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Inventor(s) NIBALI; Benjamin D. et al.

FASTENER DELIVERY TOOLS WITH GUIDE ASSEMBLIES AND METHODS

Abstract

Elongated fastener driving apparatuses and methods are disclosed. The drivers are operable to quickly and accurately install fasteners from a standing position on, for example, a floor surface.

Inventors: **NIBALI; Benjamin D. (Maryville, TN), KUKK; Kristo (Knoxville, TN), HALL; Kristopher C. (Maryville, TN), PARK; Jeremy Scott (Gallatin, TN), TILLINGHAST; Adam (Nashville, TN)**

Applicant: **SIMPSON STRONG-TIE COMPANY INC.** (Pleasanton, CA)

Family ID: **1000008586658**

Assignee: **SIMPSON STRONG-TIE COMPANY INC. (Pleasanton, CA)**

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Background/Summary

CROSS-REFERENCE [0001] This application is a divisional of U.S. application Ser. No. 17/809,112 filed Jun. 27, 2022 which claims the benefit of U.S. Provisional Application No. 63/215,597, filed Jun. 28, 2021, entitled FASTENER DELIVERY TOOLS WITH GUIDE ASSEMBLY, METHODS AND SYSTEMS which applications are incorporated herein in their entirety by reference.

BACKGROUND

[0002] The disclosure relates to elongated member driving apparatus, including a driving apparatus that assures correct orientation of a fastener.

[0003] Fastener driving tools are known in the art. Such tools are typically electric-actuated tools for driving fasteners through a surface, such as a wood deck, a metal deck or metal roof. The fasteners that are driven include, for example, a shank having a self-tapping, self-driving or self-drilling tip at one end and head integral with the other end of the shank. A sealing washer can also be positioned on the shank with an interference fit.

[0004] Known fastener-driving tools generally include a driver such as an electric-actuated driver that is mounted to telescoping tubes. A first tube (upper or outer tube) is stationary relative to the driver and a second (lower or inner tube) telescopes relative to the upper tube. A shaft is mounted to the driver and extends through the tubes. The lower tube telescopes relative to the upper tube to permit movement of the driver shaft relative to a distal end of the lower tube. An end of the shaft includes, for example, a hex or socket-like element to engage the fastener head for driving. The lower tube telescopes to permit movement between a retracted position and a contracted position. In the retracted or extended position, a fastener is loaded onto an end of the shaft for driving into the surface. In the contracted position, the fastener is driven from the tool outwardly, through the distal end of the lower tube, into the surface.

[0005] Fastener driving tools include, for example, a spring positioned between the tubes to urge the tubes and thus the tool into the retracted or loading position. In some driving tools, the lower tube is fitted immediately within the upper tube. Although this assures proper alignment of the tubes relative to one another and straight movement of the fastener, there is surface-to-surface contact of the tubes which may be undesirable.

[0006] Generally, a stop is positioned on the end of the upper tube that cooperates with a stop positioned along the length of the lower tube. This limits that travel of the tubes relative to one another and assures that the fastener is properly driven into the surface. That is, the stops are positioned relative to one another so that the fastener is driven a predetermined amount into the surface.

[0007] Known fastener driving tools include a nosepiece assembly that supports the fastener prior to and as it is engaged by the driver shaft (e.g., socket-like element). An opening in the nosepiece provides a track or path through which the fastener is driven from the tool.

[0008] One draw back to current solutions is that fasteners that are longer than 3 inches and/or larger than #10 in diameter cannot easily be installed from a standing position with currently available tools. Additionally, if the wrong fastener is loaded, or is loaded in an incorrect position (e.g., head first), the fastener cannot be easily removed from existing driving tools.

[0009] Accordingly, there is a need for a fastener driving tool that can install structural screws which is both ergonomic for the user to use in a standing position and allows for efficient installation. Additionally, what is needed is a fastener driving tool that allows for easy removal of fasteners from the driving tool prior to installation. What is also needed is also needed is a fastener driving tool which is operable to provide improved delivery, alignment and installation of fasteners, including driving fasteners into a preformed hole.

SUMMARY

[0010] Disclosed are fastener driving tools and methods operable to install structural screws which is both ergonomic for the user to use in a standing position and allows for efficient installation. Also disclosed are fastener driving tools that allows for easy removal of fasteners from the driving tool prior to installation. Additionally, the disclosed fastener driving tools and which is operable to provide improved delivery, alignment and installation of fasteners, including driving fasteners into a preformed hole.

[0011] Both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the disclosed embodiments, as claimed.

INCORPORATION BY REFERENCE

[0012] All publications, patents, and patent applications mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference.

[0013] U.S. Pat. No. 3,960,191 A dated Jun. 1, 1976 to Murray;

[0014] U.S. Pat. No. 4,397,412 A dated Aug. 9, 1983 to Dewey;

[0015] U.S. Pat. No. 5,058,464 A dated Oct. 22, 1991 to McGovern et al.;

[0016] U.S. Pat. No. 6,341,542 B1 dated Jan. 29, 2002 to Ade et al.;

[0017] U.S. Pat. No. 6,622,596 B2 dated Sep. 23, 2003 to Janusz et al.;

[0018] U.S. Pat. No. 6,729,522 B2 dated May 4, 2004 to Hempfling et al.;

[0019] U.S. Pat. No. 6,769,332 B2 dated Aug. 3, 2004 to Muro;

[0020] U.S. Pat. No. 8,220,367 B2 dated Jul. 17, 2012 to Hsu;

[0021] U.S. Pat. No. 8,356,534 B2 dated Jan. 22, 2013 to Hale et al.;

[0022] U.S. Pat. No. 8,869,656 B2 dated Oct. 28, 2014 to Desmond et al.;

[0023] U.S. Pat. No. 10,421,176 B2 dated Sep. 24, 2019 to Vandenberg;

[0024] US 2006/0236815 A1 dated Oct. 26, 2006 to Beecherl et al.;

[0025] US 2004/0226977 A1 dated Nov. 18, 2004 to Hofbrucker et al.;

[0026] WO 2011/005996 A2 dated Jan. 13, 2011 to Vempati et al.;

[0027] Black and Decker, Screw Feeder Screwdriver Extension Attachment, available from https://www.blackanddecker.com/product-repository/products/2015/02/01/00/20/fs100sf (accessed June 2021);

[0028] Hitachi SuperDrive Sub-Floor and Decking Screwgun Lets You Stand Up and Work, available from https://toolguyd.com/hitachi-superdrive-sub-floor-deck-screwgun/(accessed June 2021);

[0029] PAM P13KDE Stand-up Screwgun Kit includes 2500 RPM 6.5A Milwaukee Screwgun, Dedicated Extension System and Case, available at https://www.bestmaterials.com/detail.aspx?ID=17135 (accessed June 2021);

[0030] Senco DS440-AC 3 in. Attachment Kit, available from https://www.homedepot.com/p/Senco-DS440-AC-3-in-Attachment-Kit-with-4-000-RPM-Screwdriver-6W 0011N/206620154 (accessed June 2021); and

[0031] Simpson Strong-Tie, Quik Drive Auto-Feed Screw Driving Systems, available from https://strongtie.co.nz/products/quik-drive-auto-feed-screw-driving-systems (accessed June 2021).

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The novel features of the invention are set forth with particularity in the appended claims. A better understanding of the features and advantages of the present invention will be obtained by reference to the following detailed description that sets forth illustrative embodiments, in which the principles of the invention are utilized, and the accompanying drawings of which:

[0033] FIG. **1**A illustrates a power driver;
[0034] FIG. **1**B illustrates a power driver in combination with a fastener delivery tool from an upper perspective facing a work surface;
[0035] FIGS. **1**C-I illustrate a power driver in combination with a fastener delivery tool from different views;
[0036] FIG. **1**J is an exploded view of a fastener delivery tool;
[0037] FIG. **2**A illustrates a side partial perspective view of a loading assembly of the fastener delivery tool;
[0038] FIG. **2**B illustrates an exploded view of the loading assembly of FIG. **2**A;
[0039] FIG. **2**C is a view of a power driver in combination with the fastener delivery tool including the loading assembly of FIG. **2**A;
[0040] FIG. **3** is an exploded view of a driver shaft assembly of the fastener delivery tool;
[0041] FIGS. **4**A-E illustrate a portion of the loading assembly of the fastener delivery tool of FIG. **2** illustrating a shifting process for shifting the fastener during fastener loading;
[0042] FIG. **4**F illustrates a fastener entering the drop tube of the fastener delivery tool of FIG. **2**
[0043] FIG. **4**G illustrates a fastener leaving the drop tube of the fastener delivery tool of FIG. **2** and entering the catch assembly;
[0044] FIG. **4**H illustrates a fastener resting in the jaws of the drop tube of the fastener delivery tool of FIG. **2** with the catch aligned with the drop tube;
[0045] FIG. **41** illustrates a side view of the fastener delivery tool of FIG. **2** with the bottom assembly with the toggle in a first orientation;
[0046] FIGS. **5**A-M illustrate a jaw assembly for delivery tool of FIG. **1**;
[0047] FIG. **6**A illustrates a fastener delivery tool engaging a work surface;
[0048] FIG. **6**B illustrates a screw catch aligned with the bit and the drive shaft;
[0049] FIG. **6**C illustrates a close-up of the distal end of the screw catch aligned with the bit and the drive shaft of FIG. **6**B;
[0050] FIGS. **7**A-F illustrate nose pieces for the fastener delivery tools including partial cross-sections, an external view, and an exploded view;
[0051] FIGS. **8**A-C further illustrate the angled nose piece for the fastener delivery tool; and
[0052] FIGS. **9**A-B further illustrate the flat nose piece for the fastener delivery tool.

DETAILED DESCRIPTION

[0053] As disclosed herein, a fastener delivery tool **100**, **200** is provided that comprises a loading assembly. The loading assembly comprising a feed tube **150**, **250** that is operable to receive a fastener **40** at a first end of the feed tube **150**, **250** and deliver the fastener **40** at a second end of the feed tube **150**, **250**. A driver shaft assembly **300** is also provided that is operable to engage a power driver **110**, such as a drill, at a first driver shaft assembly end and receive the fastener **40** from the feed tube **150**, **250**. Both the shift assembly **180** and timing controller **236** are provided to control the speed at which the fastener **40** travels from the distal end of the feed tube **150**, **250** into the driver shaft assembly for delivery to the work surface. A jaw assembly **500** is also provided for engaging the second end of the driver shaft assembly **300**. The jaw assembly **500** is operable to receive the fastener **40** from the feed tube **150**, **250**. The jaw assembly **500** opens and closes in response to a control signal received from the shift assembly **180** or timing controller **236** Activating the power driver **110** delivers torque to a head of the fastener.
[0054] The driver shaft assembly can further comprise a handle and/or a coupler. The coupler secures the driver shaft assembly to the power driver **110**. The handle can be positioned near the coupler and extend laterally from a long axis of the driver shaft assembly. Additionally, the feed tube **150**, **250** can comprises a cap **212** and/or a flanged ring **216** The outer tube **164** can have a spring **166** that is coupled to the power driver **110** at a first outer tube end. An upper support **172** can also be provided that is coupled to a lower mount **178** Additionally, the upper support **172** can have a first support plate **173** with a first support plate aperture **174** and a second support plate **175**

with a second support plate aperture **176**

[0055] A variety of jaw assemblies can be provided that control delivery of the fastener to the work surface. In one configuration, the jaw assembly **500** comprises a plurality of upper blades **514**, **516**, **518**. The upper blades define a central jaw aperture **502** with an aperture size that is controllable by a plurality of corresponding upper blade controllers **522**, **524**, **526**, **528** The jaw assembly can also include a plurality of lower blades corresponding to the upper blades that are controllable by a plurality lower blade controllers. One or more jaw springs **590**, **592** can be provided that are operable to control a motion of the plurality of the upper blades.

[0056] A height adjustment mechanism **187** can also be provided to adjust space between the jaw assembly **500** and a work surface **30**. The height adjustment mechanism **187** can further comprise an upper slide **188** and a lower slide **190** operable to slidingly engage the upper slide **188**. A change in the orientation of the upper slide **188** and the lower slide **190** results in an increase or decrease in the length of the overall height of the adjustment mechanism **187**. For example, when the lower slide **190** is moved in one direction the overall height of the adjustment mechanism **187** increases and when the lower slide **190** is moved in a second direction, opposite the first direction, the overall height of the adjustment mechanism **187** decreases.

[0057] A variety of nosepiece configurations can be provided that are operable to engage a work surface. For example, the nosepiece can have a flat distal surface or a pointed distal surface. Additionally an extension foot can be provided that is operable to provide a gap between the jaw and the work surface.

[0058] Turning now to FIG. **1**A, the power driver **110** has a body **112** with a handle **114** and on/off controller **118** (e.g., trigger) and a chuck **116**. The power driver **110** can be, for example, a drill or an impact driver. When a drill is used, the chuck **116** may have a collapsible jaw that is sized and configured to engage a shank of, for example, a drill bit. The power driver **110** is shown with a proximal end **10** and a distal end **20**, where the proximal end is nearest the user and the distal end is nearest the work surface. For ease of reference, components of the system will be described with respect to a proximal end and a distal end. Where the distal end of one component engages the proximal end of the next component.

[0059] Turning now to FIG. **1**B a power driver **110** is illustrated in combination with a fastener delivery tool **100** from an upper perspective facing a work surface. The fastener delivery tool **100** has a loading assembly and a driver shaft assembly **160**. The power driver **110** operates the driver shaft assembly **160**. A nosepiece (also shown in FIGS. **4**-**9**) is positioned at the distal end **20** of the fastener delivery tool **100** and engages the work surface **30**. As is appreciated by those skilled in the art, suitable fasteners have a head with a drive interface (e.g., shaped and operable to engage a bit), and a length. The length can be further separated into a shank portion and a thread length portion, where a threaded portion has a major diameter (corresponding to the crest or highest part of the thread), and a minor diameter. Each thread also has a thread angle and a pitch.

[0060] FIGS. **1**C-**1**I illustrate the fastener delivery tool **100** from different angles. From the various angles, it will be appreciated that a fastener drops through the loading assembly **150** and into the jaw assembly **500**. In some configurations, the fastener then passes through a gap between the jaw assembly **500** and nosepiece **700** before delivery to a work surface achieving a drop and catch process. However, a variety of nosepiece configurations can be used which do not include a drop and catch process without departing from the scope of the disclosure.

[0061] The first support plate **173** is positionable in a spaced relationship with the second support plate **175**. A portion of the first support plate **173** and the second support plate **175** are positionable within an outer housing **170** positioned distally to the outer tube **164**. The outer housing **170** is secured to the jaw assembly **500** via an elongated member **571** having an aperture for receiving a fastener at either end that engages the outer housing **170** at a first end and the jaw assembly **500** at a second end.

[0062] FIG. **1**J is an exploded view of the fastener delivery tool **100**. The driver shaft assembly **160**

has an upper assembly that includes a screw gun mount **162** at a first end (proximal end) and a bit quick release at a second end (distal end). An outer tube **164** is provided with a spring **166** positioned within the outer tube **164**. The screw gun mount **162** engages a first end of the outer tube **164** A lower stop **168** is provided at the opposing end of the outer tube **164** The lower stop **168** has a curved shape operable to surround at least a portion of the outer tube **164**. A portion of the outer tube **164** fits within an outer housing **170**. An upper support **172** is provided that is partially positioned within the outer housing **170**. The upper support **172** has a first support plate **173** with a first support plate aperture **174** sized to engage the spring **166**. A second support plate **175** is provided with a second support plate aperture **176** The second support plate **175** is positionable below the first support plate **173**. A lower mount **178** is provided which is positionable below the second support plate **175**. A tubular element **179** extends upwardly from the lower mount **178**. The tubular element **179** is sized to fit within the first support plate aperture **174** and the second support plate aperture **176**.

[0063] A shift assembly **180** is provided. The shift assembly **180** controls opening and closing of the jaw mechanism discussed below, as well as timing of the operation of the jaw. The shift assembly **180** has a first arm **181** that extends in a first direction on a first side of a shift assembly plate **183**, and a second arm **182** that extends in the same first direction on a second side of the shift assembly plate opposite the first side. Both the first arm **181** and the second arm **182** have a curved aperture **184**. The shift assembly plate **183** has a third arm **185** that extends in an opposite direction on a third side of the shift assembly plate perpendicular to the first side and the second side. A knob **186** is provided that secures the outer housing **170** and the second support plate **175**. A height adjustment assembly is provided. The height adjustment assembly has two pieces. An upper L-shaped piece, upper slide **188**, engages a lower slide **190**. The upper slide **188** is an upper slide with a long side and a short side. The long slide has a wall on either side to create a recess. A flap **189** is provided at a 90 degree angle from the inside face of the long side of the L-shaped piece. The flap has a width that is narrower than the width of the upper slide **188**. A lower slide **190** is provided that slidably engages the upper slide. The upper slide **188** can have a flange on that forms a recess in which the lower slide **190** nests and moves in a proximal and distal direction. The jaw assembly **500** assembly engages the upper jaw housing via the lower mount **178**. The jaw assembly is illustrated and described in further detail in FIG. **5**.

[0064] FIG. **2**A illustrates a side partial perspective view of a loading assembly of a fastener delivery tool **200**. FIG. **2**B illustrates an exploded view of the loading assembly of the fastener delivery tool **200** shown in FIG. **2**A. The loading assembly has a feed tube **250** with a cap **212** at a first end (proximal end). The cap **212** securely engages the feed tube **250** at the proximal end **10** of the feed tube **250**. The cap **212** defines an aperture **214** through which a fastener (not shown) passes during use. A flanged ring **216** is provided to engage a first slider rail **220**. The flanged ring **216** has an aperture that allows the flanged ring **216** to fit around the feed tube **250**. The flange **218** of the flanged ring **216** extends away from the outer surface of the flanged ring **216**. The flange **218** engages the first slider rail **220**. A second slider rail **222** is provided. The first slider rail **220** and the second slider rail **222** fit within the springs of the driver shaft assembly **300** (shown in FIG. **3**). A hex drive screw **224** and washer can be provided for each of the slider rails to secure the slider rails relative to the flanged ring **216** and the drive shaft assembly. The loading assembly base **230** can have flat upper surface and a plurality of apertures. A variety of securement mechanisms can be provided to engage the loading assembly base including one or more of any of the following: hex drive screw **223**, machine screw style hangers **225**, a hex lock nut **226** and washer **227**, a shoulder screw **228**, head hex drive screws **229**. A high strength threaded rod **231** is also provided which passes through an aperture in the bottom surface of the loading assembly base **230** and is engaged at an upper end by a hex nut **232**. A dowel **233** engages an aperture in the side of a loading assembly base **230**.

[0065] In one configuration, a timing controller **236** is provided. As illustrated in this embodiment

the timing controller **236** is a flat bar with an elbow bend and a plurality of apertures. The timing controller **236** has a longer end on one a first side of the bend and a shorter end on the second side of the bend. During use, the timing controller **236** rotates about an axis to control the operation of the tool so that it stops or prevents the tool from compressing until the assembly is shifted into place (e.g., tool and the fastener to be driven) by moving towards and away from a longitudinal axis formed by, for example, the feed tube **250**. The timing controller **236** is operable to control engagement of the bit with the fastener. Bent shaft **240** and two straight shafts **242** are provided which are operable to engage the fastener deliver tool and the nosepiece to control delivery of the fastener from the fastener delivery tool **200**. The timing controller operates similarly to the shift assembly **180** shown in FIG. **1**J.

[0066] FIG. **2**C illustrates a fastener delivery tool configured as shown in FIGS. **2**A-B with the power driver **110**.

[0067] FIG. **3** is an exploded view of a driver shaft assembly **300** for a fastener delivery tool. The drive shaft assembly **300** has a handle **310** at a proximal end **10**. The handle **310** is elongated with an aperture **312** through and end which is perpendicular to an axis along its length. A coupler **314** is provided which is sized at one end to fit within the aperture **312** if the handle **310**. The second end of the coupler **314** engages a tubular member **316**, which in turn engages a drive shaft assembly base **320**. The tubular member **316** has, for example, a pair of socket cap screws **321**, **321′** and screws **315**, **315′**. As with the fastener delivery tool **200**, a variety of securement mechanisms can be provided to engage the body **323** of the drive shaft assembly base **320** including one or more of any of the following: a cap screw **322**, a shoulder screw **324**, and a hex nut **325**. A bushing **319** can also be provided. A ball bearing **326** is provided, along with a pair of washers **327**. A stopper bolt **328** is also provide, along with a pair of compression springs **330**, **332** The compression springs **330**, **332** are sized so that the first slider rail **220** and second slider rail **222** can pass through an aperture formed by the compression springs **330**, **332**. The compression springs **330**, **332** (with the first slider rail **220** and the second slider rail **222**) engage the loading assembly base **230** and the drive shaft assembly base **320**. A pair of dowels **334** are provided which pass through a portion of the compression springs and slider rails. An elongated member **336** is provided which engages a bit **338**. The bit **338** engages a fastener during use and the elongated member controls spinning of the bit **338** to drive the fastener into the work surface.

[0068] FIGS. **4**A-E illustrate a portion of an exemplar loading tool or loading assembly illustrating an active shifting process for shifting the position of the fastener during the fastener loading process. As shown in FIG. **4**B, the feed tube **250** is positioned at an angle from a y-axis. During operation, the receiving tube shifts as shown in FIG. **2**C so that the feed tube **250** and the receiving tube **410** align, this allows the fastener to pass from the feed tube **250** into the receiving tube **410**. From a starting position, the feed tube **250** and the receiving tube **410** are aligned. When the user lifts the tool off the work surface, springs return the tool to a fully open and rest position. With the feed tube **250** and receiving tube **410** aligned, the next fastener can be loaded. Thus, once the fastener has passed into the receiving tube, the feed tube and receiving tube return to their starting position so that the receiving tube, now containing the fastener, is aligned with the drive shaft assembly as shown in FIG. **2**E.

[0069] Turning now to FIGS. **5**A-J, a jaw assembly **500** is illustrated. The jaw assembly **500** is operable for use in a fastener-driving tool. The jaw assembly comprises a plurality of upper blades **512**, **514**, **516**, **518** having an upper blade surface **512′**, **514′**, **516′**, **518′** with a first portion and a second portion angled across a bend in the upper blade surface, an interior facing blade edge **512″**, **514″**, **516″**, **518″** and an exterior facing blade edge **512‴**, **514‴**, **516‴**, **518‴** wherein the interior facing edge of the plurality of upper blades defines a variably sized central jaw aperture **502**. A plurality of upper blade controllers **522**, **524**, **526**, **528** are also provided. The plurality of upper blade controllers **522**, **524**, **526**, **528** each have a first controller end **522‴**, **524‴**, **526‴**, **528‴**, and a second controller end **522″**, **524″**, **526″**, **528″**. The plurality of upper blade controllers engage an

adjacent upper blade along a portion of the interior facing upper blade edge on a first side. Moreover, the plurality of upper blade controllers **522**, **524**, **526**, **528** are positioned along an exterior edge of the corresponding upper blade at the first controller end **522‴**, **524‴**, **526‴**, **528‴**, and along an exterior edge of an adjacent upper blade along a length (L) of the upper blade controller. Each of the plurality of upper blades **512**, **514**, **516**, **518** engages an adjacent upper blade controller **522**, **524**, **526**, **528** along a portion of the interior facing upper blade edge on a first side, and is positioned along an exterior edge of the upper blade on a second side.

[0070] Thus, for example, upper blade **514** has an upper blade controller **524** that extends from a portion of the interior facing blade edge of adjacent the upper blade **512** and extends along an exterior edge of the upper blade **514**. A jaw mount **560** substantially surrounds the plurality of upper blades and upper blade controllers. Additionally, a pair of jaw springs **590**, **592** are provided that are operable to control a motion of the plurality of upper blades.

[0071] In operation, the jaw assembly **500** is operable to receive a fastener **40** from a feed tube. The point and shank of the fastener are allowed to pass through and the fastener comes to rest when the head of the fastener lands on the upper blades **512**, **514**, **516**, **518**. The bit engages with the fastener and eventually pushes the fastener through the jaw assembly **500**. Consequently, the fastener can force the jaw assembly to open, typically at the head. The jaw assembly **500** further comprises a plurality of lower blades controllable by a plurality lower blade controllers **522′**, **524′**, **526′**, **528′**, which can also be controllable by the springs.

[0072] As will be appreciated by those skilled in the art, upper blades **512**, **514**, **516**, **518** each have an edge that engages with the adjacent member. For example, as shown in FIG. **5**A the upper surface of upper blade **514** pushes on a left surface of upper blade **516** When one upper blade is pushing outward, from a central axis, the movement of the upper blade causes the adjacent upper blade to move in the same manner. Thus, the movement of one upper blade in an outward direction causes the remaining upper blades to move outward at the same time. Similarly, if an upper blade moves inward, the remaining upper blade will move in the same manner. Moving all of the upper blades in the same way maintains the same center axis for the variably sized central jaw aperture **502** The upper blades **512**, **514**, **516**, **518** pivoting about the apertures located at the end of the upper blade controllers **522**, **524**, **526**, **528**.

[0073] From an upper view shown in FIG. **5**A, the jaw assembly **500** has a plurality of upper blades **512**, **514**, **516**, **518** The plurality of upper blades **512**, **514**, **516**, **518** are controlled by a corresponding upper blade controller **522**, **524**, **526**, **528** When the blade controller is moved in a first direction **536**, the central jaw aperture **502** gets smaller, thereby preventing the entire fastener from passing through the jaw assembly **500**. As will be appreciated by those skilled in the art, the shank and threaded portion of the fastener can pass through the jaw assembly, but the head of the fastener is unable to pass through without application of force from above to move the fastener in a distal direction toward the work surface. Conversely, if the fastener is partially driven into the work surface and sitting proud (e.g., raised) of the work surface, the device can be positioned over the fastener and pushed distally so that the head of the fastener forces the jaws to open and allows the bit to engage the fastener prior to reversing the fastener from its current location (i.e., moving the fastener proximally). When the blade controller is moved in a second direction **538**, the central jaw aperture **502** gets larger. As appreciated from FIGS. **5**B-C, the blades have a sidewall **542**, **544**. The sidewall **542**, **544** has flanges **532**, **534** that extend laterally away from the surface of the sidewall. The flanges **532**, **534** engage with the jaw mount **560** which is able to rotate and is spring loaded. The rotation and loaded spring is operable to return the blades to a rest position. A second, lower set of blades can also be provided on the opposite end of the sidewall from the first, upper blades **512**, **514**, **516**, **518** The length of the sidewall can be varied to accommodate the length of a fastener. Additionally, the plurality of upper blades can form an angled surface to the sidewall as shown in FIG. **5**E, allowing for a tapered head of a fastener to nest against an upper facing surface of the upper blades.

[0074] The knob **572** is operable to adjust the jaw assembly allowing the device to optimally perform with fasteners of different dimensions. Thus, for example, turning the knob **572** in a first direction will facilitate operating the jaw assembly with a fastener having a first diameter and turning the knob **572** in a second direction, opposite the first direction, will facilitate operating the jaw assembly with a fastener having a second diameter different that the first diameter. As will be appreciated by those skilled in the art, the knob **572** can be turned incrementally in a first direction, or second direction, to optimize performance with fasteners having increasing diameter (e.g., incremental movement in a first direction) or smaller diameters (e.g., incremental movement in a second direction, opposite the first direction).
[0075] FIG. **6**A illustrates the fastener delivery tool **100** engaging a work surface **30**. FIGS. **6**B-C illustrate a partial cross-section (and close-up) of the delivery tool with a fastener **40** ready for delivery to the installation surface.
[0076] FIGS. **7**A-F illustrate nosepieces **700** for the fastener delivery tools including partial cross-sections, an external view, and an exploded view. Some nosepieces **700** have a flat work surface interface (e.g., FIG. **7**A) while other configurations have an angled work surface interface or bird beak interface (e.g., FIG. **7**B).
[0077] The nosepiece **700** has a central block **720** with an aperture that passes through the central block that is operable to receive a fastener during use. The central block **720** has a pair of fastener release elements **716** or jaws on either side that are configured to move towards a central axis passing through the central block **720**. The aperture is in communication with the feed tube to receive the fastener. Each fastener release element is coupled to a plate **714** and a fastener release controller **712** or toggle. The fastener release elements **716** have an angled surface at an upper end to engage the head of a fastener during use.
[0078] A compression spring **726** is provided. Plate **714** is stationary while the fastener release elements **716** move. The compression spring **726** pushes the fastener release elements **716** inward towards the central axis. The fastener release controller **712** determines how close the opposing jaws get at rest. Thus, for a larger diameter screw, the fastener release controller **712** is set so that the jaws are further apart at rest. For smaller diameter screws, the fastener release controller **712** is set to allow the jaws to come closer together at rest. When the screw head and the driver bit pass through, the jaws slide open and are then out of the way. Jaw fastener **728** is threaded into the jaw piece. Fastener release controller **712** interacts with jaw fastener **728**, e.g. by toggling, which in turn determines the jaw position.
[0079] A plurality of fastening devices are provided to secure the components of the nosepiece **700** together. Suitable fastening devices include one or more screws **710**, one or more socket cap screws **730**, and one or more knurled inserts for hardwood **742**. An upper guide **740** and a lower guide **750** is provided. Each of the upper guide **740** and a lower guide **750** have an aperture that passes through each guide that is operable to receive the shaft of the fastener during use. The lower guide **750** is shaped at its distal end **20** to have either a flat surface or an angled beak surface as desired.
[0080] FIGS. **8**A-C illustrate the angled worked surface interface for the fastener delivery tool. In operation, the angled work surface interface is geared to open symmetrically. Symmetrical opening prevents the interface getting pinched into the surface by a large fastener head. Moreover, the angled distal end (“beak”) is ramped inside to guide and center the point of the fastener. The combination of the jaws and the angled “beak” interface centering allow the device to accommodate a larger variety of fastener sizes, e.g., fasteners of differing lengths, while still controlling fastener delivery. For example, with a shorter fastener, the jaws eventually stop guiding the fastener which could allow the fastener to go out of the delivery axis. However, the ramped insider of the interface helps maintain the centering of the fastener.
[0081] FIGS. **9**A-B illustrate the flat work surface interface for the fastener delivery tool.
[0082] While standing, a user drops a fastener into the drop tube with the point of the fastener facing distally (away from the user and towards the work surface). If the fastener is placed into the

drop tube incorrectly (i.e., head of the fastener positioned distally), the fastener is easily removed by inverting the device. Additionally the fastener release controller **712** when activated would not fully close around the fastener because the head of the fastener would not be positioned at the proximal end of the fastener release controller **712** in the recessed area.

[0083] When the user starts to activate the device, to drive a fastener into a work surface, a four bar mechanism turns vertical movement into rotation of the nose (see, for example, FIG. **4**). Active rotation of the nose is used to result in a shifting motion. A separate actuator does not create the shifting. Instead, the shifting is created by the normal driving action when operating the device. In an alternative embodiment, the actuator can be a cable or lever level that achieve the shifting movement.

[0084] Once the fastener passes from the feed tube into the nosepiece, the fastener is positioned between two jaws that support the fastener most of the way around. The fastener is captured under the head instead of at a point for improvement alignment with the bit. Placing downward pressure on the device to drive the fastener makes it harder for the jaws of the nosepiece to open enough for the head of the fastener to pass through the central aperture. Rollers **760** are added to address this issue. Additionally, the jaws are configured to allow the tool to be lifted off the work surface without dropping the fastener. The stroke of the jaws is also operable to allow the head of the fastener to fully clear the device while also being able to securely engage fasteners with a smaller head. The fastener release controller **712** makes the jaw spacing adjustable. As noted above, the driving motion shifts the fastener into a drive position. To control this process the bit engagement is timed to avoid jams. The timing controller controls the timing of the bit engagement.

[0085] In some applications, locating holes in a steel strap or steel plate is necessary. For installations that require locating holes the tapered (beak) interface further facilitates accurate use of the device and increases precision. The jaws of the beak are operable to open at the same time. The modular nature of the nosepiece allows the length to be changed (e.g., by removing the upper guide) to accommodate fasteners of shorter length.

[0086] While preferred embodiments of the present invention have been shown and described herein, it will be obvious to those skilled in the art that such embodiments are provided by way of example only. Numerous variations, changes, and substitutions will now occur to those skilled in the art without departing from the invention. It should be understood that various alternatives to the embodiments of the invention described herein might be employed in practicing the invention. It is intended that the claims define the scope of the invention and that methods and structures within the scope of these claims and their equivalents be covered thereby.

Claims

1. A fastener driving tool comprising: a loading assembly comprising a feed tube operable to receive a fastener at a first end and deliver the fastener at a second end; a driver shaft assembly operable to engage a power driver at a first driver shaft assembly end and receive the fastener from the feed tube; a jaw assembly engaging the second end of the driver shaft assembly comprising a plurality of upper blades having an upper blade surface, an interior facing blade edge, an exterior facing blade edge, wherein the interior facing blade edge of the plurality of upper blades defines a variably sized central jaw aperture; a plurality of upper blade controllers, wherein each of the plurality of upper blade controllers has a first side operable to engage a portion of an exterior facing upper blade edge, and a second side positioned along an exterior edge of an adjacent upper blade along a length of the upper blade controller; and a jaw mount substantially surrounding the plurality of upper blades and upper blade controllers.

2. The fastener driving tool of claim 1 wherein the driver shaft assembly further comprises one or more of a handle and a coupler.

3. The fastener driving tool of claim 1 wherein the feed tube further comprises one or more of a

cap, and a flanged ring.
4. The fastener driving tool of claim 1 further comprising one or more of an outer tube with a spring positioned therein coupled to the power driver at a first outer tube end, an upper support coupled to a lower mount, a height adjustment assembly, a nosepiece operable to engage a work surface, a fastener release controller, a pair of jaw springs operable to control a motion of the plurality of upper blades, a knob operable to adjust the jaw assembly to accommodate a plurality of fastener sizes
5. The fastener driving tool of claim 4 wherein the upper support has a first support plate with a first support plate aperture and a second support plate with a second support plate aperture.
6. The fastener driving tool of claim 4 wherein the height adjustment assembly further comprises an upper slide and a lower slide operable to slidingly engage the upper slide.
7. The fastener driving tool of claim 4 wherein the nosepiece has a flat distal surface or a pointed distal surface.
8. The fastener driving tool of claim 7 further comprising an extension foot operable to provide a gap between the jaw assembly and the work surface.
9. The fastener driving tool of claim 1, wherein the jaw assembly is operable to receive a fastener from a feed tube and opens and closes.
10. The fastener driving tool of claim 1, wherein the jaw assembly further comprises a plurality of lower blades controllable by a plurality lower blade controllers.
11. The fastener driving tool of claim 10, wherein using the lower blade controllers controls a motion of the plurality of the lower blades.
12. The fastener driving tool of claim 10, further comprising a plurality of sidewalls between the plurality of upper blades and the plurality of lower blades.
13. The fastener driving tool of claim 4, wherein a driving tool with the plurality of lower blades further comprises a plurality of flanges.
14. The fastener driving tool of claim 13, wherein a flange of the plurality of flanges extends laterally from a surface of a sidewall of a plurality of sidewalls.
15. The fastener driving tool of claim 10, wherein the jaw mount is rotatable.
16. The fastener driving tool of claim 1, wherein the plurality of upper blades includes a first upper blade, a second upper blade, a third upper blade, and a fourth upper blade.
17. The fastener driving tool of claim 1, wherein the plurality of upper blade controllers includes a first upper blade controller, a second upper blade controller, a third upper blade controller, and a fourth upper blade controller.
18. The fastener driving tool of claim 1, wherein the plurality of upper blades and the plurality of upper blade controllers are configured such that by moving one of the upper blade controllers causes the variably sized aperture to change its size.
19. The fastener driving tool of claim 10, wherein the plurality of lower blades controllers includes a first lower blade controller, a second lower blade controller, a third lower blade controller, and a fourth lower blade controller.
20. The fastener driving tool of claim 14, wherein: the plurality of upper blade controllers includes a first upper blade controller, a second upper blade controller, a third upper blade controller, and a fourth upper blade controller, and the plurality of lower blades controllers includes a first lower blade controller, a second lower blade controller, a third lower blade controller, and a fourth lower blade controller.
21. The fastener driving tool of claim 20, wherein: an end the first upper blade controller and an end of the first lower blade controller overlap each other in a first direction, an end of the second upper blade controller and an end of the second lower blade controller overlap each other in the first direction, an end of the third upper blade controller and an end of the third lower blade controller overlap each other in the first direction, and an end of the fourth upper blade controller and an end of the fourth lower blade controller overlap each other in the first direction.

22. The fastener driving tool of claim 21, wherein one or more of the first upper blade controller and the first lower blade controller are configured to move in a same direction and the end of the first upper blade controller and the end of the first lower blade controller are coupled together.
23. A fastener driving tool comprising: a loading assembly comprising a feed tube operable to receive a fastener at a first end and deliver the fastener at a second end; a driver shaft assembly operable to engage a power driver at a first driver shaft assembly end and receive the fastener from the feed tube; a jaw assembly engaging the second end of the driver shaft assembly wherein the jaw assembly operable to receive the fastener from the feed tube and open and close; and a knob operable to adjust operation of the jaw assembly.
24. A method of installing a fastener comprising: providing a fastener driving tool comprising a loading assembly comprising a feed tube operable to receive a fastener at a first end and deliver the fastener at a second end, a driver shaft assembly operable to engage a power driver at a first driver shaft assembly end and receive the fastener from the feed tube, and a jaw assembly engaging the second end of the driver shaft assembly comprising a plurality of upper blades having an upper blade surface, an interior facing blade edge, an exterior facing blade edge, wherein the interior facing blade edge of the plurality of upper blades defines a variably sized central jaw aperture; a plurality of upper blade controllers, wherein each of the plurality of upper blade controllers has a first side operable to engage a portion of the exterior facing upper blade edge, and a second side positioned along an exterior edge of an adjacent upper blade along a length of the upper blade controller; and a jaw mount substantially surrounding the plurality of upper blades and upper blade controllers; placing a distal end of the fastener driving tool on a work surface; inserting the fastener into the feed tube; receiving the fastener into the jaw assembly of the fastener driving tool; and activating the power driver to deliver torque to a head of the fastener.
25. The method of claim 24 wherein one or more of the fastener driving tool further comprises a knob further comprising the step of turning the knob in a first direction to adjust the jaw assembly based on a diameter of the fastener and the fastener driving tool further comprises a timing controller operable to control engagement of a bit further comprising moving the timing controller in a first direction to engage the bit and a second direction to disengage from the bit.
26. A fastener driving tool comprising: a loading assembly comprising a feed tube operable to receive a fastener at a first end and deliver the fastener at a second end; a driver shaft assembly operable to engage a power driver at a first driver shaft assembly end and receive the fastener from the feed tube; a timing controller operable to control engagement of a bit; and a jaw assembly engaging the second end of the driver shaft assembly wherein the jaw assembly.