



US 20170008189A9

(19) **United States**
(12) **Patent Application Publication**
Gass et al.

(10) **Pub. No.: US 2017/0008189 A9**
(48) **Pub. Date: Jan. 12, 2017**
CORRECTED PUBLICATION

(54) **BLADE TILT MECHANISMS FOR TABLE SAWS**

Related U.S. Application Data

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(60) Provisional application No. 61/741,493, filed on Jul. 20, 2012.

Publication Classification

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(51) **Int. Cl.**
B27B 5/24 (2006.01)
(52) **U.S. Cl.**
CPC **B27B 5/243** (2013.01)

(21) Appl. No.: **13/946,101**

(57) **ABSTRACT**

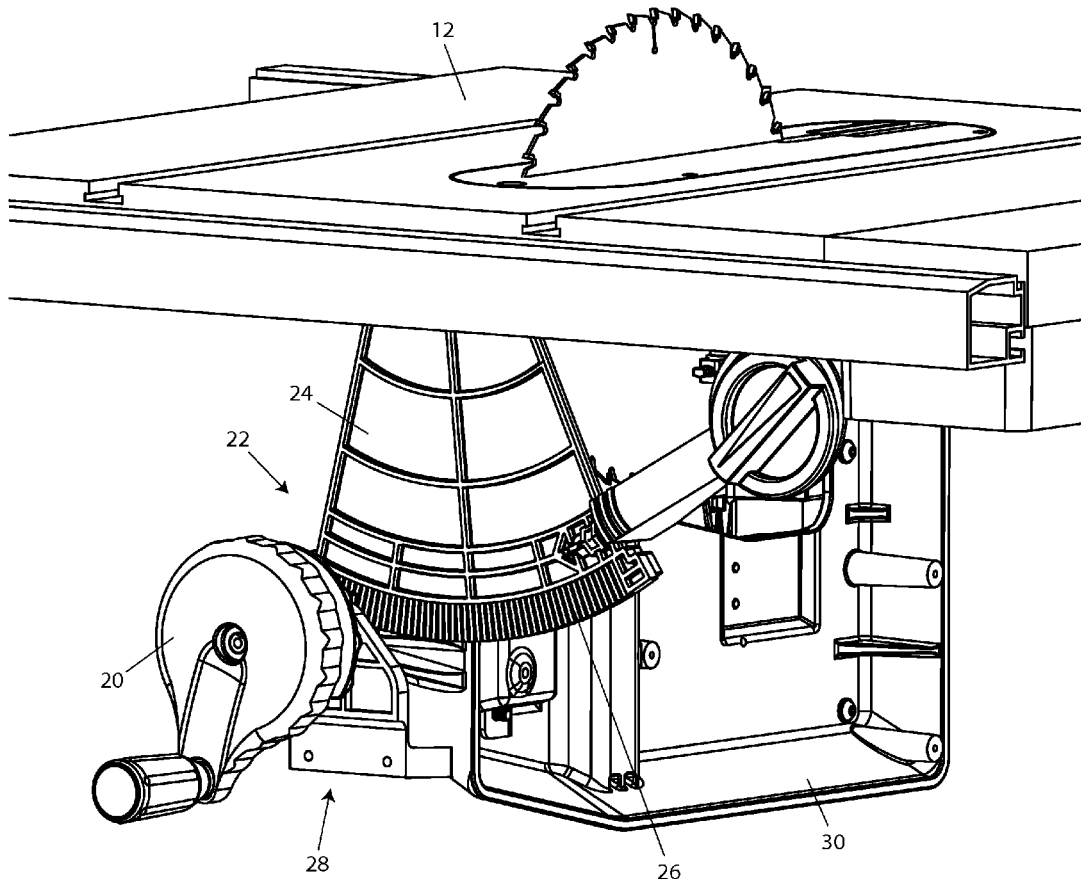
(22) Filed: **Jul. 19, 2013**

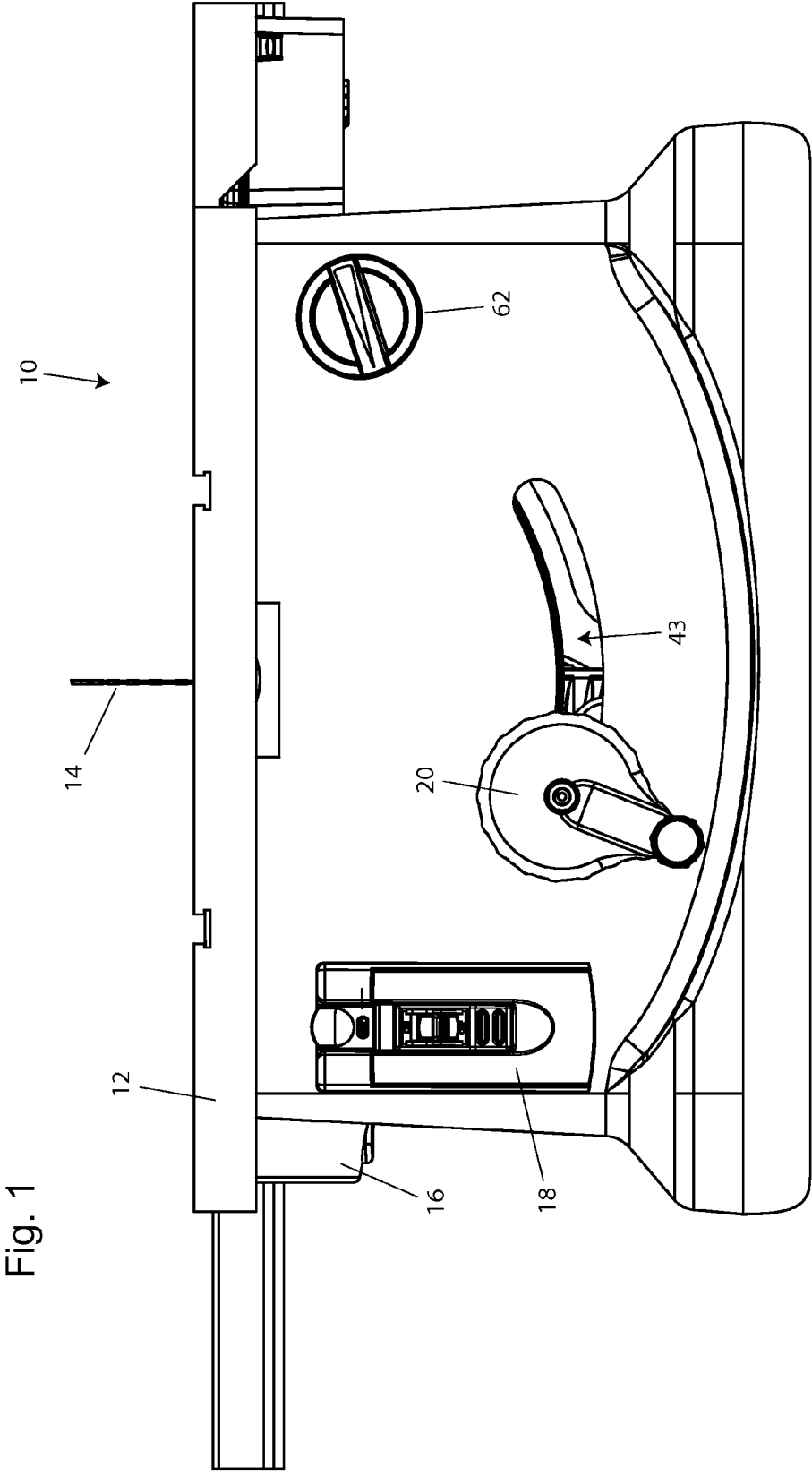
Prior Publication Data

(15) Correction of US 2015/0020668 A1 Jan. 22, 2015
See (60) Related U.S. Application Data.

(65) US 2015/0020668 A1 Jan. 22, 2015

Blade tilt mechanisms for table saws are disclosed. The disclosed tilt mechanisms provide easy and intuitive operation. They also provide auto-locking so that a user simply releases a component to lock the blade at a specific angle. The tilt mechanisms also provide defined incremental steps for the tilt of the blade and the steps are typically spaced at 1-degree intervals.





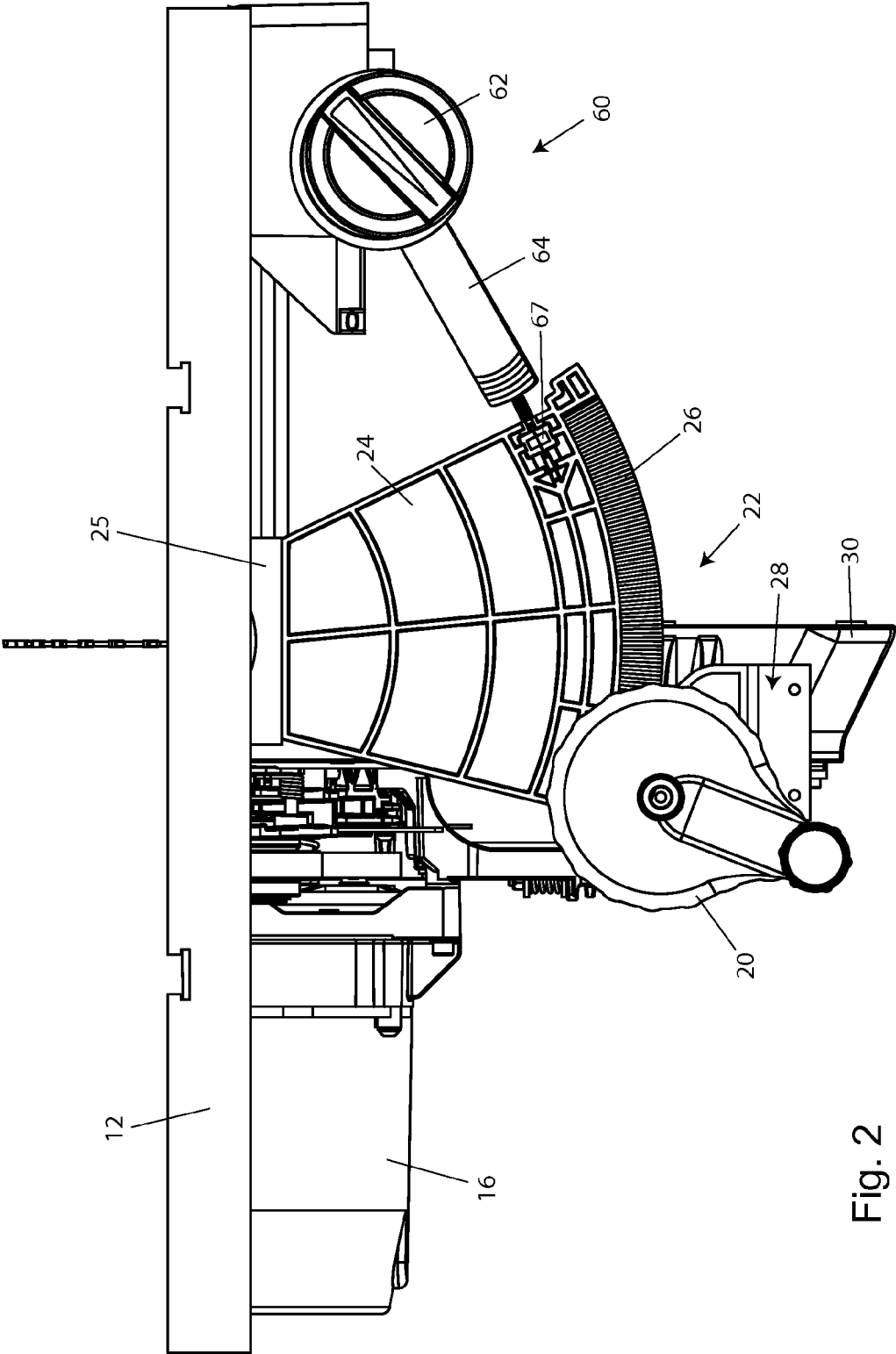


Fig. 2

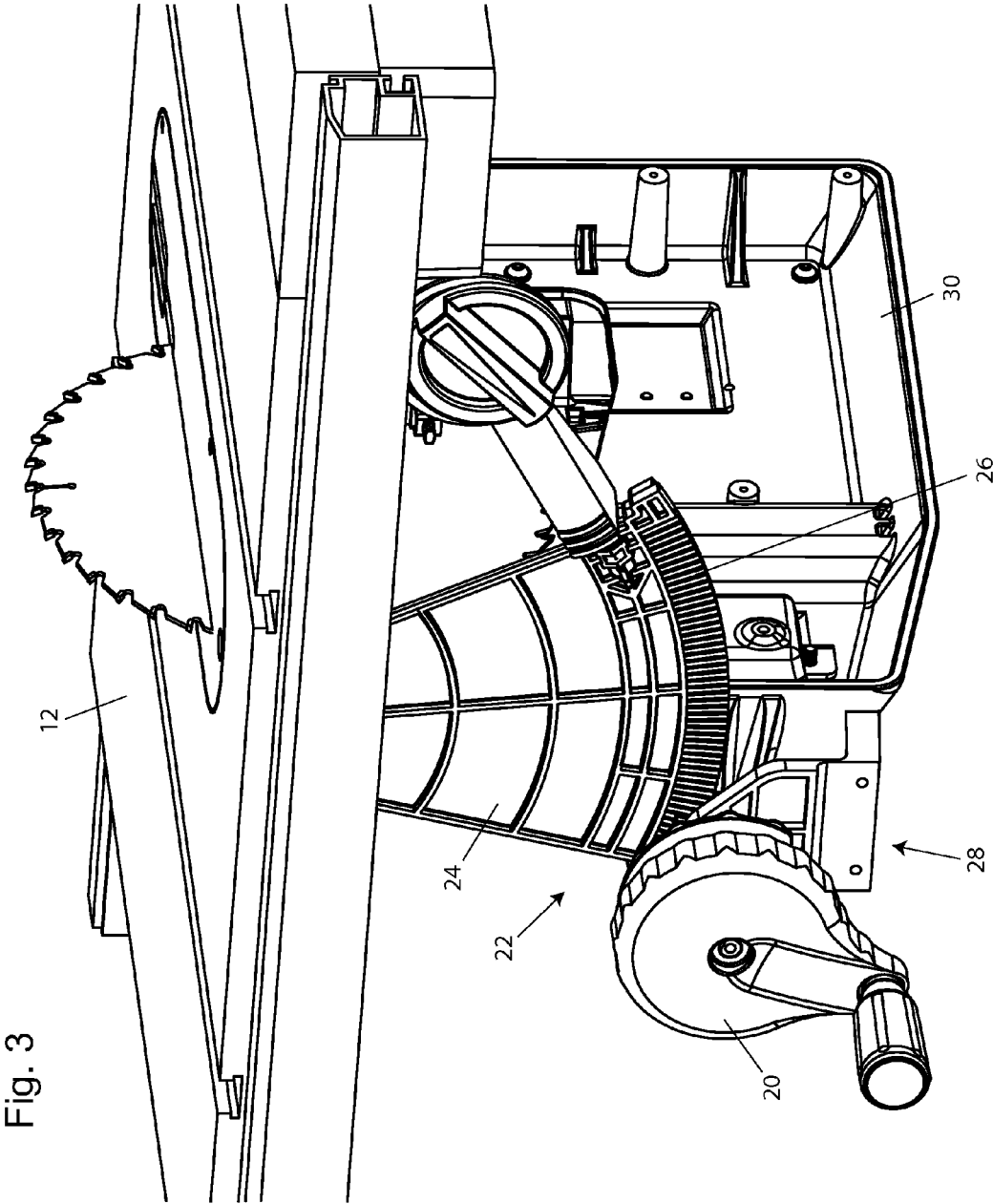
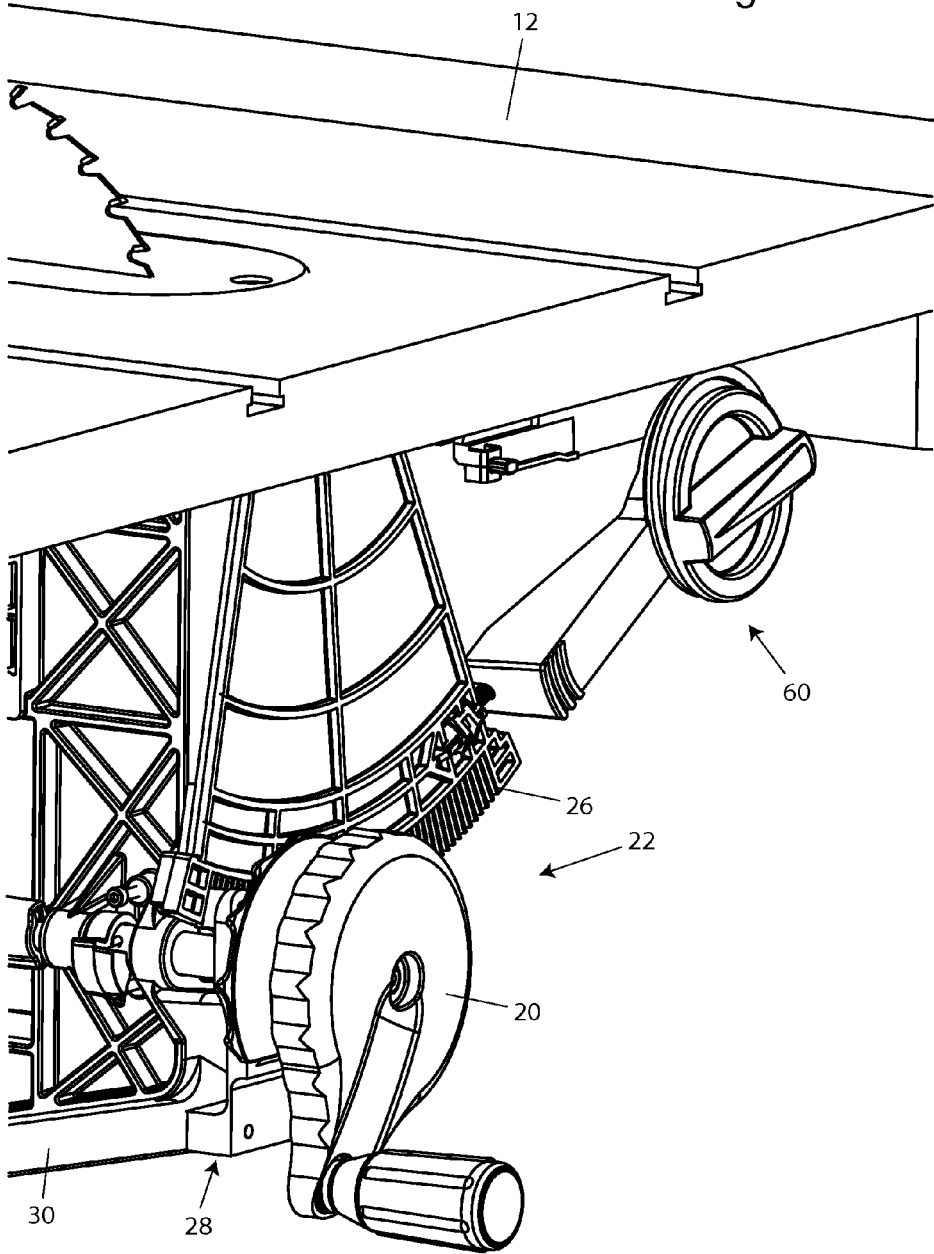


Fig. 4



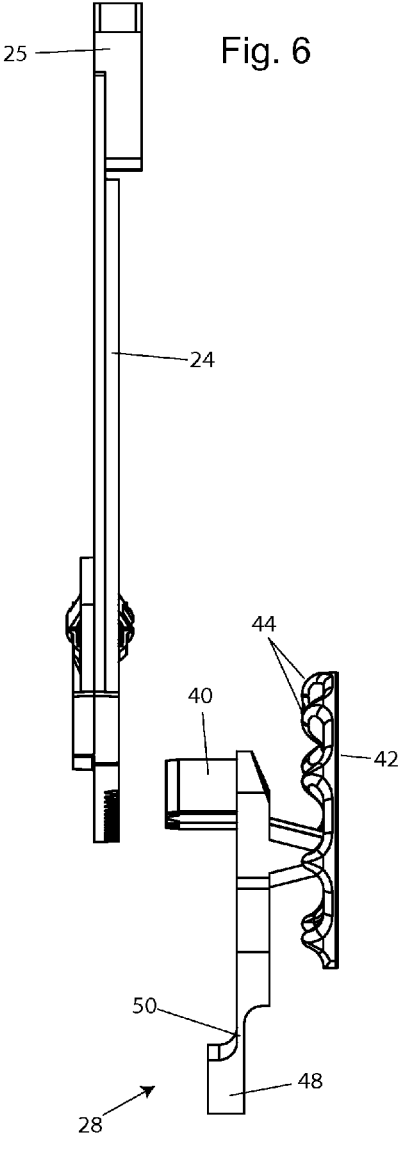
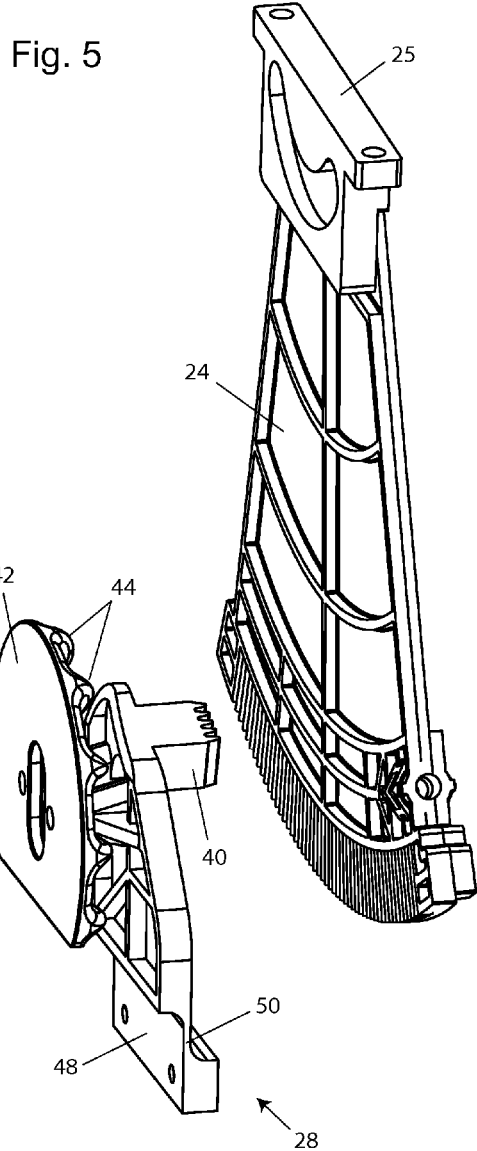


Fig. 7

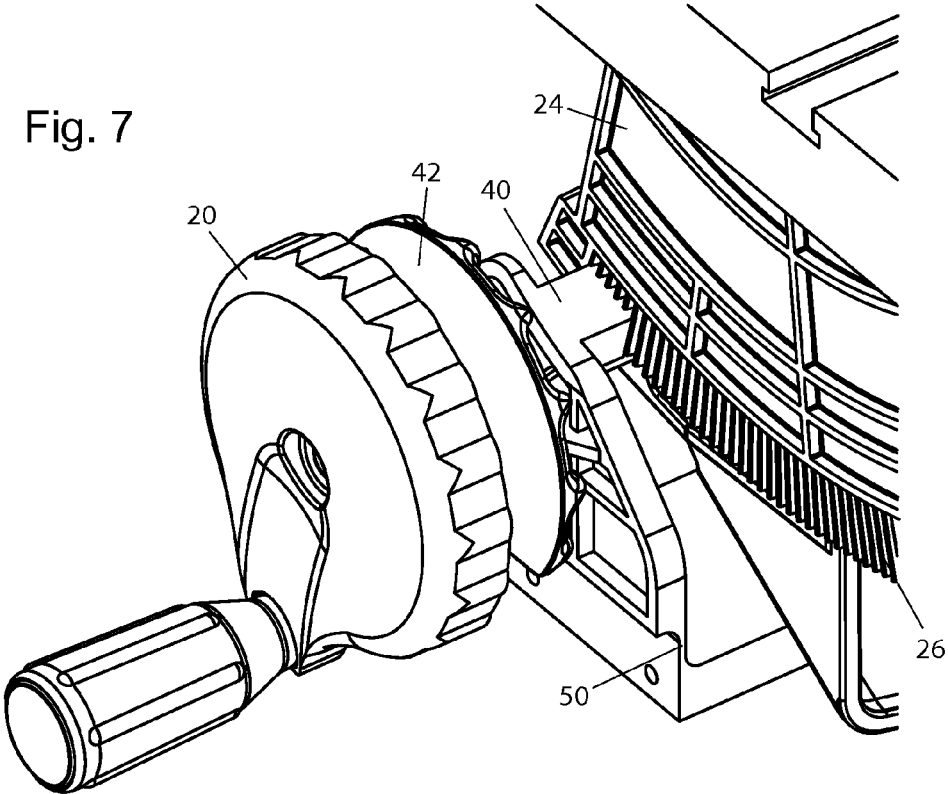


Fig. 8

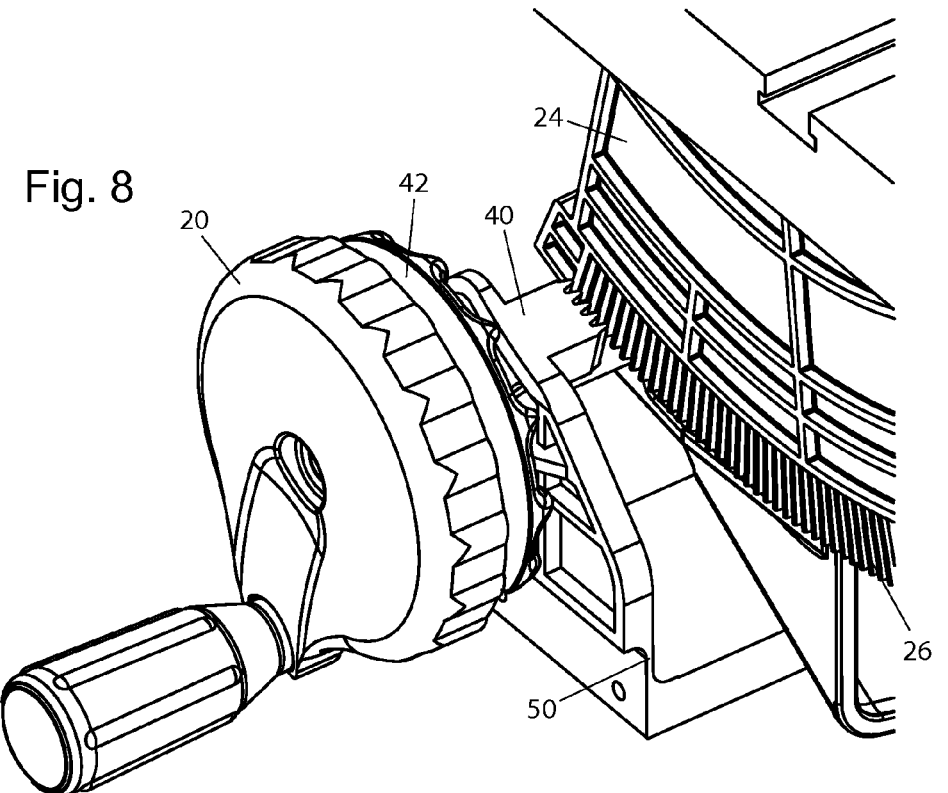


Fig. 9

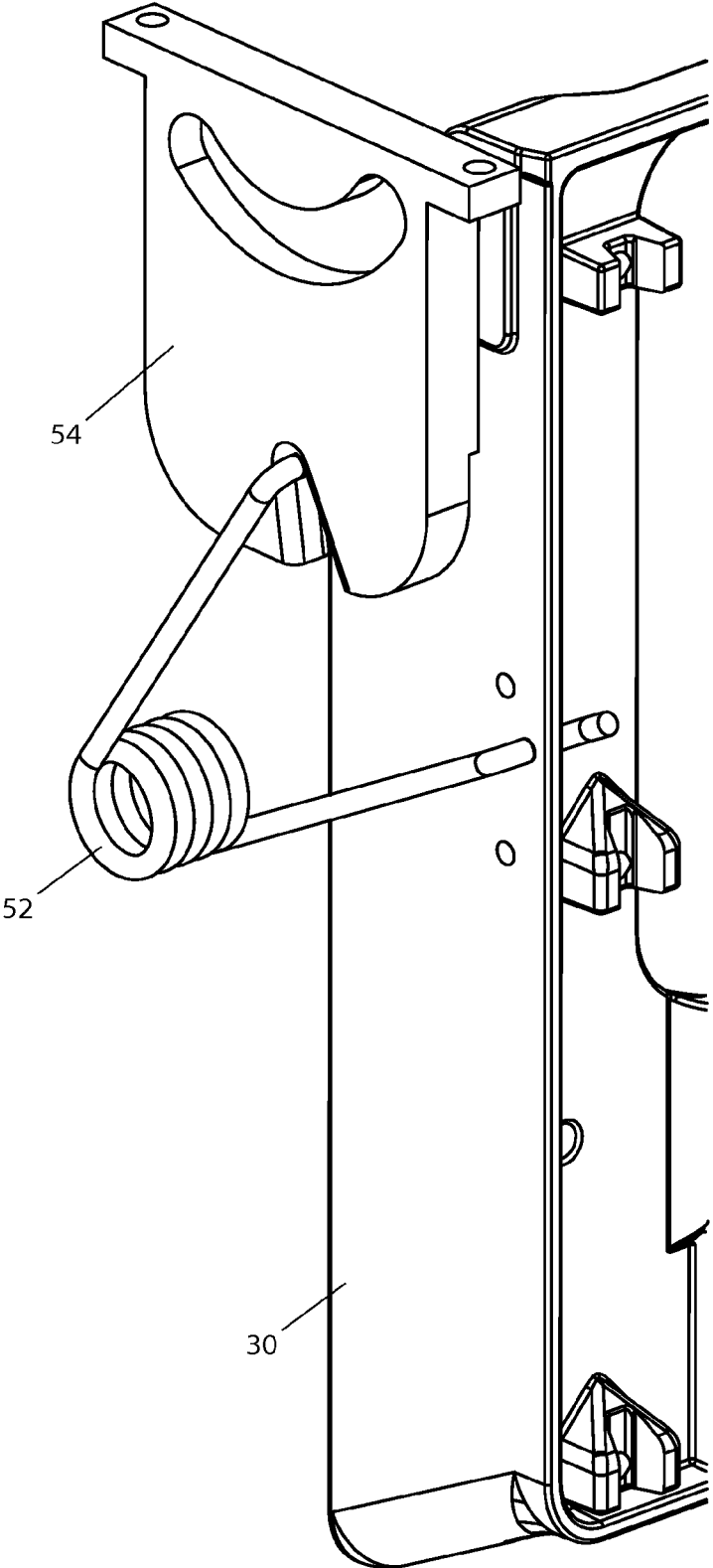
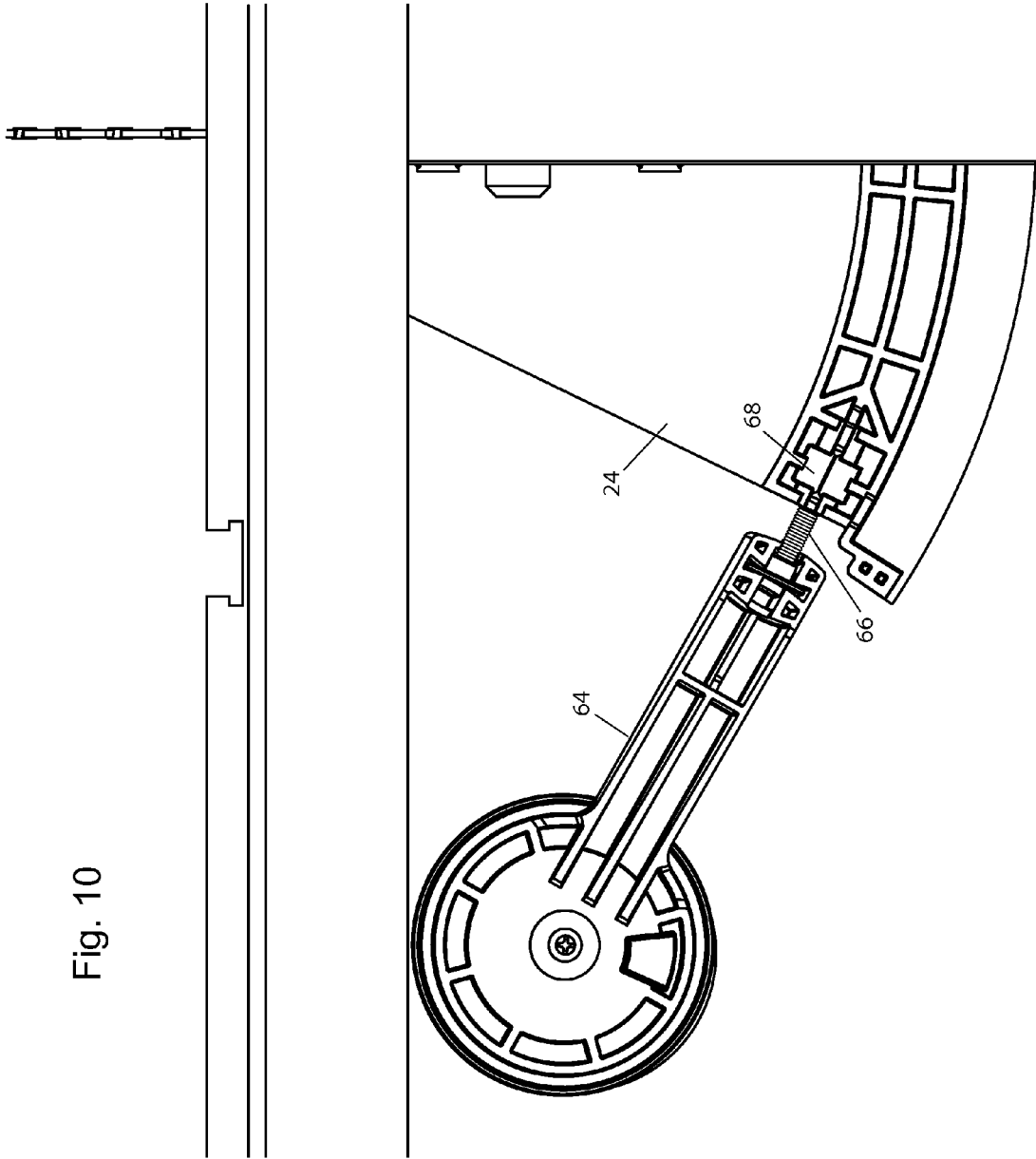


Fig. 10



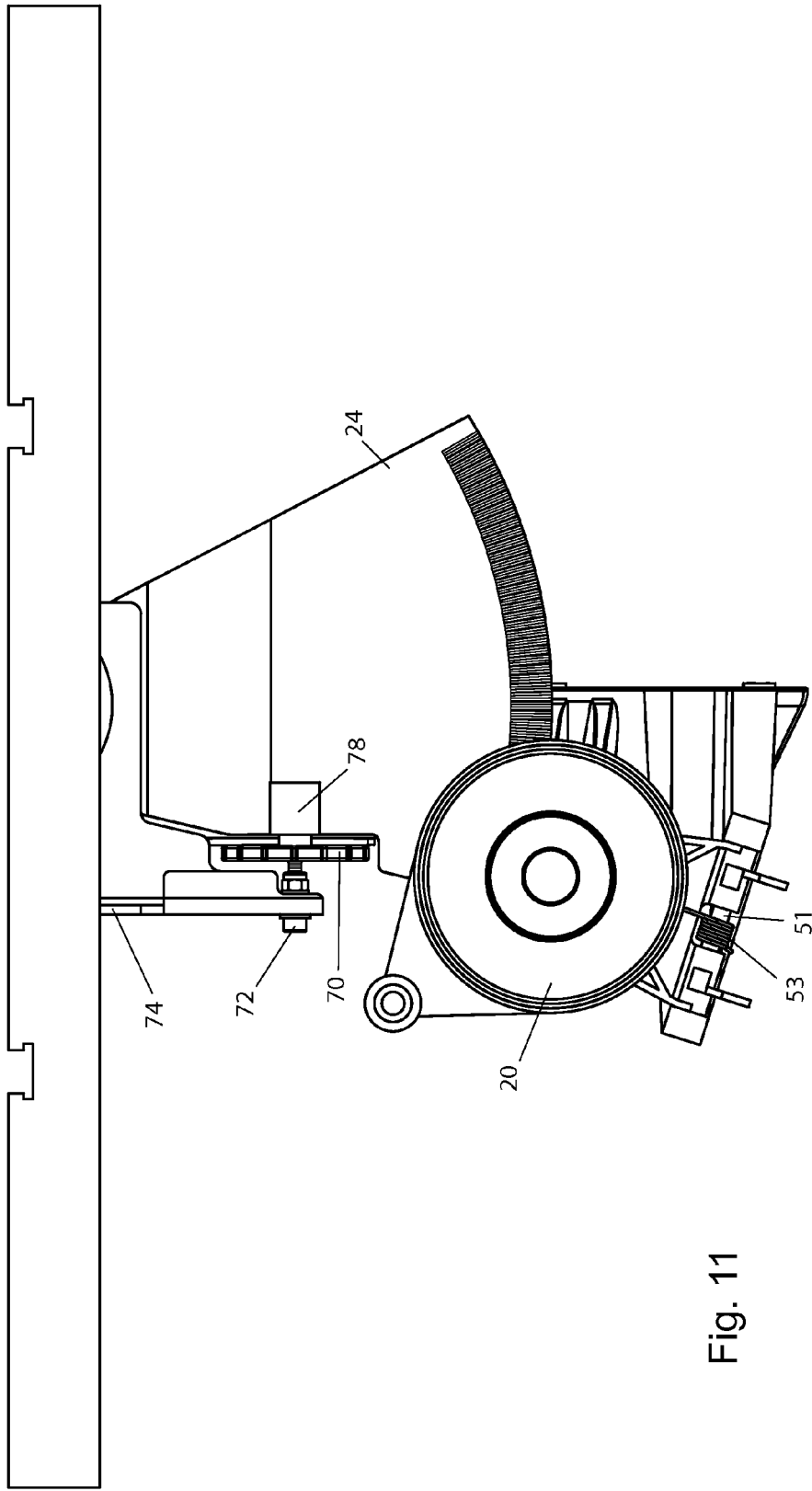


Fig. 11

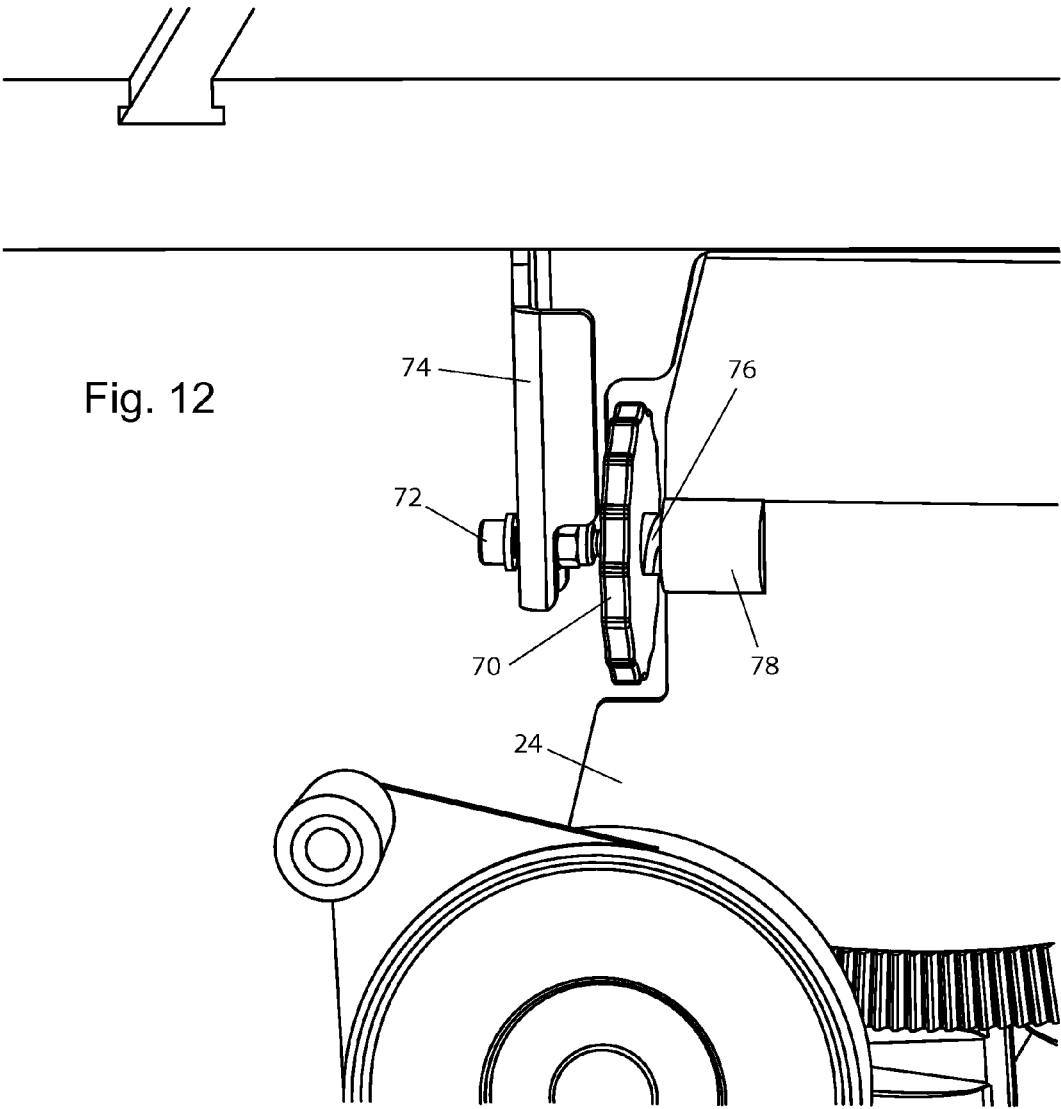


Fig. 12

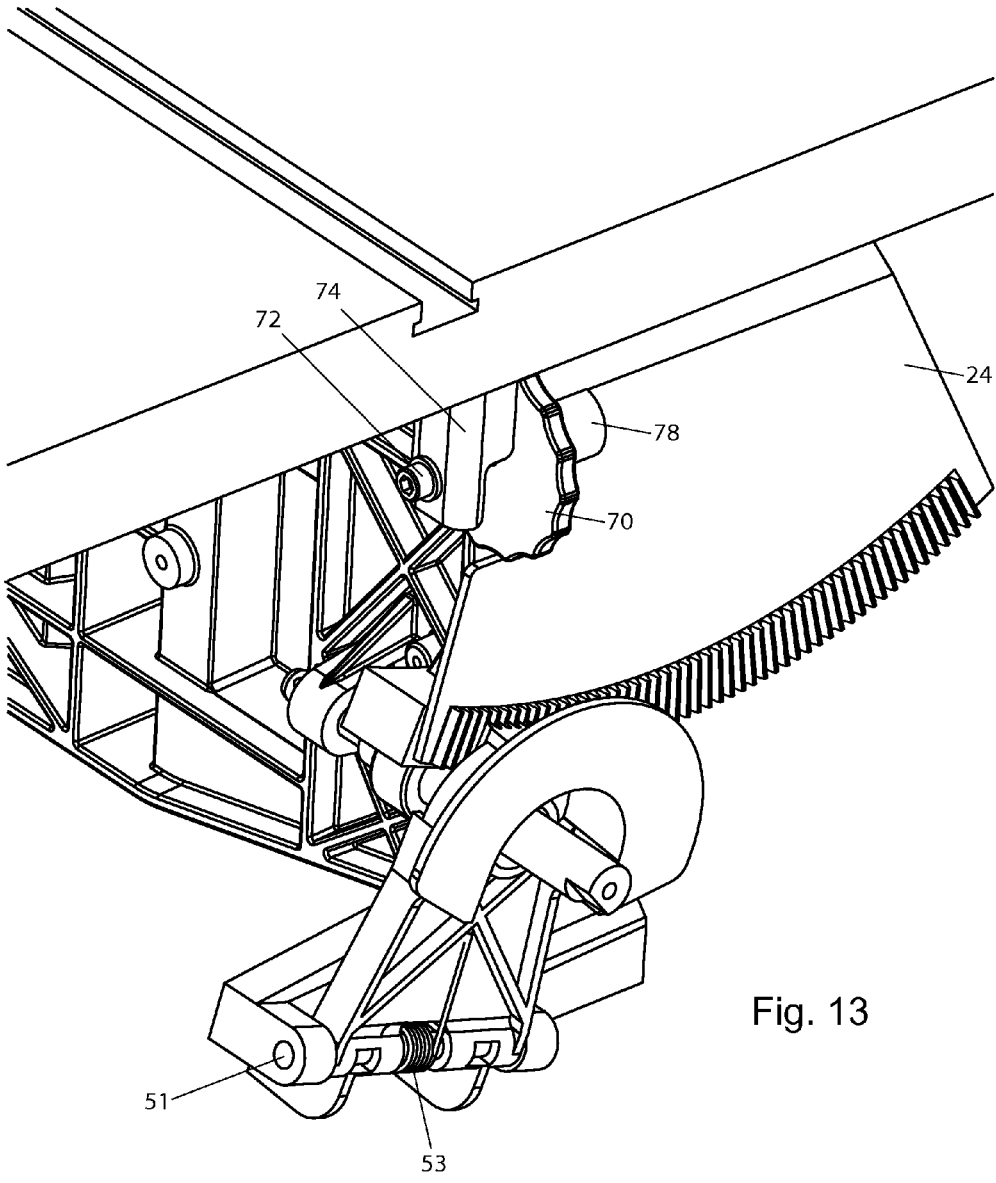


Fig. 13

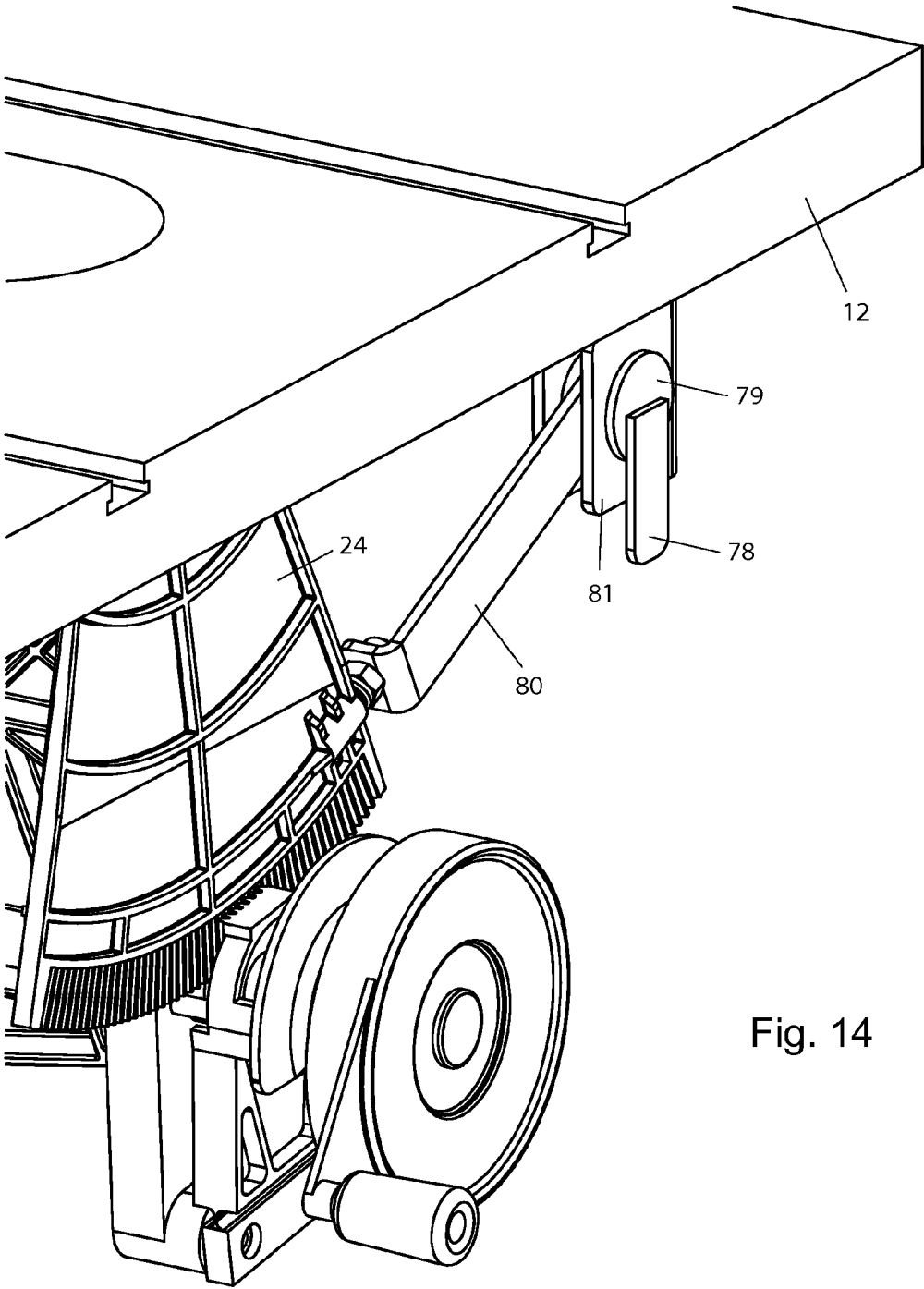
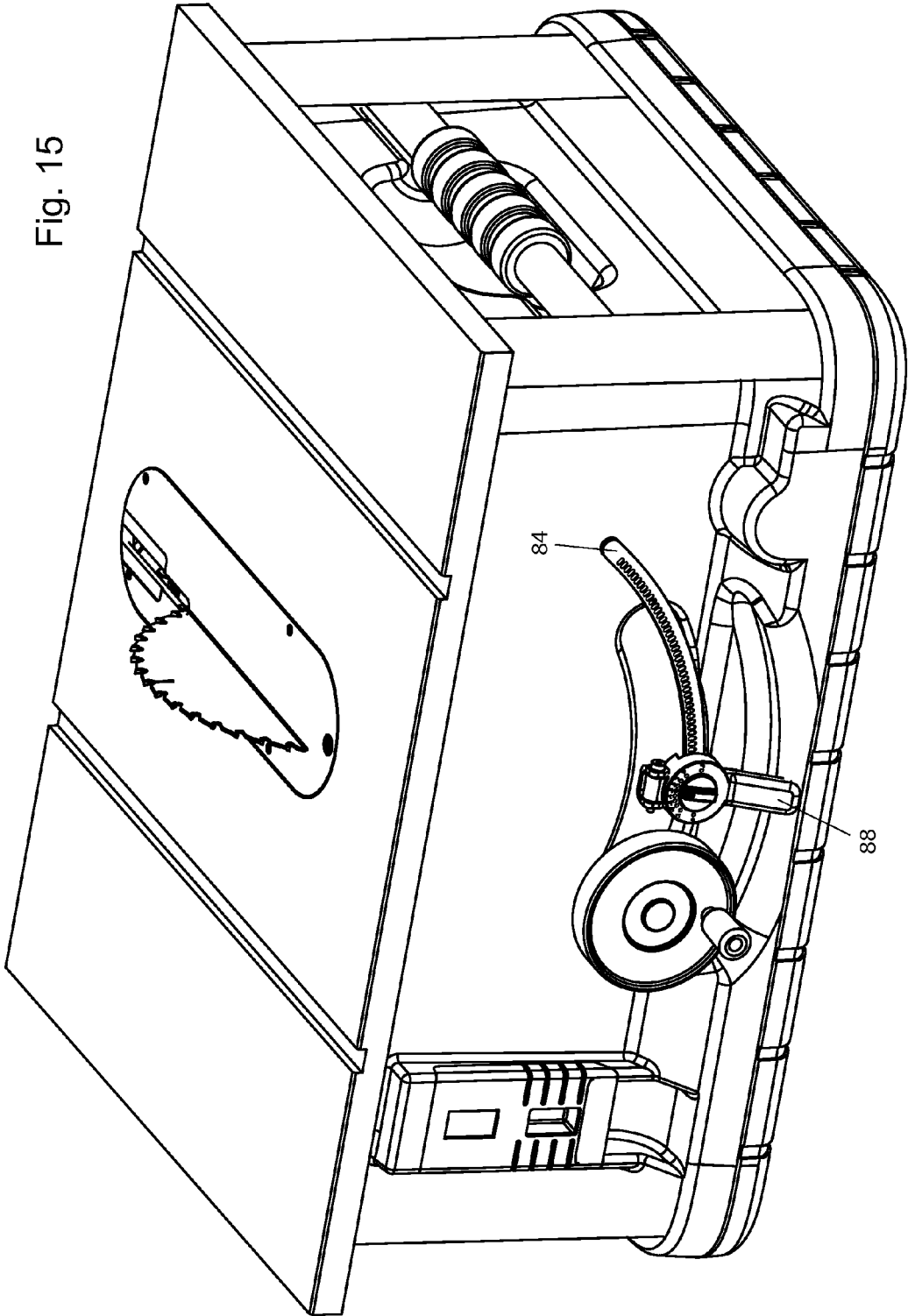


Fig. 14

Fig. 15



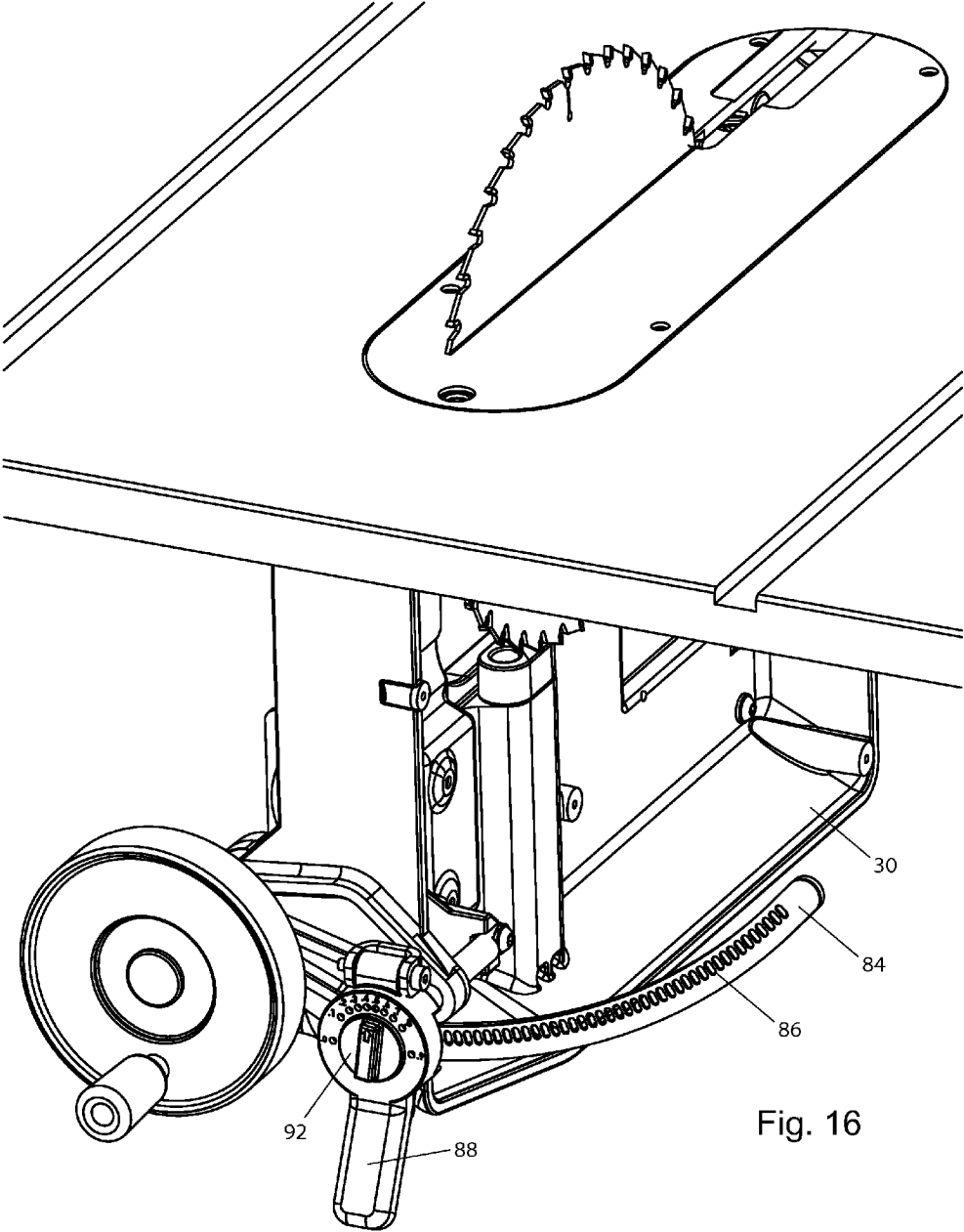


Fig. 16

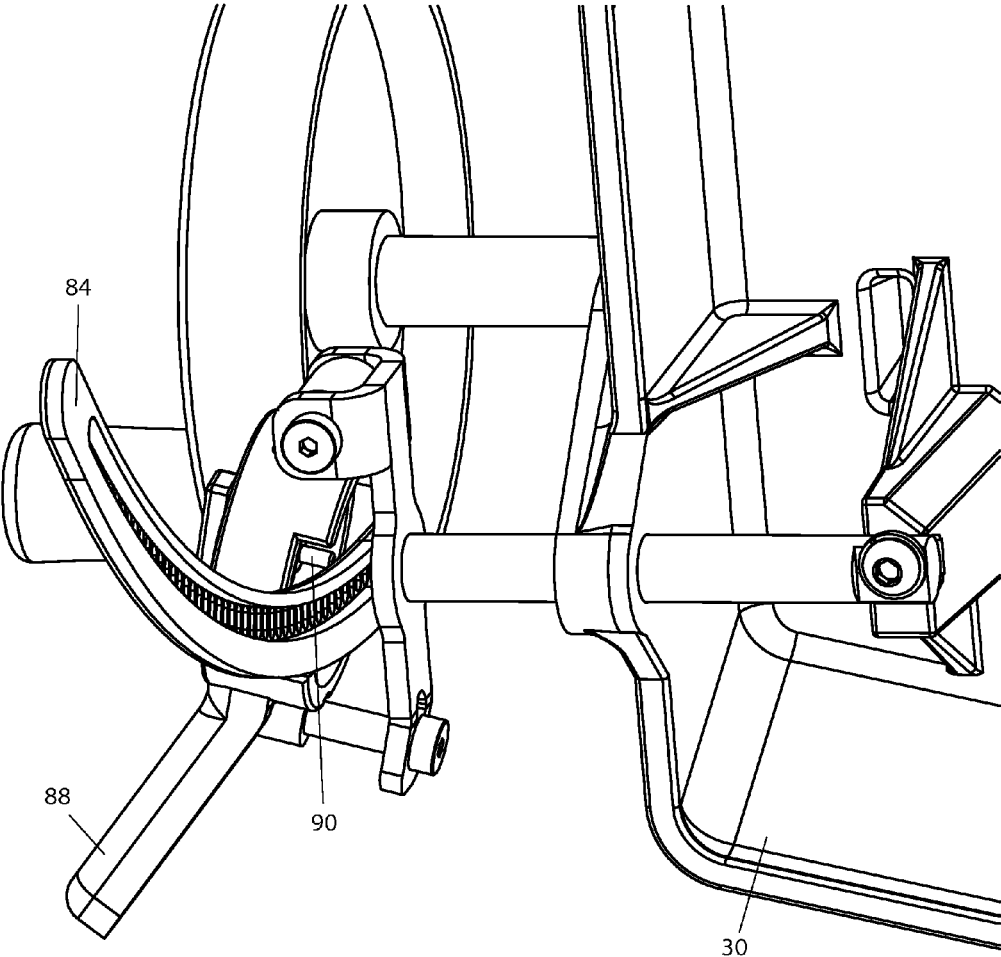


Fig. 17

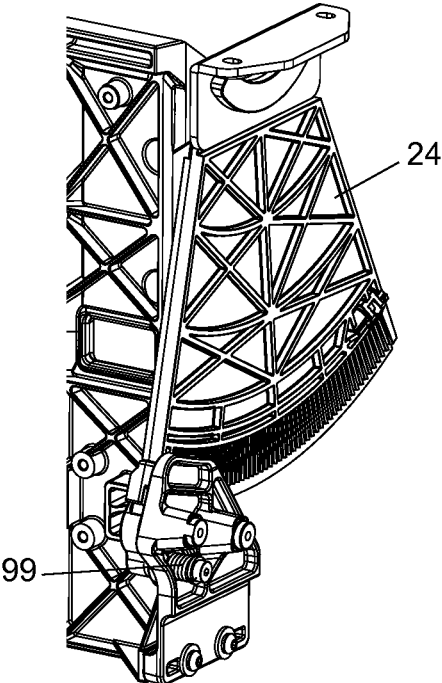


Fig. 18

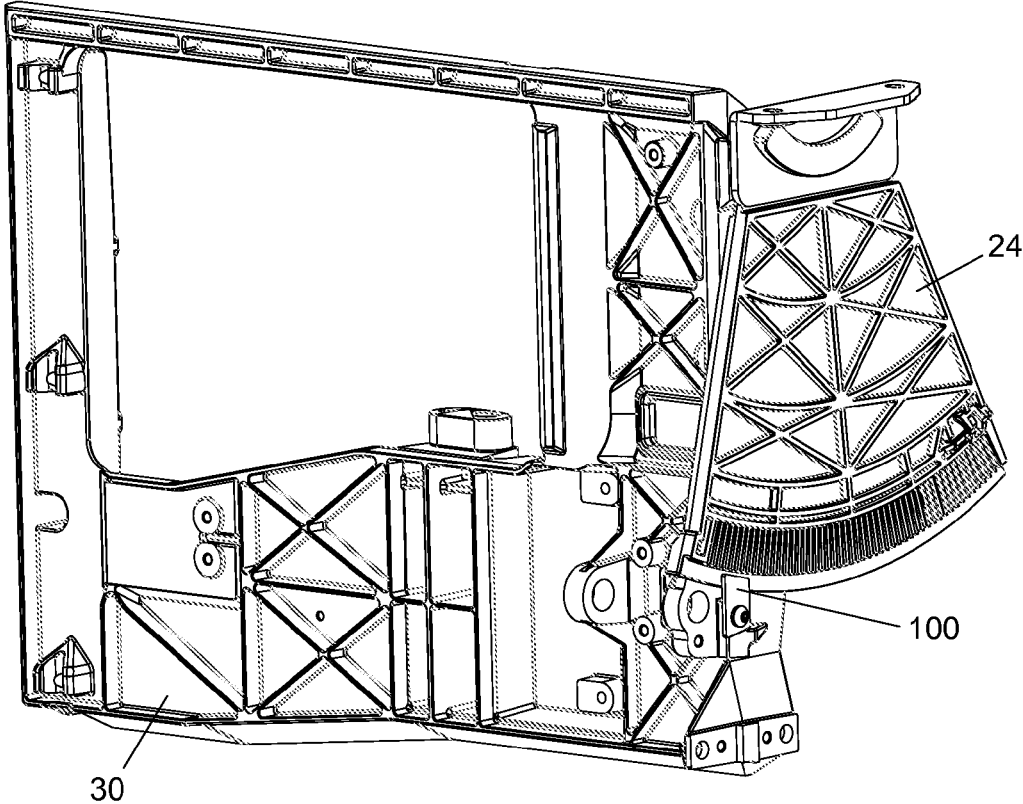


Fig. 19

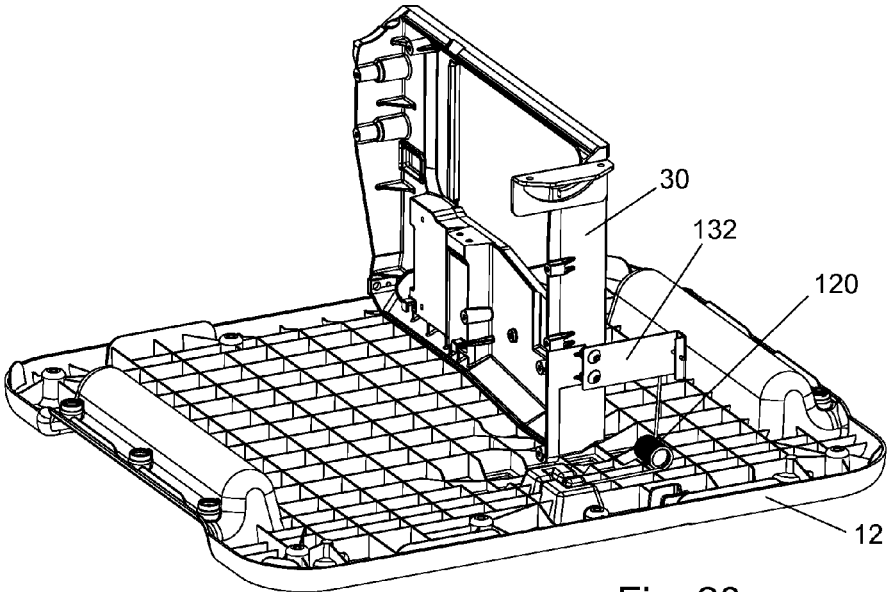


Fig. 20

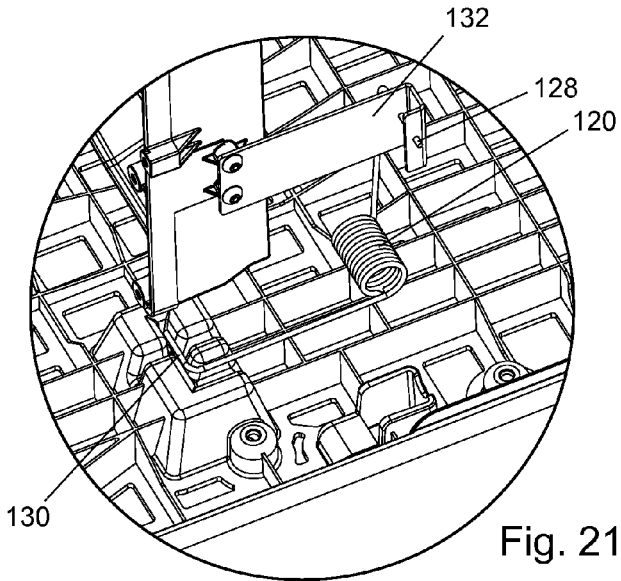


Fig. 21

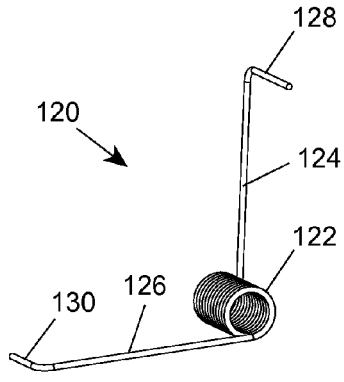


Fig. 22

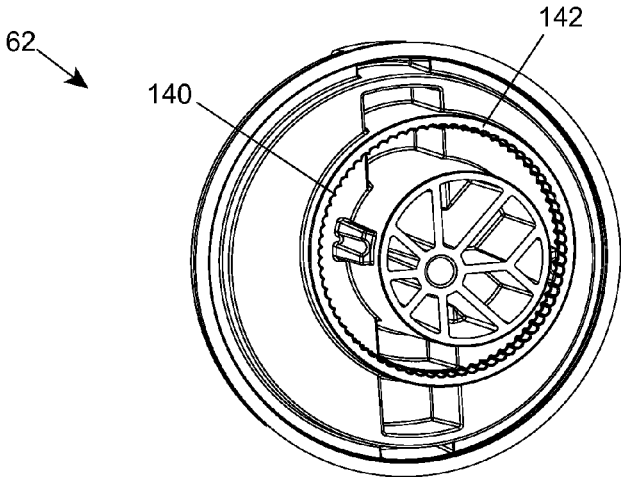


Fig. 23

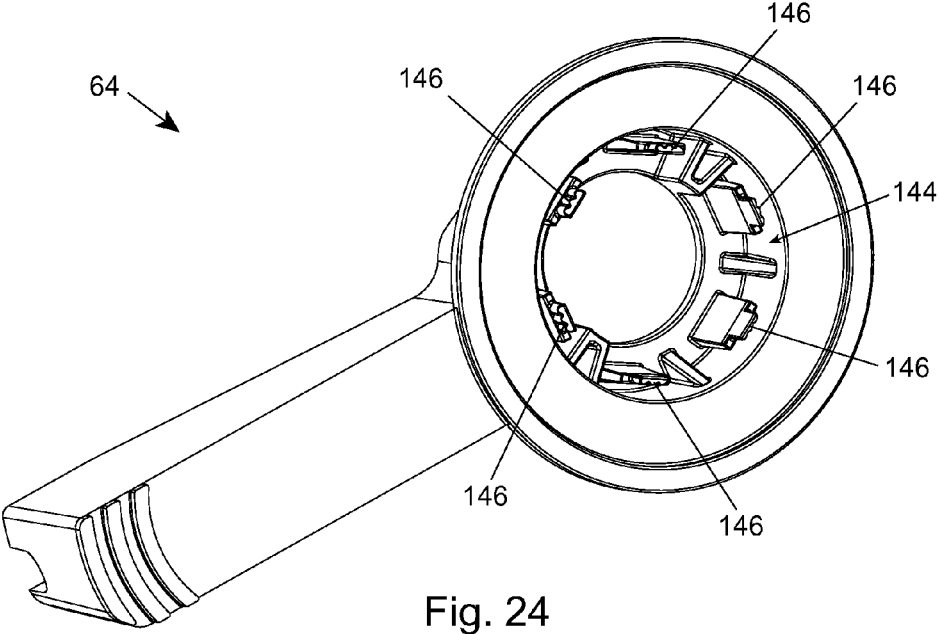


Fig. 24

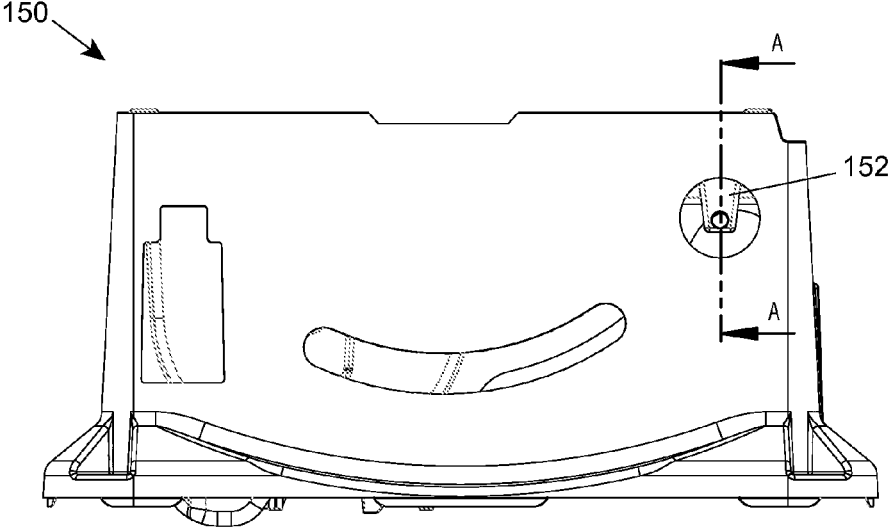


Fig. 25

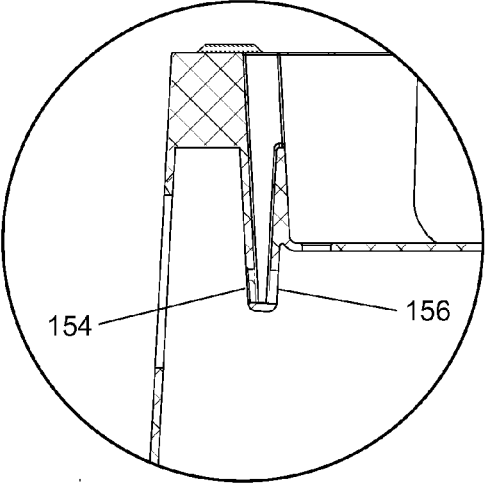


Fig. 26

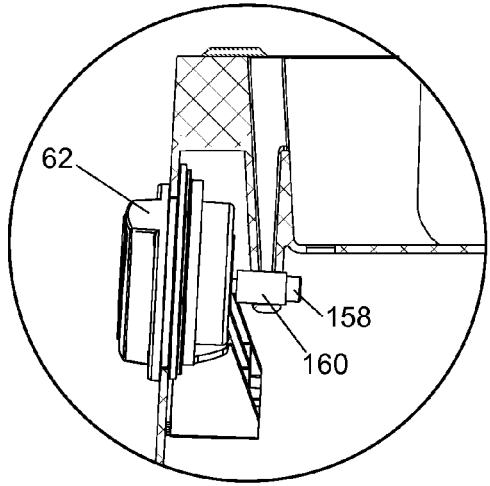


Fig. 27

BLADE TILT MECHANISMS FOR TABLE SAWS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of and priority from U.S. Provisional Patent Application Ser. No. 61/741,493, filed Jul. 20, 2012, which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to table saw mechanisms designed to improve convenience and performance. More specifically, this specification relates to mechanisms used to tilt the blade to make beveled or angled cuts.

BACKGROUND

[0003] A table saw is a power tool used to cut a workpiece to a desired size or shape. A table saw includes a work surface or table and a circular blade extending up through the table. A person uses a table saw by placing a piece of wood or other workpiece on the table and feeding it past the spinning blade to make a cut.

[0004] Table saws are typically constructed so that a user can adjust the angle or tilt of the blade relative to the table in order to make beveled or angled cuts. Some table saws include hand wheels that a user turns to tilt the blade. Other table saws include a clamp to hold the blade at a specific angle relative to the table. In those saws, a user changes the blade's tilt by releasing the clamp, manually tilting the blade to a desired position, and then performing some specific action to re-engage the clamp, such as tightening a knob or moving a lever.

[0005] This specification discloses tilt mechanisms that enable a user to tilt the blade easily and intuitively, that provide an auto-lock feature, and that provide defined and incremental positions for the blade.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 shows a table saw.
 [0007] FIG. 2 shows a front view of a tilt mechanism in a table saw.
 [0008] FIG. 3 shows perspective view of the tilt mechanism of FIG. 2.
 [0009] FIG. 4 shows another perspective view of the tilt mechanism of FIG. 3.
 [0010] FIG. 5 shows a perspective and exploded view of a rack and an engagement member used in the tilt mechanism of FIG. 2.
 [0011] FIG. 6 shows a side view of the rack and engagement member of FIG. 5.
 [0012] FIG. 7 shows an engagement member engaging a rack.
 [0013] FIG. 8 shows an engagement member disengaged from a rack.
 [0014] FIG. 9 shows a spring to counterbalance the weight of the blade, trunnion, motor and related structure.
 [0015] FIG. 10 shows a back view of an adjustment mechanism.
 [0016] FIG. 11 shows another embodiment of an adjustment mechanism.
 [0017] FIG. 12 shows a dial used in the adjustment mechanism shown in FIG. 11.

[0018] FIG. 13 shows a view of the adjustment mechanism shown in FIG. 12 with a hand wheel removed for clarity.

[0019] FIG. 14 shows another embodiment of an adjustment mechanism.

[0020] FIG. 15 shows another embodiment of a tilt mechanism.

[0021] FIG. 16 shows the tilt mechanism of FIG. 15 with the housing removed for clarity.

[0022] FIG. 17 shows a pin used in the tilt mechanism of FIG. 15.

[0023] FIG. 18 shows a spring in a tilt mechanism.

[0024] FIG. 19 shows a tab used in a tilt mechanism.

[0025] FIG. 20 shows another embodiment of spring to counterbalance the weight of the blade, trunnion, motor and related structure.

[0026] FIG. 21 shows an enlarged view of the spring of FIG. 20.

[0027] FIG. 22 shows an isolated view of the spring of FIG. 20.

[0028] FIG. 23 shows ridges used in a tilt adjustment mechanism.

[0029] FIG. 24 shows tabs used in a tilt adjustment mechanism.

[0030] FIG. 25 shows a saw housing with an arm to support a dial used in a tilt adjustment mechanism.

[0031] FIG. 26 shows a cross-section of the arm shown in FIG. 25.

[0032] FIG. 27 shows a dial supported by the arm shown in FIG. 25.

DETAILED DESCRIPTION

[0033] FIG. 1 shows a table saw 10 including a table 12 and a circular blade 14 extending up through the table. A piece of wood, or other material to be cut, is placed on the table and pushed into contact with the spinning blade to make a cut. The saw includes a motor 16 to spin the blade, and a switch 18 to turn the motor on and off.

[0034] Table saw 10 also includes an elevation mechanism to raise or lower the blade to cut workpieces of varying thicknesses. The elevation mechanism includes a hand wheel and a user turns hand wheel 20 to raise and lower the blade.

[0035] Table saw 10 further includes a tilt mechanism 22 to adjust the angle or tilt of the blade relative to the table in order to make beveled or angled cuts. FIGS. 2-4 show different views of table saw 10 with the housing removed in order to see tilt mechanism 22. Various components typically included in a table saw, such as dust shrouds, riving knife mounts, elevation mechanisms, etc., have been removed from FIGS. 2-4 to more clearly show the tilt mechanism.

[0036] Tilt mechanism 22 includes a rack 24 mounted in the saw to a front trunnion bracket 25, which in turn is mounted to the underside of table 12. The bottom of rack 24 includes an arcuate or curved section having teeth 26 with gullets between the teeth. In the embodiment shown, teeth 26 are spaced at 1-degree intervals, although they may be spaced at greater or smaller intervals. Rack 24 may be made from hard plastic or any other suitable material.

[0037] Tilt mechanism 22 also includes an engagement member 28 positioned behind hand wheel 20 and mounted to a trunnion 30. Trunnion 30 carries the blade and is

supported at least in part by front trunnion bracket **25** so that the trunnion can pivot from side to side in order to tilt the blade.

[0038] Engagement member **28** includes a toothed portion **40** configured to mesh with teeth **26** on rack **24**, as seen in FIGS. **5** and **6**. Engagement member **28** also includes a grip plate **42** configured to be engaged by a user. Grip plate **42** includes bumps **44** to increase friction with a user's hand, but may alternatively have a textured surface, a smooth surface, or some other surface.

[0039] Grip plate **42** is connected to toothed portion **40** but spaced apart so that the housing of the saw can extend between the grip plate and the toothed portion. In this configuration, grip plate **42** is outside the saw while toothed portion **40** is inside the saw. The connection between grip plate **42** and toothed portion **40** extends through an opening **43** in the housing (the opening is shown in FIG. **1**). Opening **43** can be minimized by decreasing the size of the connection between grip plate **42** and toothed portion **40**.

[0040] Engagement member **28** can be made from plastic, and it includes a base **48** used to mount the engagement member to trunnion **30**. A thin section **50** connects base **48** to toothed portion **40** and to grip plate **42**. Thin section **50** acts as a spring and allows toothed portion **40** and grip plate **42** to flex or bend relative to base **48**.

[0041] FIGS. **7** and **8** illustrate how the teeth on engagement member **28** mesh with teeth **26** on rack **24**. As seen in FIGS. **7** and **8**, grip plate **42** is positioned behind hand wheel **20**. In operation, a user would place his fingers along bumps **44** on grip plate **42** and squeeze or pull the grip plate toward hand wheel **20**. As stated, thin section **50** on engagement member **28** acts as a spring and allows grip plate **42** and toothed portion **40** to flex away from rack **24** so that toothed portion **40** disengages from teeth **26** on rack **24**. After squeezing or flexing the grip plate toward the hand wheel to disengage toothed portion **40** from teeth **26**, the user manually tilts the blade to a desired angle or position by moving engagement member **28** to the right or left. As stated, engagement member **28** is mounted to trunnion **30** supporting the blade, and trunnion **30** is mounted in the saw to pivot to the right or left (when viewing the saw from the front), so the blade tilts as the user moves engagement member **28**. When the blade is at the desired angle, the user simply releases grip plate **42**. The grip plate and toothed portion automatically return back to their original position due to the spring force of thin section **50**, and toothed portion **40** again engages teeth **26** on rack **24** to hold the blade at the desired angle. In this manner, the user can tilt the blade from 0 to 45 degrees. A hinged joint between the base section and the grip plate and toothed portion can replace thin section **50** in other embodiments. Such a hinged joint is shown in FIGS. **11** and **13**, discussed below, and may include an axle **51** and a spring **53** to bias the grip plate and toothed portion toward rack **24**. Additionally, in some embodiments a spring supported by a bolt threaded into the trunnion may be used to bias the grip plate and toothed portion toward rack **24**, as shown at **99** in FIG. **18**.

[0042] FIG. **7** shows toothed portion **40** engaging teeth **26** on rack **24** to hold the blade in position. FIG. **8** shows toothed portion **40** pulled away from and disengaging teeth **26** on rack **24**. In the condition shown in FIG. **8**, a user may tilt the blade to a desired angle by moving engagement member **28** to the right or left because toothed portion **40** does not engage teeth **26**, as explained.

[0043] Toothed portion **40** of engagement member **28** meshes with teeth **26** on rack **24** to hold the blade in position. Toothed portion **40** includes a plurality of teeth in order to securely mesh with teeth **26** on rack **24** and to support the weight of the blade, trunnion and motor when the blade is tilted. Teeth **26** on rack **24** and the teeth on toothed portion **40** have the same profile and are shaped so that the teeth mesh well with little chance that vibration will cause the teeth to disengage. In the depicted embodiment the teeth have a pitch angle of 14.5-degrees to provide solid abutments to support the weight of the blade, motor, trunnion and related structure, although other pitch angles and profiles are possible.

[0044] As stated, rack **24** may be made from hard plastic or any other suitable material. Rack **24** is also supported in the saw to prevent it from flexing away from engagement member **28**, which might cause the teeth to disengage. In one embodiment, a tab may be added to help keep rack **24** in position so that teeth **26** on the rack and toothed portion **40** on engagement member **28** mesh reliably. FIG. **19** shows a tab **100** positioned adjacent the bottom of a rack **24** to help keep the rack in position. Tab **100** overlaps a bottom edge of the rack, and the top of the tab is cut at an angle to better match the curved bottom edge of the rack. Tab **100** may be attached to trunnion **30** in various ways, such as with a screw.

[0045] FIG. **9** shows a spring **52** that can be used with the tilt mechanism to offset the weight of the blade, trunnion, motor and related structure. Spring **52** has two arms, one connected to the back side of trunnion **30** and the other connected to a rear trunnion bracket **54**, as shown in FIG. **9**. When the blade is perpendicular to the table top, the position and weight of the motor creates a force tending to tilt the blade, and spring **52** is positioned to offset that force, at least partially. In the embodiment depicted in FIG. **9**, spring **52** is compressed so that the arms of the springs push out with a force of approximately 30 to 35 pounds when the blade is perpendicular to the table, although springs applying other forces could be used, including forces ranging from just a few pounds (e.g., 3 to 5 pounds) to 50 pounds or more. As the trunnion tilts, the spring continues to push out to balance the weight of the blade, trunnion, motor, and related structure. Tilting the trunnion toward 45-degrees compresses the spring further so that the spring applies a greater counterbalancing force.

[0046] FIGS. **20-22** show an alternative counterbalance spring **120**. Counterbalance spring **120** includes a coil **122** with straight segments **124** and **126** at each end of the coil at a right angle to each other. The straight segments continue for a length before bending ninety degrees at ends **128** and **130** in directions parallel to the coil and back toward the coil so that the ends are pointing in opposite directions. A bracket **132** is attached to trunnion **30**, and end **128** of spring **120** fits through a set of concentric holes in the bracket, as shown in FIGS. **19** and **20**. (FIGS. **20** and **21** show a perspective looking at the underside of a table **12** in order to better see spring **120**.) End **130** of spring **120** fits into and around a projection extending out from the bottom of table **12**, as shown.

[0047] When a user tilts the blade and releases grip plate **42**, toothed portion **40** will spring back toward rack **26** and the teeth will mesh. If the positions of the teeth on toothed portion **40** do not exactly align with teeth **26** on rack **24**

when the user releases grip plate **42**, the engagement member will shift slightly due to gravity until the teeth mesh and lock in place.

[0048] As stated, teeth **26** on rack **24** are spaced 1-degree apart, which means the blade can be tilted in 1-degree increments by moving engagement member **28**. This provides the advantage of being able to tilt the blade easily to precise angles, such as 37-degrees. Accordingly, teeth **26** may be thought of as an index or indices to allow a user to tilt a blade to a defined position.

[0049] Tilt mechanism **22** includes an adjustment mechanism **60**, also called a micro-adjust or micro-adjust system, to allow a user to tilt the blade to any angle between the 1-degree increments. Adjustment mechanism **60** is perhaps best shown in FIG. 2. It includes a dial **62** positioned outside the saw so that a user can engage and turn the dial. Dial **62** is eccentrically connected to an arm **64**, which is inside the housing of the saw, so the dial and arm “sandwich” the housing. The other end of arm **64** attaches to rack **24**. Because of the eccentric connection between dial **62** and arm **64**, turning dial **62** causes arm **64** to move to the right or left. Arm **64**, in turn, moves rack **24** to the right or left, and rack **24** moves engagement member **28** and blade **14** because of the engagement between toothed portion **40** and teeth **26**. Dial **62** may be constructed with stops to limit the rotation of the dial and thereby limit the possible adjustment. In the depicted embodiment, dial **62** includes internal stops that limit the rotation of the dial to plus or minus 60-degrees. Additionally, the dial should be constructed so that it stays in place when turned, and the depicted embodiment includes an internal O-ring to create friction between the dial and the saw housing to hold the dial in position. Alternatively, ridges or notches between various parts of the dial may be used to hold the dial in position. For example, dial **62** may include a series of ridges **140** along an interior surface of a cylindrical shell **142** that extends out from the backside of the dial, as shown in FIG. 23. Cylindrical shell **142** fits within a corresponding cylindrical cavity **144** on arm **64**. Positioned around the cylindrical cavity **144** are a number of tabs **146**, as shown in FIG. 24, and each tab includes corresponding ridges or notches configured to mesh with the ridges in shell **142**. Tabs **146** can flex as dial **62** is installed so that cylindrical shell **142** fits between the inner wall of cylindrical cavity **144** and the tabs. The tabs can also flex when dial **62** is rotated. Once the dial is set, the tabs spring back so that the notches in the tabs mate with the notches in the dial to help hold the dial in position. Of course other embodiments are possible.

[0050] FIG. 10 shows the back side of dial **62** and arm **64** in order to show how arm **64** connects to rack **24**. The head of a bolt **66** is captured in a socket in arm **64**, and the threaded end of the bolt engages a nut **67** (shown in FIG. 2) captured in a socket **68** in rack **24**. The bolt can be turned using a 90-degree hex wrench, and turning the bolt adjusts the spacing between rack **24** and arm **64** to properly align the blade and rack in the saw.

[0051] Dial **62** may be supported in the saw by “sandwiching” the housing, as mentioned above. Dial **62** may also be supported by an arm formed as part of the housing, as shown in FIGS. 25 through 27. FIG. 25 shows a housing **150** made as a molded, plastic part, and an arm **152** extends down to provide a support for dial **62**. Supporting the dial with an arm helps maintain the position of the dial if the outer wall of the housing flexes. FIG. 26 is a cross-sectional

view taken along the line A-A in FIG. 25, showing arm **152** with holes **154** and **156**. As shown in FIG. 27, a bolt **158** and a spacer **160** may extend through holes **154** and **156** to support dial **62**.

[0052] FIGS. 11-13 show another embodiment of an adjustment mechanism. In this embodiment, a dial **70** is threaded on a bolt **72** held by a bracket **74** mounted to table **12**. Dial **70** extends through an opening in the front of the housing so a user can turn the dial to adjust the tilt. Dial **70** includes a threaded projection **76** that threads into a socket **78** in rack **24**. Turning dial **70** turns threads **76**, which in turn move rack **24**. Threads **76** are configured to provide sufficient motion of rack **24** when dial **70** is turned a desired amount.

[0053] FIG. 14 shows another embodiment of an adjustment mechanism. This embodiment includes a handle **78** on an eccentric **79**. The eccentric is linked to an arm **80** connected to rack **24**. The eccentric is supported by a bracket **81** mounted to table **12**. A user turns the handle to turn the eccentric, and the eccentric then moves arm **80** and rack **24** back and forth.

[0054] FIGS. 15-17 show another embodiment of a tilt mechanism that provides an index or indices allowing a user to tilt the blade to defined positions. The mechanism includes an arcuate bracket or index **84** having apertures or holes, such as hole **86** in FIG. 16, spaced at defined intervals, such as every 1-degree. A handle **88** is mounted in the saw adjacent index **84**. The back side of the handle includes a pin **90** configured to fit into the holes in index **84**. The handle is adapted to pivot so that a user can move pin **90** into and out of the holes in index **84**. Other structure in the saw provides support for handle **88** and holds handle **88** in position so that pin **90** aligns with the holes in index **84**. Index **84** can be mounted on the outside of the saw's housing, as shown in FIG. 15, or it can be mounted to the inside of the saw provided there is an opening in the housing to allow pin **90** to engage the index. A user operates this tilt mechanism by pulling the handle out, tilting the blade to a desired position, and releasing the handle so that pin **90** moves into one of the holes in the index. The handle can be spring-biased so that pin **90** moves toward index **84** and through a hole when the handle is released.

[0055] A different embodiment of an alternative adjustment mechanism can be used with the tilt mechanism shown in FIGS. 15-17. A dial **92** can be positioned in handle **88**, as shown in FIG. 16. Pin **90** is mounted to the back of the dial and handle **88** is attached to trunnion **30** so that the trunnion and blade move with the handle. In use, turning the dial moves both the handle and trunnion because pin **90** engages index **84** which is fixed to the saw's housing.

[0056] Variations of the above-described embodiments are possible within the scope of this disclosure.

INDUSTRIAL APPLICABILITY

[0057] The blade tilt mechanisms disclosed herein are applicable to woodworking power tool equipment, and particularly to table saws. The tilt mechanisms discussed above may be referred to as tilt means for positioning the blade at desired angles, tilt means for changing the angle of the blade relative to a work surface, means for tilting, or some other similar appellation.

[0058] It is believed that the disclosure set forth above encompasses multiple distinct inventions with independent utility. While each of these inventions has been disclosed in

its preferred form, the specific embodiments thereof as disclosed and illustrated herein are not to be considered in a limiting sense as numerous variations are possible. The subject matter of the inventions includes all novel and non-obvious combinations and sub-combinations of the various elements, features, functions and/or properties disclosed herein. No single feature, function, element or property of the disclosed embodiments is essential to all of the disclosed inventions. Similarly, the recitation of “a” or “a first” element, or the equivalent thereof, should be understood to include incorporation of one or more such elements, neither requiring nor excluding two or more such elements. [0059] It is believed that the following claims particularly point out certain combinations and sub-combinations that are directed to disclosed inventions. Inventions embodied in other combinations and sub-combinations of features, functions, elements and/or properties may be claimed through amendment of the present claims or presentation of new claims in this or a related application. Such amended or new claims, whether they are directed to a different invention or directed to the same invention, whether different, broader, narrower or equal in scope to the original claims, are also regarded as included within the subject matter of the inventions of the present disclosure.

1. A table saw comprising:
 - a table defining a work surface;
 - a substantially planar, circular blade configured to extend at least partially above the work surface;
 - a motor to spin the blade; and
 - a tilt system configured to change the angle of the blade relative to the work surface, where the tilt system is operated by a user engaging a component, and where the system auto-locks the tilt position of the blade when the user releases the component.
2. A table saw comprising:
 - a table defining a work surface;
 - a substantially planar, circular blade configured to extend at least partially above the work surface;
 - a motor to spin the blade; and
 - a tilt system configured to change the angle of the blade relative to the work surface, where the tilt system

includes indices spaced at defined intervals, and where the angle of the blade relative to the work surface is set by the defined intervals.

3. The table saw of claim 3 where the defined intervals are spaced 1-degree apart.
4. The table saw of claim 3 where the defined intervals are spaced less than 1-degree apart.
5. The table saw of claim 3 where the defined intervals are spaced more than 1-degree apart.
6. The table saw of claim 2 further comprising an adjustment mechanism to adjust the tilt of the blade between the defined intervals.
7. The table saw of claim 2 where the indices comprise teeth on a rack.
8. The table saw of claim 2 where the indices comprise apertures.
9. A table saw comprising:
 - a table defining a work surface;
 - a substantially planar, circular blade configured to extend at least partially above the work surface;
 - a motor to spin the blade; and
 - a tilt system configured to change the angle of the blade relative to the work surface, where the tilt system includes an index and an engagement member having at least one projection configured to engage the index, where at least a portion of the engagement member is moveable by a user to disengage the at least one projection from the index, and where the engagement member is configured so that the at least one projection automatically engages the index when the engagement member is released by the user.
10. The table saw of claim 9, further comprising a hand wheel that may be turned to raise and lower the blade relative to the work surface, and where the portion of the engagement member moveable by a user is positioned adjacent the hand wheel.
11. The table saw of claim 10, where the portion of the engagement member moveable by a person is configured to be moved by a user squeezing the portion toward the hand wheel.
12. The table saw of claim 9 where the index is a rack with teeth and where the at least one projection is a tooth.

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