now **96** in the member **44** for the rotation releasable locking engagement. For the locking action, the pine **92** will ride into and out of the selected hole **96** upon rotation of the annulus **86**.

It should be understood that the variations shown in these embodiments are arranged to have each embodiment constructed and operate as intended and indicated. Such as, the three springs **53** are not employed in the embodiment of FIG. **13**, and thus the three holes **54** in annulus **27** are not needed. All the embodiments can employ either one or two pawls, as disclosed, and the selector and body can be as appropriate in either FIG. **6** or FIG. **11**. The annulus lock pin **42** or **92** and its mounting can be in any embodiment.

The embodiments are described in their construction, and it will be understood that changes can be made therein and still be within the scope of this invention. Further, the showings and the description both disclose the methods for constructing and assembling these screwdrivers.

What is claimed is:

1. In a ratchet screwdriver, a body (**17**, **72**) having a longitudinal axis (A), a gear (**56**) disposed within the body and rotatable by the handle about the axis (A), a pawl (**21**, **22**, **71**) pivoted on the body and being selectively rotationally engageable with the gear, a selector (**27**, **73**) rotatable on the body about the axis (A) to selective rotated positions on the body for engaging the pawl for selective direction of rotation drive, the improvement comprising:

said selector being axially movable on said body, and

said body and said selector being selectively relatively non-rotationably engageable for locking said selector in selected rotated positions in response to the axial and rotating movement of said selector.

2. The ratchet screwdriver as claimed in claim **1**, further comprising:

a member (**44**) attached to said body,

said member and said selector having a pin (**42**, **92**) extending in the axial direction to be engageable between said member and said selector for achieving the selective locking of said selector on said body.

3. The ratchet screwdriver as claimed in claim 2, further comprising:

said pin being engaged between said selector and said member to have said pin penetrate said member to a depth for the engagement, and

said selector being axially movable on said body for an axial displacement in an amount greater than said depth.

4. The ratchet screwdriver as claimed in claim 3, Furth comprising:

a plurality of springs (53) circularly spaced apart relative to said selector and operative between said selector and said body for urging said body axially to an unlocked mode.

5. The ratchet screwdriver as claimed in claim 4, further comprising:

fasteners (64) connected with said member and operative on said body and said springs, wherein said fasteners axially urge said member, said springs and said pin into axial restraint for the selector locking mode.

6. In a ratchet screwdriver, a body (17, 72) having a longitudinal axis (A), a gear (56) disposed within the body and rotatable by the handle about the axis (A), a pawl (21, 22, 71) pivoted on the body and being selectively rotationally engageable with the gear, a selector (27, 73) rotatable on the body about the axis (A) to selective rotated positions on the body for engaging the pawl for selective direction of rotation drive, the improvement comprising:

said body having a surface (60) facing in a first axial direction relative to said axis and on a first axial side of said gear for restricting axial movement of said gear,

a member (44) on a second axial side of said gear and being connected to said body for applying axial force along said axis onto said gear to restrict axial movement of said gear relative to said axis and away from said body surface (60),

said selector being an annulus and having axially spaced apart interior circular surfaces (49), and

said body and said member respectively having circular surfaces (48, 47) in sliding contact with said selector surfaces for movably guiding said selector on said body and said member.

7. The ratchet screwdriver as claimed in claim 6, further comprising:

threaded connectors (64) extending between said body and said member for drawing said body and said member toward each other in applying the axial force therebetween.

8. The ratchet screwdriver as claimed in claim 7, further comprising:

a wave washer (62) adjacent to said gear for axially forcing on said gear in response to tightening of said threaded connectors in the applying of axial force.

9. in a ratchet screwdriver, a body (17, 72) having a longitudinal axis (A), a gear (56) disposed within the body and rotatable by the handle about the axis (A), a pawl (21, 22, 71) pivoted on the body and being selectively rotationally engageable with the gear, a selector (27, 73) rotatable on the body about the axis (A) to selective rotated positions on the body for engaging the pawl for selective direction of rotation drive, the improvement comprising:

said body having a surface (60) facing in a first axial direction relative to said axis and on a first axial side of said gear for restricting axial movement of said gear,

a member (44) on a second axial side of said gear and being connected to said body for applying axial force along said axis onto said gear to restrict axial movement of said gear relative to said axis and away from said body surface (60), and

said body having a surface (55) disposed to face said handle and said selector being arranged to be axial movable toward said body surface (55) and to present a space (51) adjacent to said body for the axial movement of said selector in the assembled screwdriver.

10. The ratchet screwdriver as claimed in claim 9, further comprising:

said selector being an annulus arranged to be axial movable along said axis toward and onto said body and said member being arranged to contact said annulus for movably supporting said annulus.

* * * * *