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## Gripping Hand Tools


### Abstract

Various embodiments of pliers and pipe wrenches are provided. Wire cutters enable a finger pivot hole to enhance the grasp of the wire cutters while rotating the tool and/or stripping wire. Pipe wrenches include different configurations of teeth to improve durability and grip on a workpiece. Pliers are provided with axial teeth to enhance gripping a workpiece in different directions. Pliers are provided with selectable mechanical advantages so that a user may select the mechanical advantage desirable for a particular application.



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## Background/Summary

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS [0001] The present application is a continuation of U.S. patent application Ser. No. 18/153,866, filed Jan. 12, 2023, which is a continuation of U.S. patent application Ser. No. 16/745,042, filed on Jan. 16, 2020, which is a continuation of International Application No. PCT/US2020/013692, filed on Jan. 15, 2020, which claims the benefit of and priority to U.S. Provisional Application No. 62/793,276 filed on Jan. 16, 2019, which are incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION
[0002] The present invention relates generally to the field of pliers and wrenches. Pliers typically include two plier members connected through a pivot that allows the upper handle to move a lower jaw and a lower handle to move an upper jaw about the pivot. Pipe wrenches typically include a head with a first set of teeth coupled to a hook jaw with a second set of teeth. Rotation of a thumbwheel moves the first set of teeth relative to the second set of teeth.
SUMMARY OF THE INVENTION
[0003] One embodiment of the invention relates to a pair of electricians pliers. The pliers include a first body with an upper handle, a lower jaw coupled to the upper handle, and a first pivot body located between the upper handle and the lower jaw. The pliers include a second body with a lower handle, an upper jaw coupled to the lower handle, and a second pivot body located between the lower handle and the upper jaw. A pivot is formed between the first pivot body and the second pivot body such that the upper jaw pivots relative to the lower jaw about a pivot axis of the pivot. An inner surface of the first pivot body and an inner surface of the second pivot body define a finger hole that receives a user's finger. The pivot axis is at least partially surrounded by the inner surfaces of the first and second pivot bodies such that the pivot axis is located in the finger hole.
[0004] Another embodiment of the invention relates to high leverage pliers. The high leverage pliers include an upper jaw, a lower jaw, an upper handle coupled to the lower jaw, and a lower handle coupled to the upper jaw. A low leverage pivot has a low leverage pin and a low level pivot opening and a high leverage pivot has a high leverage pin and a high level pivot opening. A selector switch allows a user to select between the low leverage pivot and the high leverage pivot by selecting a rotational pivot about either the low leverage pivot or the high leverage pivot. When the low leverage pin passes through the low level pivot opening a low leverage pivot is formed and when the high leverage pin passes through the high leverage opening the rotational pivot is formed about the high leverage pivot.
[0005] Another embodiment of the invention relates to a pipe wrench that has a handle, a head located on an end of the handle and that forms an aperture. A lower jaw with teeth is coupled to the head. A thumbwheel is located in the aperture and a V-shaped hook jaw has a first set teeth having tips lying in a first engagement plane and a second set of teeth having tips lying in a second engagement plane. The first engagement plane is oriented at a non-zero angle relative to the second engagement plane and the hook jaw is threadedly coupled to the thumbwheel and extends through the aperture of the head such that rotating the thumbwheel moves the hook jaw relative to the lower jaw on the head.
[0006] Another embodiment of the invention relates to pipe wrenches. Pipe wrenches can include a body having a head forming a lower jaw and a handle. A first set of teeth is coupled to the head to cooperate with a second set of teeth coupled to a hook jaw to grip and rotate a workpiece (e.g., a pipe). The head includes an aperture that receives the hook jaw. A thumbwheel captured between the body and aperture of the pipe wrench is threadedly coupled to the hook jaw such that rotating

the thumbwheel moves the hook jaw relative to the lower jaw on the head. Applicant has found that using a V-shaped hook jaw and/or lower jaw increases the gripping force the jaws exert on a workpiece. In addition, use of the pivotable lower jaw reduces the working area between the hook jaw and pivotable lower jaw. The rotation of the pivotable lower jaw increases the compressive forces on the workpiece and increasing the frictional gripping force between the jaws and the workpiece. In some embodiments, the teeth of the hook jaw and/or lower jaw may be coupled and/or formed from carbide steel and/or diamond grit.
[0007] Another embodiment of the invention relates to pliers with a front cutout (e.g., lineman's pliers). The pliers may include a front cutout with axial teeth to grip two or more wires and provide grip in a rotational direction about the central axis of the wires. This configuration enables twisting the wires about one another to form an electrical contact. The front axial teeth and cutout may serve other purposes, such as facilitating the removal of stripped screws.
[0008] Another embodiment of the invention relates to selectable high-leverage pliers. Traditional pliers have a 1:1 relationship between handle position and jaw position. High-leverage pliers require more handle movement to achieve the same jaw movement. For example, high-leverage pliers may have a 2:1 relationship, such that opening the handles 30° opens the jaws 15°. Traditional pliers (e.g., with a 1:1 relationship) allow the jaws to open a larger distance (e.g., have a greater working area). High-leverage pliers use mechanical advantage to provide greater compressive force relative to the force applied at the handles. Selectable high-leverage pliers allow a user to select a leverage ratio between two or more ratios.
[0009] Another embodiment of the invention relates to a pair of pliers. The pliers have an upper handle with a finger hole and a lower jaw and a lower handle with a finger hole and an upper jaw. A finger hole pivot is formed between the upper handle and the lower handle at the finger holes of the upper handle and the lower handle. The upper jaw pivots relative to the lower jaw about the finger hole pivot that is configured to receive a finger of a user to grip the finger hole pivot and extend a finger through the finger hole.
[0010] Alternative exemplary embodiments relate to other features and combinations of features as may be generally recited.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0011] This application will become more fully understood from the following detailed description, taken in conjunction with the accompanying figures, wherein like reference numerals refer to like elements in which:
[0012] FIG. **1** shows a top view of a pair of electrician's pliers with a finger hole pivot, according to an exemplary embodiment.
[0013] FIG. **2** shows a pipe wrench with a maximized V-grip head and jaw, according to an exemplary embodiment.
[0014] FIG. **3** shows a pipe wrench with a pivotable lower jaw, according to an exemplary embodiment.
[0015] FIG. **4** shows a pipe wrench with carbide steel teeth, according to an exemplary embodiment.
[0016] FIG. **5** shows a pipe wrench with diamond grit teeth, according to an exemplary embodiment.
[0017] FIG. **6** shows lineman's plies with a front cutout for axial teeth, according to another embodiment.
[0018] FIG. **7** shows a perspective view of selectable high-leverage pliers with a selector switch, according to an exemplary embodiment.

[0019] FIG. **8** shows a side view of the selectable high-leverage pliers of FIG. **7**, according to one embodiment.

[0020] FIG. **9** shows a top view of the head of the selectable high-leverage pliers of FIG. **7** with the selector switch removed, according to an exemplary embodiment.

[0021] FIG. **10** shows an exploded view of the upper jaw and lower handle, the upper handle, and the lower jaw, of the selectable high-leverage pliers of FIG. **7**, according to another embodiment.

DETAILED DESCRIPTION

[0022] Referring generally to the figures, various embodiments of pliers and wrenches are shown. Pliers include wire cutters, lineman's pliers, and selectable high-leverage pliers. Pliers include a first handle and a first jaw pivotably coupled to a second handle and a second jaw through a first pivot. The pliers include opposing workpiece engagement planes on the first and second jaw. In general, in the embodiments described herein, at least one of the workpiece engagement planes is movably coupled to the associated jaw element allowing relative movement between the workpiece engagement plane and the jaw.

[0023] Pipe wrenches include a body having a head and a handle. A first set of teeth is coupled (e.g., selectively coupled or fixedly coupled) to the head. The head includes an aperture sized to slidably receive a hook jaw coupled to a second set of teeth (selectively coupled or fixedly coupled). Rotating a thumbwheel that is threadedly coupled to the hook jaw, the second set of teeth move relative to the first set of teeth to cooperate and grip an object, such as a pipe.

[0024] Applicant has found that replacing a traditional pivot of the handles and jaws of wire cutters improves the ability to grip and rotate the wire cutters. For example, providing a finger hole pivot in wire cutters enables a user to rotate the wire cutters and strip the sheath off wires efficiently. Similarly, providing V-shaped jaws on pipe wrenches improves the gripping force of pipe wrenches on a workpiece by distributing the frictional load through a greater number of teeth. Pivotable jaws pivot to reduce the area between jaws when the wrench is rotated, thus increasing the compression and frictional forces on the workpiece. This increased frictional force reduces slipping of the workpiece in the wrench as the wrench is rotated. Applicant has found that the use of carbide and/or diamond grit teeth improves the durability and wear performance of various pipe wrenches and pliers.

[0025] Pliers may include axial teeth to provide another gripping direction. For example, axial teeth can grip parallel wires and enhance twisting wires together about the central axis of the pliers. Axial teeth provide enhanced grip in alternative directions and may provide other benefits.

[0026] Conventional pliers have a 1:1 rotational relationship between handle movement and jaw movement. For example, each degree the handles move (in an opening or closing direction), the jaws move one degree. This ratio allows the jaws to open fully when the handles are fully open but provides no mechanical advantage for compressing the jaws on a workpiece. Applicant has found that by using a leveraged motion, greater compressive forces can be applied to a workpiece. For example, configuring a pivot location so that the handles move two degrees for every degree the jaws move, uses mechanical advantage to increase the clamping force of the jaws. Applicant has found that by allowing a user to select the ratio of movement between the handles and the jaws, a user can selectively choose the leverage based on the application of the pliers. For example, the user can select a lower (e.g., relatively equal) ratio to maximize the distance between the jaws of the pliers. Alternatively, a user can select a higher ratio to maximize the compressive force generated at the jaws.

[0027] FIG. **1** shows a top view of a pair of electrician's pliers **10** (e.g., 6-in-1 electrician's pliers). Pliers **10** include an upper handle **12** coupled to a lower jaw **14** and a lower handle **16** coupled to an upper jaw **18**. A finger hole pivot **20** couples upper handle **12** and lower jaw **14** to lower handle **16** and upper jaw **18**. Pliers **10** also include a locking mechanism **22**, needle-nose gripping tips **24**, and wire strippers **26**. Needle-nose gripping tips **24** may be used to apply pressure in narrow spaces or bend a wire in a desired direction. The wire strippers **26** are configured to house several different gages of wires within the jaws **14** and **18** to strip the sheath (e.g., plastic) surrounding the wire (e.g., copper) to create electrical contacts, for example, to an adjacent wire. In some embodiments, needle-nose gripping tips **24** form a taper from finger hole pivot **20**. For example, a thickness or width of pliers **10** as measured along a pivot axis **21** (FIG. **6**) at finger hole pivot **20** is greater than a thickness of pliers **10** at needle-nose gripping tips **24**. Pivot axis **21** is defined as the axis **21** about which the upper and lower handles **12** and **16** and upper and lower jaws **14** and **18** rotate. In some embodiments, different parts of pliers **10** may include different materials or composites of materials. For example, upper and lower handles **12** and **16** and upper and lower jaws **14** and **18** comprise a carbide steel material and needle-nose gripping tips **24** comprise a diamond grit.

[0028] Wire strippers use a traditional pivot to couple upper handle **12** and lower jaw **14** to lower handle **16** and upper jaw **18**. Finger hole pivot **20** permits the user's finger to pass through finger hole pivot **20** of pliers **10**, enhancing the grip on pliers **10** when rotating and stripping wire. This ratio allows upper handle **12** and lower handle **16** to rest in the operator's palm. This configuration facilitates the wire stripping function of pliers **10**. In addition, pliers **10** can be spun or rotated about the wire (e.g., 90° in both directions) to cut the plastic sheath surrounding the wire. Finger hole pivot **20** allows the operator to grip pliers **10** through the hole while exerting pressure from the palm to the handles **12** and **16** to strip the sheath surrounding the wire.

[0029] In some embodiments, pliers **10** may have a spring **23** (e.g., under locking mechanism **22**) that biases handles **12** and **16** and/or jaws **14** and **18** to an open position. In this configuration, an operator may use locking mechanism **22** to lock and rotate pliers **10** about a wire. In some embodiments, the spring may bias the handles towards a closed position to facilitate rotation of pliers **10** about a wire. For example, locking mechanism **22** locks upper and lower handles **12** and **16** relative to each other such that lower and upper jaws **14** and **18** are locked (e.g., in a locked position) and/or are adjacent to one another. Similarly, spring **23** biases upper handle **12** away from lower handle **16** such that lower and upper jaws **14** and **18** pivot to an open position relative to each other.

[0030] In some embodiments, pliers **10** have first and second bodies **25***a* and **25***b*. First body **25***a* has upper handle **12**, lower jaw **18** which is coupled to upper handle **12** and a first pivot body **27***a* located between upper handle **12** and lower jaw **18**. Second body **25***b* has lower handle **16**, upper jaw **18** coupled to lower handle **16** and a second pivot body **27***b* located between lower handle **16** and upper jaw **18**. Pivot **20** is formed between first and second pivot bodies **25**, such that upper jaw **18** pivots relative to lower jaw **14** about a pivot axis **21** of pivot **20**. An inner surface **29***a* of first pivot body **27***a* and an inner surface **29***b* of second pivot body **27***b* define a finger hole **31** that receives a user's finger, for example, to grip pliers **10** while stripping a wire. In some embodiments, pivot axis **21** is surrounded, or partially surrounded by inner surfaces **29** of first and/or second pivot bodies **27** such that pivot axis **21** is located in finger hole **31**. As illustrated in the embodiment of FIG. **1**, inner surfaces **29** of first and second pivot bodies **27** are curved surfaces, such that when lower and upper jaws **14** and **18** are in a closed position (as illustrated), inner surfaces **29** define a circle that defines the outer perimeter of finger hole **31**.

[0031] FIG. **2** illustrates a pipe wrench **40** according to one embodiment. The pipe wrench **40** includes a body **42** having a head **44** and a handle **46**. A first or lower jaw **48** forms a V-shape and is coupled (e.g., selectively coupled or fixedly coupled) to head **44**. Head **44** includes an aperture **50** sized to slidably receive a second or hook jaw **52** forming an upper V-shaped jaw **54**. By rotating a thumbwheel **56**, which is threadedly coupled to hook jaw **52**, hook jaw **52** moves relative to lower jaw **48**. In this way, lower jaw **48** cooperates to move relative to the upper V-shaped jaw **54** to grip an object (e.g., a pipe). Lower jaw **48** is formed on head **44** in a V-shape with a front set of teeth **47** and a rear set of teeth **49**. Similarly, the upper V-shaped jaw **54** forms a front set of teeth **53** that are offset from a rear set of teeth **55**.

[0032] V-shaped hook jaw **54** includes first and second engagement planes **71** and **73**. In some embodiments, V-shaped hook jaw **54** includes additional planar surfaces. Each engagement plane (e.g., **71** or **73**) has its own teeth. In the embodiment shown, first engagement plane **71** is approximately the same size as the second engagement plane **73**.

[0033] In various embodiments, a width W1 of first engagement plane **71** is within +10% of a width W2 of the second engagement plane **73**, specifically, width W1 is within +5% of width W2. (FIG. **4**). Similarly, a length L1 of first engagement plane **71** is within +10% a length L2 of second engagement plane **73**, specifically, length L1 is within +5% of length L2. Engagement planes **71** and **73** are oriented at a non-zero angle relative to one another. Applicant has found that by using similarly sized engagement planes **71** and **73** oriented at an angle, hook jaw **25** and lower jaw **48** surround more of the pipe, which results in teeth **47**, **49**, **53**, and **55** more evenly distributing frictional loads as wrench **40** is moved relative to the pipe.

[0034] In some embodiments, pipe wrench **40** has a V-shaped configuration on both the head **44** and hook jaw **52**. For example, hook jaw **54** includes first and second engagement planes **71** and **73** and lower jaw includes similar third and fourth engagement planes **75** and **77**. The front sets of teeth **47** and **53** create an oblong or orthogonal angle A1 with the rear sets of teeth **49** and **55**. For example, the front sets of teeth **47** and **53** (and/or engagement planes **71** and **73** or **75** and **77**) may form an angle of less than 90°, 100°, 110°, 120°, 130°, 135°, 140°, 150°, 160°, or 170°. First and second engagement planes **71** and **73** of hook jaw **52** include sets of teeth **53** and **55** that have tips that lying in the engagement planes **71** and **73**. In some embodiments, engagement planes **71** and/or **75** are oriented at a non-zero angles relative to engagement planes **73** and/or **77** respectively.

[0035] In one embodiment, lower jaw **48** does not include front set of teeth **47**. In this configuration, lower jaw **48** forms a line or curve along head **44** of pipe wrench **40**. When a force is applied to handle **46**, a torque is applied to a workpiece captured between lower jaw **48** and V-shaped jaw **54** of hook jaw **52**. In some embodiments, only the rear set of teeth **49** on lower jaw **48** engage the workpiece. For example, due to the movement of the V-shaped jaw **54** or the compressive force applied to lower jaw **48** when pipe wrench **40** is rotated in a clockwise direction, oriented as illustrated in FIG. **2**, the rear set of teeth **49** engage the workpiece as the handle **46** is rotated. In some embodiments, the forward set of teeth **47** on lower jaw **48** may be eliminated to enlarge the working area between lower jaw **48** and hook jaw **52** and provide the operator more freedom to engage or disengage the workpiece with pipe wrench **40**. The working area is the area between lower jaw **48** and V-shaped jaw **54**.

[0036] FIG. **3** shows a pipe wrench **60** with a pivotable lower jaw **68**, according to another embodiment. For example, lower jaw **68** is coupled to head **64** by a pivot point **69**, such that lower jaw **68** rotates about pivot **69** located in head **64**. Pipe wrench **60** may have a V-shaped lower jaw **48** and/or an upper V-shaped jaw **54**, as described with reference to FIG. **2**. Pipe wrench **60** includes a body **62** having a head **64** and a handle **66**. Pivotable lower jaw **68** rotates about a pivot point **69** located on the head **64** and/or body **62** of pipe wrench **60**. An aperture **70** located on head **64** is sized to slidably and/or threadedly receive a hook jaw **72**. Hook jaw **72** moves relative to pivotable lower jaw **68** when a thumbwheel **76** is rotated, threadedly engaging, and moving hook jaw **72** relative to pivotable lower jaw **68**. Working area **74** is the area between the teeth on hook jaw **72** and the teeth on pivotable lower jaw **68**. Pivotable lower jaw **68** reduces working area **74** as pipe wrench **60** is rotated about a workpiece.

[0037] Pivotable lower jaw **68** pivots to increase the gripping force on a workpiece captured between hook jaw **52** and pivotable lower jaw **68**. As illustrated in FIG. **3**, when pivotable lower jaw **68** rotates from a forward position to a rearward position (shown in outline), working area **74** between hook jaw **72** and pivotable lower jaw **68** decreases. This movement increases the pressure pivotable lower jaw **68** exerts on the workpiece. The resulting increased friction on the workpiece reduces slipping as the pipe wrench is rotated. Thus, pipe wrench **60** can apply a greater torque on the workpiece without slipping.

[0038] In some embodiments, as pivotable lower jaw **68** rotates, the upper hook jaw **72** also moves as hook jaw **72** shifts within aperture **70**. This motion further increases the grip of pivotable lower jaw **68** and hook jaw **72** on the workpiece by maximizing the area of the workpiece in contact with the teeth on hook jaw **72**. Working area **74** between pivotable lower jaw **68** and hook jaw **72** decreases as torque is applied to the workpiece because pivotable lower jaw **68** decreases working area **74** more significantly than the shift of hook jaw **72** within aperture **70**. As such, the compressive force exerted on the workpiece is increased as pipe wrench **60** applies torque and reduces working area **74**. The increased compressive force increases the friction on the workpiece and reduces slipping as pipe wrench **60** is rotated.

[0039] FIG. **4** shows a pipe wrench **80** with carbide steel teeth to increase the hardness and durability of the teeth, according to another embodiment. Pipe wrench **80** is substantially the same as or similar to pipe wrench **40** and **60** as described above except for the differences described. In contrast to the design of pipe wrench **40** and **60**, lower jaw **88** and/or hook jaw **92** comprise, and/or are coupled to carbide teeth. Pliers **10**, discussed above, and/or lineman's pliers **120** or selectable high-leverage pliers **140**, discussed in greater detail below with reference to FIGS. **6-10**, may also be fitted with carbide teeth.

[0040] In some embodiments, pipe wrench **80** may have a V-shaped lower jaw **48** and/or hook jaw **52**, as described in reference to FIG. **2**. In some embodiments, pipe wrench **80** may have a pivotable lower jaw **68**, as described in reference to FIG. **3**. Pipe wrench **80** includes a body **82** having a head **84** and a handle **86**. A lower jaw **88** includes a first set of teeth **89**. An aperture **90** located on head **84** is sized to slidably and/or threadedly receive a hook jaw **92** with a second set of teeth **95**. The hook jaw **92** moves relative to lower jaw **88** when a thumbwheel **96** is rotated, threadedly engaging and moving the hook jaw **92** relative to lower jaw **88**. Carbide steel teeth **89** and **95** may include laser-welded carbide blades on the lower jaw **68** and hook jaw **92**. In some instances, carbide teeth **89** and **95** are replaceable. For example, a user may replace carbide teeth **89** and **95** without replacing pipe wrench **80**. A pin **87** may connect lower jaw **88** to head **84** of pipe wrench **80** to facilitate rotation and/or replacement of lower jaw **88**.

[0041] FIG. **5** shows a pipe wrench **100** with diamond grit teeth to increase the hardness and durability of the teeth, according to another embodiment. Pipe wrench **100** is substantially the same as or similar to pipe wrench **40**, **60**, and **80** as described above except for the differences described. In contrast to the design of pipe wrenches **40**, **60**, and **80**, lower jaw **108** and hook jaw **112** comprise, and/or are coupled to, diamond grit teeth. Pliers **10**, discussed above, and/or lineman's pliers **120** or selectable high-leverage pliers **140**, discussed in greater detail below with reference to FIGS. **6-10**, may also be fitted with diamond grit teeth.

[0042] In some embodiments, pipe wrench **100** may have a V-shaped lower jaw **48** and/or hook jaw **52**, as described in reference to FIG. **2**. In some embodiments, pipe wrench **100** may have a pivotable lower jaw **68**, as described in reference to FIG. **3**. Pipe wrench **100** includes a body **102** having a head **104** and a handle **106**. A lower jaw **108** includes a first set of teeth **109**. An aperture **110** located on head **104** is sized to slidably and/or threadedly receive a hook jaw **112** with a second set of teeth **115**. The hook jaw **112** moves relative to lower jaw **108** when a thumbwheel **116** is rotated, threadedly engaging and moving the hook jaw **112** relative to lower jaw **108**.

[0043] In some embodiments, diamond grit is provided to a surface of lower jaw **108** and/or hook jaw **112**. The engagement planes of lower jaw **108** and hook jaw **112** may have a checkered or milled surface. For example, the surface may be clad with a carbide material (e.g., as described with reference to pipe wrench **80**) and then milled to create the checkered pattern. This process may result in pyramids of carbide and/or diamond grit on a steel base or frame.

[0044] FIG. **6** shows a pair of lineman's pliers **120**, according to an exemplary embodiment. Pliers **120** include an upper handle **122**, a lower handle **124**, an upper jaw **126**, and a lower jaw **128**. Upper handle **122** and lower jaw **128** are coupled to lower handle **124** and upper jaw **126** at a pivot **130**. Pliers **120** include horizontal teeth **132** and a front cutout **135** for axial teeth **134**. Lineman's pliers **120** may be used in a variety of circumstances, including to twist wires together. Axial teeth **134** facilitate twisting multiple wires together with front axial teeth **134** providing the front cutout

**135** with teeth **134** to grip two or more wires. As handles **122** and **124** are rotated, jaws **126** and **128** grip the wires in a rotational direction around the central axis of the pliers **120**. The gripping force causes the wires to twist about one another. For example, the wires may be generally parallel with handles **122** and **124** in a closed position. The front axial teeth **134** provide an area in front of cutout **135** that prevents the wires from being crushed when jaws **126** and **128** are closed. Axial teeth **134** design configuration may be useful in other circumstances, e.g., to remove screws that have had the heads stripped.

[0045] FIGS. **7-10** illustrate a pair of selectable high-leverage pliers **140**, according to an exemplary embodiment. Selectable high-leverage pliers **140** are capable of selectively operating in one of two modes to change the leverage of the pliers **140**. Traditional pliers **140** have a direct 1:1 rotational relationship between the handle position (e.g., upper handle **142** relative to lower handle **144**) and the jaw position (e.g., upper jaw **146** relative to lower jaw **148**). Such pliers with a 1:1 ratio move jaws **146** and **148** an equal rotational distance as input at handles **142** and/or **144**. For example, if handles **142** and/or **144** of conventional pliers (with a 1:1 rotational relationship) are opened 20°, jaws **146** and **148** also open 20°. High-leverage pliers **140** (e.g., with a 2:1 rotational relationship ratio) do not have a direct rotational relationship between the handle position and the jaw position. As such, high-leverage pliers **140** require more handle movement to achieve the same jaw movement when compared to traditional pliers **140** (e.g., with a 1:1 relationship). For example, opening handles **142** and **144** of high-leverage pliers **140** with a 2:1 rotational relationship by 30° only opens the jaws 15° (e.g., upper jaw **146** and lower jaw **148**). As such, pliers **140** with a direct 1:1 rotational relationship between handle **142**, **144** and jaw **146**, **148** positions may allow jaws **146**, **148** to open wider than high-leverage pliers **140**, thus creating a larger working area. As described above with reference to FIG. **3**, the working area is defined as the distance between upper jaw **146** and lower jaw **148** available to grasp a workpiece. Specifically, the working area is defined as the area between the teeth of upper and lower jaws **146** and **148**.

[0046] High-leverage pliers **140** may have a rotational ratio of 1.25:1, 1.5:1, 1.75:1, 2:1, 2.5:1, 3:1, 3.5:1, 4:1, 5:1 or more. For example, a high-leverage plier **140** with a 2:1 ratio means that for every 2° of movement of upper handle **142** relative to lower handle **144**, upper jaw **146** moves 1° relative to lower jaw **148**. Similarly, a 1.5:1 ratio means that for every 1.5° of movement at handles **142**, **144**; jaws **146**, **148** move 1°. Similar factors apply for the other ratios. Thus, high-leverage pliers **140** provide greater compressive forces and conventional **1**:**1** pliers **140** provide greater working areas. In some embodiments, the increased compressive force is a direct multiple of the leverage ratio of high-leverage pliers **140**. A user may want an increased compressive force for one application and a greater working area for another. For example, during a job, the user may find it preferable to have the larger working area of conventional (e.g., 1:1) pliers **140** for a specific application and later find it preferable to have a greater compressive force (e.g., as applied by 2:1 pliers). A user may often need to switch between lower ratio and higher ratio pliers **140**. Applicant has found that providing a selector switch **150** enables the user to select various ratios during the operation of the selectable high-leverage pliers **140**.

[0047] In conventional pliers, upper handle **142** and lower jaw **148** are part of the same integral piece. High-leverage pliers **140** couple lower jaw **148** to upper handle **142** via a mechanical linkage. The mechanical linkage translates the movement of handles **142** and **144** into a smaller movement in jaws **146** and **148**, creating the high-leverage ratio.

[0048] Selectable high-leverage pliers **140** have a selector switch **150** that allows the user to switch between high-leverage pliers **140** (e.g., with a 2.5:1 ratio) and traditional pliers **140** with a 1:1 ratio, easily. In some embodiments, pliers **140** include multiple selectable ratios. For example, selector switch **150** selects or changes a rotational pivot or pivot axis **21** of upper handle **142** relative to lower handle **144**. Selector switch **150** has a low leverage pin **154** associated with a low leverage opening or pivot **166** and a high leverage pin **152** associated with a high leverage pivot **158**. When selector switch **150** selects rotational pivot axis **21** to be about low leverage pivot **158**, low leverage pin **154** passes through low leverage pivot **166**. Similarly, when selector switch **150** selects rotational pivot axis **21** to rotate about high leverage pivot **158**, high leverage pin **152** passes through high leverage pivot **158**.

[0049] Referring to FIGS. **7** and **8**, pliers **140** are shown in the high-leverage position. High-leverage pin **152** is depressed and passes through lower jaw **148**, upper handle **142**, and upper jaw **146**. Low leverage pin **154** (e.g., traditional pin) is elevated and passes through only lower jaw **148**. High-leverage pin **152** is longer than low leverage pin **154**. In other words, selector switch **150** has pushed high-leverage pin **152** through high-leverage pinhole or pivot **158**, so that high-leverage pin **152** rotates through a high-leverage opening or slot **156**. In this configuration, handles **142** and **144** translate jaws **146** and **148** by the selected ratio.

[0050] When selector switch **150** is reversed (e.g., when low leverage pin **154** is depressed), the high-leverage pin **152** is elevated and passes through only lower jaw **148**. Low leverage pin **154** is depressed and passes through upper handle **142** and lower jaw **148**. In this position, lower jaw **148** and upper handle **142** are coupled together such that they do not move with respect to one another. FIG. **9** shows a top view of the high-leverage pin **152** and low leverage pin **154** with selector switch **150** removed. Center arm **164** does not move in center slot **162** of lower jaw **148**. Low leverage pin **154** prevents upper handle **142** from moving with respect to lower jaw **148**. Rather, upper handle **142** and lower jaw **148** are joined together and pivot about jaw pivot **160**.

[0051] The ratios determined by selection of high-leverage pin **152** and/or low leverage pin **154** can be selected from any of the leverage ratios previously described. In one example, low leverage pin **154** creates a 1:1 relationship between the handle movement and the jaw movement and the high-leverage pin creates a 2:1 relationship. Specifically, low leverage pivot **166** provides a 1:1 ratio such that movement of upper handle **142** relative to lower handle through an angle A2 results in movement of upper jaw **146** relative to lower jaw **148** by the same angle A2. Similarly, high leverage pivot **158** provides a 2:1 ratio, such that movement of upper handle **142** relative to lower handle **144** through an angle A2 results in movement along angle A3 of upper jaw **126** relative to lower jaw **128** by two times the angle A2.

[0052] In some embodiments, low leverage pin **154** creates a 1.5:1 relationship and the high-leverage pin creates a 3:1 relationship between the handle movement and the jaw movement. Other combinations and ratios may be designed. In addition, selector switch **150** may select more than two positions. For example, selector switch **150** may select a first ratio in a first position, a second ratio in a second position, a third ratio in a third position, a fourth ratio in a fourth position, and so forth. For example, a third leverage pin such as center arm **164** is the same as or similar to high leverage pin **152** and can be associated with a third leverage pivot or central slot **162**, e.g., the same as or similar to pivot **158**. In this case, selector switch **150** selects the rotational pivot axis **21** of handles **142** and **144** among low leverage pivot **166**, high leverage pivot **158**, and third leverage pivot or center arm **164**. In some embodiments, third leverage pivot arm **164** has a leverage ratio that is greater than low leverage pivot **166** and less than high leverage pivot **158**.

[0053] With reference to FIGS. **7-10**, when selector switch **150** is in the high-leverage mode, lower jaw **148** and upper handle **142** move relative to one another. In this configuration, high-leverage pin **152** passes through the high-leverage pivot **158** (FIG. **10**) in upper jaw **146** and high-leverage slot **156** in lower jaw **148**. Upper handle **142** pivots relative to upper jaw **146** and lower handle **144** about high-leverage pin **152**. When upper handle **142** is opened, the center arm **164** of upper handle **142** presses against the side of the center slot **162**. Rotation about this point causes lower jaw **148** to pivot about the jaw pivot **160**. As such, upper handle **142** pivots about high-leverage pin **152** and lower jaw **148** pivots about jaw pivot **160**, creating a rotational ratio between the movement of handles **142**, **144**, and jaws **146**, **148**. As handles **142**, **144** open and close, center arm **164** moves within center slot **162** and high-leverage pin **152** moves within the high-leverage slot **156**.

[0054] FIG. **10** is an exploded view of the components of selectable high-leverage pliers **140**, according to an exemplary embodiment. As shown, lower handle **144** and upper jaw **146** form an integral continuous piece. Lower handle **144** and upper jaw **146** piece includes a high-leverage pivot **158** for selectively receiving high-leverage pin **152**. A jaw pivot fastens lower handle **144** upper jaw **146** to upper handle **142** and lower jaw **148**.

[0055] As shown, upper handle **142** and lower jaw **148** are two separate pieces that are coupled together in various ways to create different ratios in handle movement relative to jaw movement. Upper handle **142** is joined to lower handle **144** upper jaw through the jaw pivot **160** and includes a center arm **164** and a second pinhole or low leverage pivot **166**, configured to receive low leverage pin **154** selectively. In this configuration, when low leverage pivot **166** receives low leverage pin **154**, upper handle **142** and lower jaw **148** are joined at both the jaw pivot **160** and the low leverage pivot **166** and move together as a single piece. As such, lower handle **144** and upper jaw **146** pivot about jaw pivot **160** with upper handle **142** and lower jaw **148** as though upper handle **142** and lower jaw **148** was a single continuous piece (e.g., a 1:1 ratio). As described above, alternative configurations for coupling upper handle **142** and lower jaw **148** may result in different rotational ratios.

[0056] Lower jaw **148** forms various selectable connections with lower handle **144** upper jaw **146** and upper handle **142** to create different rotational ratios between handles **142**, **144** and jaws **146**, **148**. Lower jaw **148** includes a high-leverage slot **156** to receive high-leverage pin **152** which joins with high-leverage pivot **158** on lower handle **144** and/or upper jaw **146**. When high-leverage pin **152** is depressed, high-leverage slot **156** allows translation of pin **152** through slot **156** to increase the compressive force on the workpiece. Center slot **162** receives center arm **164** on upper handle **142** and allows translation of center arm **164** through center slot **162**. Low leverage pivot **166** may selectively receive low leverage pin **154** to join lower jaw **148** to upper handle **142**. In some embodiments, the locations of the pivots relative to the jaws and/or handles defines whether the pivot is a high or low leverage pivot. For example, low leverage pin **154** passes through low leverage pivot **166** located between central arm **164** of selector switch **150** and either upper or lower handle **142** or **144**. Similarly, high leverage pin **152** passes through opening or pivot **160** located between central arm **152** and either upper or lower jaw **142** or **144**. In this configuration, the location of high and low leverage pins **152** and **154** relative to central pin **164** determines which pin **152** or **154** is high leverage relative to other pin **152** or **154**.

[0057] It should be understood that the figures illustrate the exemplary embodiments in detail, and it should be understood that the present application is not limited to the details or methodology set forth in the description or illustrated in the figures. It should also be understood that the terminology is for the purpose of description only and should not be regarded as limiting.

[0058] Further modifications and alternative embodiments of various aspects of the invention will be apparent to those skilled in the art in view of this description. Accordingly, this description is to be construed as illustrative only. The construction and arrangements, shown in the various exemplary embodiments, are illustrative only. Although only a few embodiments have been described in detail in this disclosure, many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter described herein. Some elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. The order or sequence of any process, logical algorithm, or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes, and omissions may also be made in the design, operating conditions, and arrangement of the various exemplary embodiments without departing from the scope of the present invention.

[0059] For purposes of this disclosure, the term “coupled” means the joining of two components directly or indirectly to one another. Such joining may be stationary in nature or movable in nature.

Such joining may be achieved with the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional member being attached to one another. Such joining may be permanent in nature or alternatively may be removable or releasable in nature.
[0060] While the current application recites particular combinations of features in the claims appended hereto, various embodiments of the invention relate to any combination of any of the features described herein whether or not such combination is currently claimed, and any such combination of features may be claimed in this or future applications. Any of the features, elements, or components of any of the exemplary embodiments discussed above may be used alone or in combination with any of the features, elements, or components of any of the other embodiments discussed above.

## Claims

**1**. A pipe wrench, comprising: a handle; a head located on an end of the handle, the head comprising an aperture; a lower jaw coupled to the head, the lower jaw comprising teeth; a hook jaw coupled to the head, the hook jaw comprising teeth; a thumbwheel located in the aperture; and a working area that is defined between the teeth on the lower jaw and the teeth on the hook jaw; wherein the hook jaw is threadedly coupled to the thumbwheel and extends through the aperture of the head such that rotating the thumbwheel moves the hook jaw relative to the lower jaw on the head; wherein the lower jaw is coupled to the head by a pivot such that the lower jaw rotates about the pivot located in the head; and wherein, when the lower jaw rotates about the pivot located in the head, a size of the working area is decreased.
**2**. The pipe wrench of claim 1, wherein the hook jaw is configured to shift within the aperture of the head when a torque is applied to a workpiece by the hook jaw such that an area of the workpiece in contact with the teeth of the hook jaw is increased when a magnitude of the torque applied to the workpiece is increased.
**3**. The pipe wrench of claim 1, wherein the teeth on the lower jaw and the teeth on the hook jaw comprise a carbide steel and a diamond grit.
**4**. The pipe wrench of claim 1, wherein the hook jaw is a V-shaped hook jaw, the V-shaped hook jaw comprising a first set of teeth having tips lying in a first engagement plane and a second set of teeth having tips lying in a second engagement plane, the first engagement plane being oriented at a non-zero angle relative to the second engagement plane.
**5**. The pipe wrench of claim 4, wherein a width of the first engagement plane is within plus or minus 10% of a width of the second engagement plane.
**6**. The pipe wrench of claim 4, wherein a length of the first engagement plane is within plus or minus 10% a length of the second engagement plane.
**7**. The pipe wrench of claim 4, wherein the non-zero angle of the first engagement plane relative to the second engagement plane is less than 1700.
**8**. A pipe wrench, comprising: a handle; a head located on an end of the handle and comprising an aperture; a lower jaw coupled to the head, the lower jaw comprising lower teeth; a thumbwheel located in the aperture; and a hook jaw comprising a first set of teeth having tips lying in a first engagement plane and a second set of teeth having tips lying in a second engagement plane, the first engagement plane being oriented at a non-zero angle relative to the second engagement plane; and wherein the hook jaw is threadedly coupled to the thumbwheel and extends through the aperture of the head such that rotating the thumbwheel moves the hook jaw relative to the lower jaw on the head.
**9**. The pipe wrench of claim 8, wherein the first set of teeth and second set of teeth each comprise a carbide steel and a diamond grit.
**10**. The pipe wrench of claim 8, wherein a width of the first engagement plane is within plus or

minus 5% of a width of the second engagement plane.

**11**. The pipe wrench of claim 8, wherein a length of the first engagement plane is within plus or minus 5% a length of the second engagement plane.

**12**. The pipe wrench of claim 8, wherein the non-zero angle of the hook jaw is less than 150°.

**13**. The pipe wrench of claim 8, wherein the lower jaw is coupled to the head by a pin and wherein the lower jaw rotates about the pin located in the head.

**14**. A pipe wrench, comprising: a handle extending along a longitudinal axis of the pipe wrench; a head located on an end of the handle, the head comprising: an aperture extending along the longitudinal axis; a first jaw coupled to the head, the first jaw comprising first teeth; and an second jaw partially extending through the aperture of the head, the second jaw comprising second teeth; an actuator engaged with the second jaw such that rotation of the actuator moves the second jaw relative to the first jaw; a working area defined between the first teeth and the second teeth; and a pivot pin coupling the first jaw to the head; wherein the working area decreases as a torque is applied to a workpiece.

**15**. The pipe wrench of claim 14, wherein, when a force is applied to the handle to apply the torque to the workpiece, the first teeth pivot about the pivot pin.

**16**. The pipe wrench of claim 14, the first jaw comprising a pivot arm extending into the head toward the handle.

**17**. The pipe wrench of claim 14, wherein the first teeth and the second teeth comprise a carbide steel.

**18**. The pipe wrench of claim 17, wherein the first teeth and second teeth comprises laser-welded carbide blades.

**19**. The pipe wrench of claim 14, wherein the second teeth comprises a first set of tips lying in a first engagement plane and a second set of tips lying in a second engagement plane, the first engagement plane oriented at a non-zero angle relative to the second engagement plane.

**20**. The pipe wrench of claim 19, wherein the non-zero angle is less than 170°.