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GARDEN IMPLEMENT

Abstract

Aspects of the disclosure relate to a garden implement that includes a handle, at least one tool member having a pair of flanges extending therefrom, each flange includes a flange bore and a pinion segment that share a common center, the pair of flanges have opposing parallel surfaces that each include the pinion segment, the opposing parallel flange surfaces are spaced apart by a first distance. Also included is at least a first fixing member coupled between the pair of flanges and the handle. The first fixing member includes a boss projecting along a longitudinal axis, the boss has parallel surfaces spaced apart by the first distance, a boss bore, and a curved rack segment projecting from the boss and configured to mesh with at least a portion of the pinion segment. Also included is a fixing shaft insertably received in at least one flange bore and the boss bore.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS [0001] This application for patent is a continuation-in-part of U.S. patent application Ser. No. 18/352,922 entitled “Garden Implement” filed in the United States Patent and Trademark Office on Jul. 14, 2023, which is a continuation of U.S. patent application Ser. No. 17/033,548 (now U.S. Pat. No. 11,700,780) entitled “Garden Implement” filed in the United States Patent and Trademark Office on Sep. 25, 2020, the entire content of each recited patent application is incorporated herein by reference as if fully set forth below in its entirety and for all applicable purposes.

BACKGROUND
Field
[0002] The present disclosure relates to the field of gardening. More specifically, the present disclosure relates to gardening implements that work soil.
Background
[0003] Plants, trees, and all non-animal life forms (individually or collectively referred to herein as vegetation) surround us. Some vegetation grows in the wild and other vegetation is cultivated, by way of example, for ornamental purposes, for boundary marking purposes, for food consumption purposes, or any combination thereof. Persons that cultivate vegetation for personal use and enjoyment are often called gardeners. Gardeners may plant, grow, and tend to vegetation such as trees, flowers, shrubs, vegetables, fruits, and herbs in plots of land adjacent to or near their homes, in communal settings, and/or in indoor settings such as green houses and/or in closed-in settings where artificial light is used. These plots of land may be small in size, for example when the plot consists of a border with decorative bushes and/or flowering plants surrounding a home or apartment building. These plots of land may be medium in size, for example when a plot includes a yard of a home and consists of one or more areas of ground within which trees, vegetables, and/or ornamental plants are grown. These plots of land may be large in size, for example when a plot is used to grow vegetables to feed one or a number of households. In general, these plots of land are referred to as gardens. In contrast, other plots of land may be called farms and the people that tend to them may be referred to as farmers. Gardeners and farmers have many of the same duties but perform those duties on different scales.
[0004] Additionally, other persons that do not necessarily refer to themselves as gardeners or farmers may also be responsible for planting and tending to vegetation. For example, trees, shrubbery, and plants may be used to demarcate borders of a property and/or add ornamentation to the grounds surrounding a home or business. Trees, shrubbery, and plants may also be found in and around open spaces where persons congregate to enjoy the outdoors. These non-garden-specific, non-farm-specific plots of land may be tended to by property owners that do not necessarily consider themselves to be gardeners or farmers or may be tended to by commercial entities hired to plant and/or maintain the vegetation in these sorts of plots of land. These types of people may be referred to by various names, such as groundskeeper.
[0005] Despite the different nature and sizes of the plots of land that gardeners, farmers, and groundskeepers tend to, they all make use of many of the same or similar tools to tend to their vegetation. These tools include, for example, a spade, a trowel, and a hoe. These and many other tools are referred to herein as garden tools.
[0006] Generally, garden tools are unitary in nature; that is, each garden tool is separate from another. A first garden tool (e.g., a spade with a fixed short handle) is distinct from a second garden

tool (e.g., a hoe with a fixed long handle). Due in part to mass production, the orientation between a given working part of a garden tool and the handle of that garden tool is well established. However, consumers may find value in garden tools that are able to be customized to fit each respective consumer's own style of gardening.

SUMMARY

[0007] The following presents a summary of one or more aspects of the present disclosure, in order to provide a basic understanding of such aspects. This summary is not an extensive overview of all contemplated features of the disclosure and is intended neither to identify key or critical elements of all aspects of the disclosure nor to delineate the scope of any or all aspects of the disclosure. Its sole purpose is to present some concepts of one or more aspects of the disclosure in a form as a prelude to the more detailed description that is presented later.

[0008] A garden implement is disclosed. The garden implement includes a handle having spaced apart handle ends, at least one tool member having a pair of flanges extending therefrom, each flange including a flange bore defined by a flange internal sidewall and a pinion segment having a common first center with the flange bore, the pair of flanges having opposing parallel flange surfaces each including the pinion segment and having a flange bore center axis intersecting the common first center and perpendicular to the opposing parallel flange surfaces, the opposing parallel flange surfaces spaced apart by a predetermined first distance, at least a first fixing member coupled between the pair of flanges and a respective handle end. As used herein, the term opposing parallel flange surfaces may be understood as meaning parallel flange surfaces that face each other (e.g., oppose each other). In the garden implement, the first fixing member includes a first boss projecting along a longitudinal axis relative to the first fixing member, the first boss having parallel first boss surfaces spaced apart by the predetermined first distance, a first boss bore defined by a first boss internal sidewall, and a first boss bore center axis intersecting a first boss bore center and perpendicular to the parallel first boss surfaces, each respective first boss surface having a curved rack segment projecting perpendicularly therefrom and configured to mesh with at least a portion of the pinion segment. The garden implement also includes a fixing shaft insertably received in at least one flange bore and the first boss bore following coaxial alignment of the flange bore center axis and the first boss bore center axis.

[0009] An interchangeable toolhead is disclosed. The interchangeable toolhead includes a tool member and a pair of flanges coupled to and extending from the tool member. Each flange includes a flange bore defined by a flange internal sidewall and a pinion segment having a common first center with the flange bore, the pair of flanges having opposing parallel flange surfaces including at least the respective pinion segment and a having a pinion axis intersecting the common first centers and perpendicular to the opposing parallel flange surfaces, the opposing parallel flange surfaces spaced apart by a predetermined first distance.

[0010] A plurality of articles of manufacture packaged as a garden implement set is disclosed. The garden implement set includes a handle having spaced apart handle ends, at least two toolheads each having a pair of flanges extending therefrom and including opposing parallel flange surfaces spaced apart by a predetermined first distance, at least two fixing members each fixed to respective handle ends and configured to couple the handle to a respective one of the at least toolheads, and at least two fixing shafts, each configured to be insertably received in a first fixing shaft receiver of a respective toolhead and a second fixing shaft receiver of a respective fixing member when the fixing shaft, first fixing shaft receiver, and second fixing shaft receiver are coaxially aligned.

[0011] A tool is described. The tool includes a handle having a first handle end spaced apart from a second handle end. The tool also includes a fixing member integrally formed with the first handle end. The fixing member includes a boss projecting along a longitudinal axis relative to the first handle end, the boss having a first boss surface and a second boss surface spaced apart from and parallel to the first boss surface by a predetermined distance, a boss bore defined by a boss internal sidewall, and a boss bore center axis, each respective boss surface having a curved rack segment

having a first plurality of teeth projecting therefrom toward and partially surrounding the boss bore center axis, the first plurality of teeth forming a first compound surface spanning the first plurality of teeth. The boss bore center axis may be perpendicular to the first boss surface and the second boss surface. The tool also includes a toolhead, which includes a tool member and a pair of flanges respectively fixed to and extending from the tool member and having opposing parallel flange surfaces fixedly spaced apart by the predetermined distance. Each respective flange having a flange bore defined by a flange internal sidewall and a flange bore center axis perpendicular to the opposing parallel flange surfaces. The flange bore center axis may be perpendicular to the opposing parallel flange surfaces. Each respective flange has a curved pinion segment having a respective second plurality of teeth projecting therefrom away from and partially surrounding the flange bore center axis, the second plurality of teeth forming a second compound surface spanning the second plurality of teeth, the pair of flanges configured to slidingly receive the boss therebetween and enter into a meshed engagement between fewer than all of the second plurality of teeth and the first plurality of teeth. The tool also includes a fixing shaft configured to be insertably received in at least one flange bore and the boss bore and configured to maintain a coaxial alignment of the flange bore center axis and the boss bore center axis. The fixing shaft, once insertably received in the at least one flange bore and the boss bore may be further configured to maintain the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.

[0012] A plurality of articles of manufacture packaged as a tool set is described. The plurality of articles of manufacture include a handle having a first integrally formed fixing member at a first handle end and a second integrally formed fixing member at a second handle end, distal from the first handle end. Each of the first integrally formed fixing member and the second integrally formed fixing member include a boss projecting along a longitudinal axis relative to the first handle end, the boss having a first boss surface and a second boss surface spaced apart from and parallel to the first boss surface by a predetermined distance, a boss bore defined by a boss internal sidewall, and a boss bore center axis perpendicular to the first boss surface and the second boss surface, each respective boss surface having a curved rack segment having a first plurality of teeth projecting therefrom toward and partially surrounding the boss bore center axis, the first plurality of teeth forming a first compound surface spanning the first plurality of teeth. The plurality of articles of manufacture also include one or more toolheads. Each toolhead includes a tool member and a pair of flanges respectively fixed to and extending from the tool member and having opposing parallel flange surfaces fixedly spaced apart by the predetermined distance. Each respective flange having a flange bore defined by a flange internal sidewall and a flange bore center axis (perpendicular to the opposing parallel flange surfaces). Each respective flange has a curved pinion segment having a respective second plurality of teeth projecting therefrom away from and partially surrounding the flange bore center axis, the second plurality of teeth forming a second compound surface spanning the second plurality of teeth, the pair of flanges configured to receive the boss therebetween and slidingly and engage fewer than all of the second plurality of teeth with the first plurality of teeth. The plurality of articles of manufacture also include one or more fixing shafts, each fixing shaft configured to be insertably received in at least one flange bore and the boss bore and configured to maintain a coaxial alignment of the flange bore center axis and the boss bore center axis. The one or more fixing shafts may further be configured to maintain the meshed engagement between the fewer than all of the second plurality of teeth are engaged and the first plurality of teeth.

[0013] These and other aspects of the disclosure will become more fully understood upon a review of the detailed description, which follows. Other aspects, features, and embodiments of the present disclosure will become apparent to those of ordinary skill in the art, upon reviewing the following description of specific, example embodiments of the present disclosure in conjunction with the accompanying drawings. While features of the present disclosure may be discussed relative to certain embodiments and figures below, all embodiments of the present disclosure can include one

or more of the advantageous features discussed herein. In other words, while one or more embodiments may be discussed as having certain advantageous features, one or more of such features may also be used in accordance with the various embodiments of the disclosure discussed herein.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Reference is made to the accompanying drawings in which are shown illustrative embodiments of a garden implement in accordance with some aspects of the disclosure. In the accompanying drawings, corresponding reference characters indicate corresponding parts.

[0015] FIG. **1**A is a top plan view of an ergo-dynamic dual-headed garden implement including two interchangeable tools heads that may be selected from a plurality of interchangeable toolheads according to some aspects of the disclosure.

[0016] FIG. **1**B is the top plan view of the garden implement of FIG. **1**A with a first fixing shaft cover and a second fixing shaft cover removed.

[0017] FIG. **2** is a top plan view of another ergo-dynamic dual-headed garden implement including two interchangeable toolheads that may be selected from a plurality of interchangeable toolheads according to some aspects of the disclosure.

[0018] FIG. **3** is a perspective view of the garden implement of FIGS. **1**A and **1**B.

[0019] FIG. **4** is a cross-section along the lines **4**-**4** of FIG. **3**, of the garden implement of FIGS. **1**A and **1**B according to some aspects of the disclosure.

[0020] FIG. **5** is an exploded perspective view of a portion of the garden implement as depicted in FIG. **3** according to some aspects of the disclosure.

[0021] FIG. **6**A is a left side elevation view of a fixing member and an interchangeable toolhead of a garden implement in a spaced apart orientation according to some aspects of the disclosure.

[0022] FIG. **6**B is a top plan view of the fixing member and the interchangeable toolhead of FIG. **6**A.

[0023] FIG. **6**C is a top plan view of the fixing member and the interchangeable toolhead of FIG. **6**A and FIG. **6**B according to some aspects of the disclosure.

[0024] FIG. **7**A is a top plan view of a fixing member, a toolhead, and a portion a handle of a garden implement according to some aspects of the disclosure.

[0025] FIG. **7**B is a top plan view of the fixing member and the toolhead of FIG. **7**A, where the toolhead is in a “nominal” orientation.

[0026] FIG. **7**C is a top plan view of the fixing member and the toolhead of FIG. **7**B where the toolhead is rotated from the nominal orientation of FIG. **7**B to a maximum angular displacement counterclockwise.

[0027] FIG. **7**D is a top plan view of the fixing member and the toolhead of FIG. **7**C, where the toolhead was removed from the fixing member, rotated about the longitudinal axis, and reinstalled to the fixing member according to some aspects of the disclosure.

[0028] FIG. **8**A is a garden implement with a first fixed orientation of a toolhead relative to the handle of the garden implement according to some aspects of the disclosure.

[0029] FIG. **8**B is the garden implement of FIG. **8**A where the handle was rotated (e.g., inverted) from the orientation shown in FIG. **8**A.

[0030] FIG. **9**A is a first garden implement having a first handle with a first center segment having a first center length according to some aspects of the disclosure.

[0031] FIG. **9**B is a second garden implement having a second handle with a second center segment having a second center length according to some aspects of the disclosure.

[0032] FIG. **9**C is a third garden implement having a third handle with a third center segment

having a third center length according to some aspects of the disclosure.
[0033] FIG. **9**D is a fourth garden implement having a fourth handle with a fourth center segment having a fourth length according to some aspects of the disclosure.
[0034] FIG. **10**A is an illustrative example of a first interchangeable toolhead according to some aspects of the disclosure.
[0035] FIG. **10**B is an illustrative example of a second interchangeable toolhead according to some aspects of the disclosure.
[0036] FIG. **10**C is an illustrative example of a third interchangeable toolhead according to some aspects of the disclosure.
[0037] FIG. **11** is a graphical representation of plurality of articles of manufacture packaged as a garden implement set according to some aspects of the disclosure.
[0038] FIG. **12** is a left-top exploded perspective view of a portion of a tool according to some aspects of the disclosure.
[0039] FIG. **13** is a plan view of the second flange according to some aspects of the disclosure.
[0040] FIG. **14** is a side view of the pinion segment of FIG. **13** according to some aspects of the disclosure.
[0041] FIG. **15** is a comparative illustration of variable lengths of a hypotenuse and base of a triangle, where an interior angle between the hypotenuse and the base is changed while a side of the triangle perpendicular to the base is maintained at a value of unity according to some aspects of the disclosure.
[0042] FIG. **16** is a top plan view of the fixing member as shown and described in connection with FIG. **12** according to some aspects of the disclosure.
[0043] FIG. **17** is a cross section of FIG. **16** taken in the plane **17**-**17** according to some aspects of the disclosure.
[0044] FIG. **18** is a top plan view of first flange as shown and described in connection with FIG. **12**, except the first flange bore is presented with a circular perimeter instead of a square perimeter for ease of illustration, according to some aspects of the disclosure.
[0045] FIG. **19** is a cross section of FIG. **18** taken in the plane **19**-**19** according to some aspects of the disclosure.
[0046] FIG. **20** is a cross section of a tooth of the curved rack segment of a boss of FIGS. **12** and **16** taken in a plane looking away from the plane **17**-**17** in FIG. **16** according to some aspects of the disclosure.
[0047] FIG. **21** is a cross section of trough between teeth 4 and 5 of a curved pinion segment of a flange of FIGS. **12** and **18** taken in the plane looking away from the plane **19**-**19** in FIG. **18** according to some aspects of the disclosure.
[0048] FIG. **22**A is an illustrative example of a fourth interchangeable toolhead according to some aspects of the disclosure.
[0049] FIG. **22**B is an illustrative example of a fifth interchangeable toolhead according to some aspects of the disclosure.
[0050] FIG. **22**C is an illustrative example of a sixth interchangeable toolhead according to some aspects of the disclosure.
[0051] FIG. **23** is an illustrative example of a fixing member assembly at an end of a tool handle according to some aspects of the disclosure.

DETAILED DESCRIPTION

[0052] In the following description, specific details are given to provide a thorough understanding of the described implementations. However, it will be understood by one of ordinary skill in the art that the implementations may be practiced without these specific details. For example, in some instances, details of well-known structures and components may be shown in simplified form in order to avoid obscuring such structures and components. In other instances, well-known structures and components may be shown in detail in order not to obscure the implementations.

[0053] A garden implement having an ergonomically shaped handle is disclosed. As used herein the word “implement” may mean an object or a piece of equipment that may be used for a particular purpose. Fixing members may be coupled to either or both ends of the handle. In one non-limiting example, the gardening implement includes a handle having first and second ends. The handle may be divided into two or more segments. For example, the handle may be divided into three segments including a first segment, a center segment, and a second segment distal from the first segment and the center segment. The segments may be the same or different lengths. Angles of one segment relative to an adjacent segment may be the same or different. In one example, the handle including the first, center, and second segments, are continuously formed. In some examples, segments may be coupled to one another using an inter-segment angle fixing structure (e.g., a joint) that allows a user to changeably fix the angle between adjacent segments.
[0054] A fixing member may include a boss extending from the fixing member in a longitudinal direction relative to the fixing member. In some aspects, the fixing member is fixedly coupled to the handle, accordingly, the longitudinal direction may also be relative to the handle. The boss may be configured to couple to one of a plurality of interchangeable toolheads. In some examples, an interchangeable toolhead may include a tool member coupled to a pair of flanges. Tools may include, for example, a spade, a hoe, and a trowel. The preceding list is non-limiting; other tools are within the scope of the disclosure. In some examples, the tool member may be coupled to a pair of flanges. According to some aspects, the symmetry of the fixing member relative to the handle, the boss relative to the handle, or both the fixing member and the boss relative to the handle may have at least one of right-left symmetry, top-bottom symmetry, or axial symmetry; however, symmetry is not limitation of the disclosure.
[0055] In examples in which the interchangeable toolhead may include a tool member coupled to a pair of flanges, a width of the boss projecting from the fixing member may be substantially equal to a spacing between spaced apart opposing parallel flange surfaces. In one example, the Toolhead includes the tool member and the pair of flanges. In another example, the tool head may include the pair of flanges configured as one object. Openings, apertures, or boreholes (referred to herein as “bores”) may be provided through the flanges and the boss. Flange bores may be defined by internal sidewalls of the flange, while a boss bore may be defined by internal sidewalls of the boss. The bores in the flanges and boss may be configured to have coaxial alignment with one another when a fixing shaft fixes an interchangeable toolhead to a fixing member. The fixing shaft may restrict movement of the interchangeable toolhead by being received in at least one of the bores in the flanges and the bore in the boss. Angle fixing structures (e.g., an internal gear segment, a portion of an internal gear) configured to mesh with at least a portion of a pinion segment may be integrally formed with or in the boss and the flanges to lock the interchangeable toolhead at a predetermined angle relative to the fixing member (and therefore relative to the handle).
[0056] The boss may be configured to slide, in the direction of the longitudinal axis, between opposing parallel flange surfaces until at least some of a plurality of first teeth on the pair of flanges are meshed with at least some of a plurality of second teeth that may be formed in the boss. An angle of the interchangeable toolhead relative to the fixing member (and therefore relative to the handle) is selectable based on which of the plurality of first teeth of the respective pair of flanges are meshed with the plurality of second teeth of the boss. The fixing shaft, when received in the bore of the boss and at least one of the bores of the flanges may fix the angle of the interchangeable toolhead relative to the fixing member (e.g., relative to the longitudinal axis). Changing the angle involves complete removal of the fixing shaft from the bore of the boss of from the bore of the boss and the bores of the flanges and disengagement of the plurality of first teeth of the flanges from the plurality of second teeth of the boss.
[0057] In general, the garden implement described herein may be a dual headed implement having different toolheads at distal ends of the garden implement. The toolheads may be adjustable to various angles using a durable sprocket-like coupling structure. The toolheads may be

interchangeable and may be selected from a plurality of toolheads each implementing a different tool member (e.g., a different working part of a garden tool). The handle may be divided into segments having specific angles between adjacent segments. The angles may be the same or different. The angles enhance the usability of the garden implement. For example, the angles may provide a user with a greater mechanical advantage in comparison to a straight handle. Additionally, due to the angles, the garden implement may be flipped over (e.g., rotated about a central axis of the handle of the garden implement) to provide a second functionality to the same toolhead previously utilized for a first functionality (e.g., a soil scraper first functionality and a shovel second functionality). Furthermore, the angles of the toolheads relative to the handle are changeable by a user. The plurality of available angles between a toolhead and the handle provides a plurality of ways the tool member of a toolhead may be used by a user of the garden implement.

[0058] FIG. **1**A is a top plan view of an ergo-dynamic dual-headed garden implement **100** including two interchangeable toolheads (i.e., a first toolhead **102** and a second toolhead **104**) that may be selected from a plurality of interchangeable toolheads according to some aspects of the disclosure. FIG. **1**B is the top plan view of the garden implement **100** of FIG. **1**A with a first fixing shaft cover **106** and a second fixing shaft cover **109** removed. The first fixing shaft cover **106** and second fixing shaft cover **109** may be integrally formed with a portion of an overall structure referred to herein as a fixing shaft; however, covers for the fixing shafts are optional. Additionally, the covers may be substituted for grasping structures having shapes adapted for grasping and rotating. These structures/shapes may include a tab and a wing-nut structure/shape that may be formed integrally with the fixing shaft or may be a component part of an assembly configured to perform the function of the fixing shaft. FIG. **1**A and FIG. **1**B may be collectively referred to as FIG. **1** herein.

[0059] In the example of FIG. **1**, the first toolhead **102** is depicted as a hoe or a hoe-like tool member and the second toolhead **104** is depicted as a forked weeder or forked cultivator. The toolheads represented in FIG. **1** are interchangeable toolheads and are provided as non-limiting examples.

[0060] A first angle **110** (denoted as A**1**) of the first toolhead **102** relative to a handle **112** (or, as-illustrated in the exemplary figure, relative to a first segment **126** of the handle **112**) may be selected by a user. In the example of FIG. **1**, a tool member **103** of the first toolhead **102** is perpendicular to the longitudinal axis **108** projecting from a first fixing member **114**. This orientation may be referred to as a nominal orientation. The first toolhead **102** may be reoriented clockwise or counterclockwise relative to the nominal orientation. Reorientation requires removal of a fixing shaft **131** from at least one flange and from an opening in the first fixing member **114**. The openings are referred to as “bores” (e.g., bore holes) herein. The openings in the flanges are referred to as “flange bores” and the opening in the first fixing member **114** is referred to as a “boss bore” because the opening in located through a portion of the first fixing member **114** which is referred to as a “boss” herein. Reorientation requires removal of the fixing shaft **131** from the boss bore and at least one flange bore. Reorientation also requires the disengagement of a first locking feature (also referred to as a segment of a pinion gear or a curved pinion segment **116***a* herein) from the second locking feature (also referred to as a segment of an internal gear, an internal gear segment, a ring gear, ring gear segment, or a curved rack segment **118***a* herein). Additional details about the flange bores, boss bore, first locking feature and second locking feature are provided throughout the disclosure.

[0061] Reorientation established the first angle **110** depicted in FIG. **1**. The first angle **110** may be fixed by insertion (e.g., engagement) of the fixing shaft **131** into at least one flange bore and into the boss bore. To change the first angle **110** of the first toolhead **102**, for example, the user may proceed through several steps. In the example of FIG. **1**, the user may remove a first fixing shaft cover **106** (which in the example of FIG. **1** is formed integrally with a fixing shaft male threaded member **534** of FIG. **5**) from the first fixing member **114** and a first flange **119***a* of the first

toolhead **102**. The user may also remove a second fixing shaft cover (on the far side of the first fixing shaft cover **106**) from the first fixing member **114** and a second flange (e.g., second flange **519***b* of FIG. **5**). The second fixing shaft cover is not shown in FIG. **1**. An example of a second fixing shaft cover may be the second fixing shaft cover **528** of FIG. **5**. In the example of FIG. **5**, a fixing shaft sleeve **530** with internal female threads and/or the fixing shaft male threaded member **534** of FIG. **5** may be collectively referred to as a fixing shaft. In general, however, to change the first angle **110**, the user may remove the fixing shaft **131** from the at least one flange bore and the boss bore.

[0062] As used herein a reference to a fixing shaft, such as fixing shaft **131** of FIG. **1**A and fixing shaft **631** of FIG. **6**, is a reference to an object that is configured to be received within at least one flange bore and within the boss bore when axial centers of the at least one flange bore, the boss bore, and the fixing shaft may be coaxially aligned. Insertion of the fixing shaft **131** under these conditions fixes the relative positions of the flanges of the toolhead (e.g., first toolhead **102**) with respect to the fixing member (e.g., the first fixing member **114**, or more particularly the boss of the first fixing member **114**). Fixing the relative positions of the flanges of the toolhead with respect to the fixing member prevents translation of the fixing member relative to the at least one flange, or more particularly prevents longitudinal translation of the fixing member relative to the at least one flange in a direction of a longitudinal axis **108** of the first fixing member **114**. According to some aspects, the fixing shaft **131** may be cylindrical but other shapes are within the scope of the disclosure. The fixing shaft **131** may be smooth, have external threads, internal threads, or any combination thereof along some or all of the fixing shaft **131**. As used herein, with respect to an x-y-z coordinate system, translation means linear movement in the x-y plane, the y-z plane, or the x-z plane. Translation is distinct from rotation about the x-axis, y-axis, or z-axis.

[0063] To change the first angle **110**, following withdrawal of the fixing shaft **131**, the user may withdraw the curved pinion segment **116***a* of the first toolhead **102** from engagement with a curved rack segment **118***a* of the first fixing member **114**. Withdrawal may be along the longitudinal axis **108**. After slidingly withdrawing the curved pinion segment **116***a* from the curved rack segment **118***a*, a user may rotatably reorient the first toolhead **102** to any of a predetermined and fixed number of angular orientations. The user may then slidingly insert (e.g., slidingly engage) the curved pinion segment **116***a* into conjugate corresponding features of the curved rack segment **118***a*. The insertion may be until at least a portion of the curved pinion segment **116***a* meshes with at least a portion of the curved rack segment **118***a* and the flange bore axis is coaxially aligned with the boss bore axis. As used herein, the term “mesh” may mean an engagement of teeth of one gear (e.g., a pinion segment) to a whole depth of a space between teeth of another gear (e.g., a curved rack segment). The user may then insert the fixing shaft **131** into at least a first flange **519***a* and the boss to secure the first toolhead **102** from motion relative to the boss. In the example of FIG. **1**, the curved pinion segment **116***a* is a segment of a pinion gear with a plurality of first teeth having a first angular pitch (e.g., angular spacing between crests/crowns of adjacent teeth or between troughs/roots between adjacent teeth) and the curved rack segment **118***a* is a segment of a curved rack gear with a plurality of second teeth having the first angular pitch. As indicated, as used herein, the terms crest or crown of a tooth may be used interchangeably. Likewise, the terms trough or root of a tooth may be used interchangeably. In the exemplary illustrations, the first teeth and the second teeth are sinusoidally shaped and configured for maximum surface area contact. Other tooth shapes, such as, for example, involute, cycloidal, and trochoidal, as well as other locking feature structures are within the scope of the disclosure.

[0064] Returning to FIG. **1**A, a second angle **128** (denoted as A**2**) of the second toolhead **104** relative to the handle **112** (or, as-illustrated in the exemplary figure, relative to a second segment **130** of the handle **112**) may be selected by a user. The process for rotatably reorienting and fixing the second toolhead **104** to a second fixing member **120** may be the same or substantially similar to that just described with reference to the first toolhead **102** and the first fixing member **114**. The

third locking feature **122***a* of the second toolhead **104** and the fourth locking feature **124***a* of the second fixing member **120** may be the same or substantially similar to those just described with reference to the curved pinion segment **116***a* of the first toolhead **102** and the curved rack segment **118***a* of the first fixing member **114**. Accordingly, the processes and features will not be repeated for the sake of brevity. In general, the processes and features will be described in greater detail below.

[0065] By way of example, either or both of the first fixing member **114** and the second fixing member **120** may be formed of metal and formed by hot forging, formed of metal and formed by cold-forging, formed of metal and formed by pouring the metal in a liquid state into a casting, formed of plastic and formed by injection molding of the plastic, and/or formed of fiberglass and formed by wrapping fiberglass around a mold and impregnating the fiberglass with a resin. The preceding list is illustrative and non-limiting.

[0066] The first angle **110** may be the same or different from the second angle **128**. The angles depicted in FIG. **1** are provided for illustration and are not limiting.

[0067] The handle **112** of the garden implement **100** may be formed of one piece of stock or a plurality of pieces of stock (e.g., the stock may be hollow tubing). In the example of FIG. **1**, the handle **112** of the garden implement **100** may be a hollow rectangular length of tubing. According to one example, the tubing may be aircraft grade aluminum. It is noted that the preceding example is non-limiting. For example, solid materials and hollow materials of any cross-sectional shape are within the scope of the disclosure. Additionally, it is noted that other materials (including, for example, metals, fiberglass, and plastic) are within the scope of the disclosure.

[0068] The handle **112** may be straight or curved or take any shape. The handle **112** may be described as including a plurality of segments. In the illustrated example of FIG. **1**, the handle **112** may be formed from three segments; namely first segment **126**, second segment **130**, and center segment **132**. According to some aspects, the plurality of segments may be continuous with each other, as in the example of FIG. **1**. According to other aspects, the plurality of segments may be contiguous with each other and coupled to each other by joints between adjacent segments (e.g., as illustrated in FIG. **2**). In some examples, the handle may include one, two, three, or more segments.

[0069] In the exemplary illustration of FIG. **1**B, there may be a fixed third angle **134** (denoted as A**3**), between the first segment **126** and the center segment **132**. By way of example only, the fixed third angle **134** may be any angle in a range of about 10 to 30 degrees, or more particularly within a range of about 15 to 25 degrees, or more particularly may be about 20 degrees. In the exemplary illustration of FIG. **1**B, there may be a fixed fourth angle **136** (denoted as A**4**) between the center segment **132** and the second segment **130**. By way of example only, the fixed fourth angle **136** may be any angle in a range of about 10 to 30 degrees, or more particularly within a range of about 15 to 25 degrees, or more particularly may be about 20 degree. In the example of FIG. **1**, the fixed third angle **134** and the fixed fourth angle **136** may be the same; however, having the fixed third angle **134** different from the fixed fourth angle **136** is within the scope of the disclosure.

[0070] According to some aspects, the fixed third angle **134** and the fixed fourth angle **136** may be chosen such the ends of the segments coupled to the first fixing member **114** and the second fixing member **120**, respectively, tip toward one another, toward one side of the center segment **132** as depicted in FIG. **1**. According to other aspects, the fixed third angle **134** and the fixed fourth angle **136** may be chosen such the ends of the segments coupled to the first fixing member **114** and the second fixing member **120**, respectively, tip away from one another. According to still other aspects, a value of at least one of the fixed third angle **134** or the fixed fourth angle **136** may be zero; accordingly, in such an aspect, although the handle may be described as having three segments, only one pair of segments would share a non-zero angle therebetween. The preceding examples are illustrative and are non-limiting.

[0071] In the exemplary illustration of FIG. **1**, the first segment **126** may have a first fixed length **138** (denoted as L**1**), the center segment **132** may have a fixed center length **140** (denoted as LC),

the second segment **130** may have a fixed second length **142** (denoted as L**2**). The three lengths may be the same, or two lengths may be the same while a remaining length is different, or the three lengths may be different. In the exemplary illustration of FIG. **1**, L**1**<L**2**<LC. These differences are exemplary and non-limiting. Other relativistic arrangements of the lengths of the first segment **126**, the second segment **130**, and the center segment **132** are within the scope of the disclosure.

[0072] As explained above, FIG. **1**B depicts the garden implement **100** of FIG. **1**A with the first fixing shaft cover **106** and the second fixing shaft cover **109** removed. With the first fixing shaft cover **106** removed, the curved pinion segment **116***a* associated with the first toolhead **102** and curved rack segment **118***a* of the first fixing member **114** are visible. Similarly, with the second fixing shaft cover **109** removed, the third locking feature **122***a* associated with the second toolhead **104** and the fourth locking feature **124***a* of the second fixing member **120** are visible. The various locking features and their interaction will be described in greater detail below. While the locking features of FIG. **1**B (e.g., the curved pinion segment **116***a* and the third locking feature **122***a*, and the corresponding curved rack segment **118***a* and the fourth locking feature **124***a*, respectively) are illustrated as being the same, use of different locking features is within the scope of the disclosure. For example, one pair of locking features may offer a greater number of predetermined fixed angular orientations than a second pair of locking features, or one pair of locking features may offer a greater resistance to angular changes or may be rated to withstand a higher torque than a second pair of locking features.

[0073] FIG. **2** is a top plan view of another ergo-dynamic dual-headed garden implement **200** including two interchangeable toolheads (i.e., a first toolhead **202** and a second toolhead **204**) that may be selected from a plurality of interchangeable toolheads according to some aspects of the disclosure. FIG. **2** is similar to FIG. **1** in all respects with the exception of an addition of a first inter-segment angle fixing feature **207** (e.g., a first joint) and a second inter-segment angle fixing feature **209** (e.g., a second joint). Similar to the example of FIG. **1**, the handle **212** of the garden implement **200** may include a first segment **226**, a second segment **230**, and a center segment **232**. In the example of FIG. **2**, adjacent segments may be coupled to each other by the inter-segment angle fixing features, or joints. The first inter-segment angle fixing feature **207** may be similar in construction and operation to the curved pinion segment **116***a* and the curved rack segment **118***a* of FIG. **1**B (or the pair of the third locking feature **122***a* and fourth locking feature **124***a* of FIG. **1**B). The second inter-segment angle fixing feature **209** may be similar in construction and operation to the curved pinion segment **116***a* and the curved rack segment **118***a* of FIG. **1**B (or the pair of the third locking feature **122***a* and fourth locking feature **124***a* of FIG. **1**B). Descriptions of these features and related operations will not be repeated for the sake of brevity.

[0074] As depicted, the first inter-segment angle fixing feature **207** may be configured to permit a user to repeatably and selectively fix a fifth angle **234** (denoted as A**5**) between the first segment **226** and the center segment **232**. The fifth angle **234** may be selectable among a predetermined number of fixed angles. The fifth angle **234** may range, for example, between about plus and minus 90 degrees, or more particularly between about plus and minus 60 degrees relative to an axis of the center segment **232** of the garden implement **200** handle **212**. Likewise, the second inter-segment angle fixing feature **209** may be configured to permit a user to repeatably and selectively fix a sixth angle **236** (denoted as A**6**) between the center segment **232** and the second segment **230**. The sixth angle **236** may be selectable among a predetermined number of fixed angles. The sixth angle **236** may range, for example, between about plus and minus 90 degrees, or more particularly between about plus and minus 60 degrees relative to an axis of the center segment **232** of the garden implement **200** handle **212**. The predetermined number of fixed angles attributed to the first inter-segment angle fixing feature **207** and the second inter-segment angle fixing feature **209** may be the same or different. The step sizes between the fixed angles may also be the same or different. The configurations of the first inter-segment angle fixing feature **207** and the second inter-segment angle fixing feature **209** may be the same or different.

[0075] FIG. **3** is a perspective view of the garden implement **100** of FIGS. **1**A and **1**B. Descriptions of components of FIG. **1** that were described in connection with FIG. **1** (e.g., the handle **112**, the first fixing member **114**, the second fixing member **120**, the first toolhead **102**, and the second toolhead **104**) will not be repeated for the sake of brevity.
[0076] In FIG. **3**, a first lanyard bore **302** (e.g., a through hole formed in the first fixing member **114** and defined by internal sidewalls of the first fixing member **114**) is identified. Similarly, a second lanyard bore **304** (e.g., a through hole formed in the second fixing member **120** and defined by internal sidewalls of the second fixing member **120**) is identified. The first lanyard bore **302** and/or the second lanyard bore **304** may be used to secure one or more lanyards (not shown) (e.g., a rope that may be formed with a loop and passed around the neck, shoulder, or wrist for holding the garden implement **100**) to the garden implement. The one or more lanyards may be used, for example, to add stability to the garden implement **100** as a user employs the garden implement **100**. The one or more lanyards may be used, for example, to secure the garden implement **100** to keep it from falling to the ground or to temporarily fix the garden implement **100** to an object, such as a chair, stool, wall, or work bench, for example.
[0077] A first rivet **306** and a second rivet **308** are also identified in FIG. **3**. According to some aspects, the first fixing member **114** may be insertably fixed to the handle **112** of the garden implement **100** through use of at least the first rivet **306**. Likewise, the second fixing member **120** may be insertably fixed to the handle **112** of the garden implement through use of at least the second rivet **308**. In some aspects, the first rivet **306** and/or the second rivet **308** may be installed and their heads ground or sanded down to be flush with the surfaces of the handle **112** of the garden implement **100**. According to some examples, a rivet such as those used to couple handles to kitchen or restaurant knives may be used. Such rivets may be referred to as cutlery rivets. Of course, any fastening structure that is able to fix the first fixing member **114** and the second fixing member **120** to the handle **112** of the garden implement **100** is within the scope of the disclosure. For example, rivets, screws, bolts, and/or dowels (alone or in combination with other components such as nuts and threaded holes) may be used to fix the first fixing member **114** and the second fixing member **120** to the handle **112** of the garden implement **100**.
[0078] According to some aspects, the first fixing member **114** and the second fixing member **120** may be permanently fixed to the handle **112** of the garden implement **100**. An adhesive (not shown) may be applied to portions of the first fixing member **114** and the second fixing member **120** that are inserted into a hollow core of the handle **112** of the garden implement **100**. According to still other aspects, a fit between some or all of the surfaces of the first fixing member **114** and the second fixing member **120** that are inserted into the hollow core of the handle **112** of the garden implement **100** may be configured with close tolerances such that a “force fit” (also known as or similar to a “friction fit” or an “interference fit”) of the first fixing member **114** and the second fixing member **120** into the hollow core of the garden implement **100** handle **112** is achieved. With reference to FIG. **6**, a first rib **660** and/or second rib **662** of FIG. **6** may surround a second boss **664**. The second boss **664** may project from the body segment **604** of a fixing member **614** in a direction different from the first boss **606** and may be configured to couple to a respective end of a handle **112** of the garden implement **100**. The first rib **660** and/or the second rib **662** may have outer dimensions that facilitate the force fit between the inner surfaces of the handle **112** (which may be hollow) of the garden implement **100**. The space above, below, and/or between either or both of the first rib **660** and/or the second rib **662** may be used to receive an adhesive, for example. According to some aspects, any one or any combination of one or more rivets, adhesive, and force fit may be used to fix each fixing member (e.g., the first fixing member **114**, the second fixing member **120**) to the handle **112** of the garden implement **100**. A cross-section taken along the lines **4-4** in FIG. **3** is provided in FIG. **4**. An exploded view of a portion **500** of FIG. **3** is provided in FIG. **5**. While the second boss **664** is depicted as being configured to couple to the respective end of the handle **112** by fitting within the hollow core of the handle **112**, the disclosure is not limited to

this form of coupling. In one example, the second boss **664** could be configured to fit over the respective end of the handle, like a sleeve. In another example, the second boss **664** may be configured with threads to screw into or onto the respective end of the handle. The preceding examples are illustrative and non-limiting.

[0079] FIG. **4** is a cross-section along the lines **4-4** of FIG. **3** of the garden implement **100** of FIGS. **1**A and **1**B according to some aspects of the disclosure. Depicted is a rectangular hollow tube such as the handle **112** of the garden implement **100**. Of course, this configuration depicted in FIG. **4** is one non-limiting example. Other cross-sections are within the scope of the disclosure. A portion of the first fixing member **114** is depicted as filing the hollow cross-section of the handle **112**. According to some aspects, dimensional tolerances of the portion of the first fixing member **114** that enters the hollow space of the handle **112**, and/or one or more ribs (e.g., first rib **660** and second rib **662** of FIG. **6**C) that enter the hollow space of the handle **112** may have close tolerance to ensure a force fit therebetween. According to other aspects, the material of the first fixing member **114** may be relatively more malleable than the material of the handle **112**; the portion of the first fixing member **114** that is inserted into the handle **112** may be caused to deform and/or to flow, thus fixing the portion of the first fixing member to the handle **112**. The first rivet **306** and a rivet sleeve **307** (previously hidden from view) are depicted in FIG. **4**. The heads of the first rivet **306** and the rivet sleeve **307** are depicted in a flush-to-surface configuration. The illustrated configuration may be achieved, for example, by sanding and/or grinding down any portion of a head (or other protruding part) of the first rivet **306** and/or the rivet sleeve **307** that protrudes from the outer surface of the handle **112**.

[0080] FIG. **5** is an exploded perspective view of a portion **500** of the garden implement **100** as depicted in FIG. **3** according to some aspects of the disclosure. Depicted are the first fixing member **114** coupled to a first handle end **502** (where, for example, the first handle end **502** may be a respective handle end of a pair of distal handle ends) of the handle **112** of the garden implement **100**. A second flange **519***b*, which is hidden in FIG. **1**, FIG. **2**, and FIG. **4** is visible. Although the first rivet **306** and the rivet sleeve **307** are used in connection with the illustrated portion of the garden implement **100**, any fastening structure, such as a rivet, screw, bolt, or dowel (with or without adhesive), for example, is within the scope of the disclosure.

[0081] The first fixing member **114**, coupled to the first handle end **502**, may include (e.g., may comprise, may be formed of) a body segment **504** and a first boss **506**. A second boss (e.g., **664** of FIG. **6**) may be received within a hollow space within the handle **112** of the garden implement **100**, for example. The second boss is not depicted in the illustration of FIG. **5** to avoid cluttering the drawing. According to some aspects, the body segment **504** may have a finite non-zero length and the body segment **504** may be juxtaposed to the first handle end **502** of the handle **112**, or the body segment **504** may have a zero length and the first boss **506** may project from the second boss at the first handle end **502**. The first boss **506**, body segment **504**, and the second boss (not shown) may be formed as one integral part.

[0082] According to some aspects, the first boss **506** may project from the body segment **504**, and away from the first handle end **502**, along a longitudinal axis **508** (where, the longitudinal axis **508** is represented by a double headed arrow). The first boss **506** may include at least a portion having a first boss width (**645** of FIG. **6**) that is less than a body segment width (**647** of FIG. **6**) proximal to the first boss **606**. The spaced apart parallel boss surfaces **510***a*, **510***b* may be spaced apart by the first boss width (**645** of FIG. **6**) The first boss width (**645** of FIG. **6**) may correspond to the predetermined distance (**644** of FIG. **6**) between opposing parallel surfaces of the first flange **519***a* and the second flange **519***b*. As used herein, the term opposing parallel flange surfaces may be understood as meaning parallel flange surfaces that face each other (e.g., oppose each other). The corresponding dimensions may be selected to facilitate the sliding of the first boss **506** between the opposing parallel surfaces of the first flange **519***a* and the second flange **519***b*, within tolerance limits of manufacture. The first boss **506** may further include a boss bore **513** defined by a boss

internal sidewall **515** of the first boss **506**. The boss bore **513** may have a boss bore center axis **512** (depicted a long-dash dot line) perpendicular to the spaced apart parallel boss surfaces **510***a*, **510***b* and also perpendicular to the longitudinal axis **508**.

[0083] The first fixing member **114** (or the first boss **506** of the first fixing member **114**) may further include a pair of spaced apart second locking features including curved rack segment **118***a* projecting from the spaced apart parallel boss surfaces **510***a*, **510***b* (where **510***b* is not visible in FIG. **5**) and another second locking feature projecting from an opposite side of the first boss **506**. In one example, the pair of spaced apart curved rack segments (e.g., curved rack segment **118***a* and curved rack segment **118***b*) may be a pair of spaced apart curved walls that may project perpendicularly outward or away from the respective spaced apart parallel boss surfaces **510***a*, **510***b*. Each of the spaced apart curved walls may form curved rack segments (e.g., curved rack segment **118***a* and curved rack segment **118***b*) that may span between spaced apart edges (e.g., spaced apart edges **656** of FIG. **6**) of the first boss **506**. Each of the pair of spaced apart curved rack segments **118***a*, **118***b* may be configured, for example, as a segment of an internal gear (also referred to as an internal ring gear or a ring gear) having a plurality of second teeth with a given angular pitch.

[0084] According to some aspects, a pair of curved rack segments **118***a*, **118***b* (e.g., **618***a*, **618***b* of FIGS. **6** and **1218***a*, **1218***b* of FIG. **12**) may each be a curved rack gear segment, also individually referred to herein as a first curved rack segment **118***a* and a second curved rack segment **118***b*. According to some aspects, the curved pinion segments **116***a*, **116***b* may each be a curved pinion gear segment, also referred to herein as a curved pinion segment (collectively referred to as the pair of pinion segments **616***a*, **616***b* of FIGS. **6** and **1216***a*, **1216***b* of FIG. **12**).

[0085] The angular pitch may be the angular distance between crests of adjacent teeth or between roots of adjacent teeth. As used herein a segment may be a non-360 degree arc length of a circle, or a portion of a circular or non-circular curve. According to some aspects, the angular pitch may not evenly divide into 360 degrees. For example, according to one aspect, the angular pitch may be 31.04 degrees. An angular pitch that is not evenly able to divide into 360 degrees may facilitate the inclusion of a greatest amount of surface area for complete or partial spaces between adjacent crowns of teeth and thereby increases a total surface area against which engaged teeth of a pinion segment may exert force. By way of one example, the angular pitch of 31.04 degrees provides for three complete teeth and the spaces therebetween plus two partial spaces on either side of the three complete teeth. The angular pitch of 31.04 degrees provides for 5 positions about which a toolhead may be oriented. In this example, a total range of orientations of 124.16 degrees. Some toolheads may have more or less adjustment positions (e.g., 6 or 4 positions). For a given torque applied to the toolhead, the greater the number of teeth the more susceptible is the chance of striping teeth from the curved pinion segment **116***a*, the curved rack segment **118***a*, or both. Additional factors that relate to durability include the material used to manufacture the curved pinion segment **116***a* and the curved rack segment **118***a*, the whole depth of the spaces between adjacent teeth of the curved rack segment **118***a* and the height of adjacent teeth of the curved pinion segment **116***a*, as well as the thickness of the curved pinion segment **116***a* in comparison to the height of the curved rack segment **118***a*.

[0086] FIG. **5** also depicts the first toolhead **102**. According to some aspects, the first toolhead **102** may include a pair of flanges (e.g., the first flange **519***a* and the second flange **519***b*) and a tool member **103**. As used herein, the tool member **103** coupled to the first flange **519***a* and the second flange **519***b* may be collectively referred to as an interchangeable toolhead herein (e.g., interchangeable toolhead **602** of FIG. **6**). Interchangeable toolheads may embody respective tools. For example, a cultivator of a first interchangeable toolhead **1002** of FIG. **10**A, a push-pull rake of a second interchangeable toolhead **1004** of FIG. **10**B, a spade of a third interchangeable toolhead **1006** of FIG. **10**C.

[0087] In the example of FIG. **5**, the first flange **519***a* includes a segment of a first pinion gear,

referred to herein as a first curved pinion segment **516***a* (similar to the curved pinion segment **116***a* of FIG. **1**). The term pinion gear is used herein to refer to a gear having outwardly radiating teeth, or a portion of a circular or non-circular toothed curve having outwardly radiating teeth, that mesh with an internal gear having inwardly radiating teeth, or a portion of a circular or non-circular toothed curve having inwardly radiating teeth. The first curved pinion segment **516***a* may have a plurality of first teeth with the given angular pitch (i.e., the same or complementary pitch as those of the plurality of second teeth of a first curved rack segment **518***a* (similar to the curved rack segment **118***a* of FIG. **1**)). Again, as used herein a segment may be a non-360 degree arc length of a circle, or a portion of a circular or non-circular curve. The first curved pinion segment **516***a* may also include a first flange bore **521** defined by an internal sidewall **522**.

[0088] The first and second fixing structures may be, for example, a pinion segment and an internal gear segment configured to mesh with the pinion segment, respectively. The structures of the first and second fixing structures may be interchanged. The pluralities of teeth of these segments may be integrally formed with or in the flanges and the first boss and may be used to lock the interchangeable toolhead at a predetermined angle relative to the longitudinal axis **508** of the first boss **506** of the first fixing member **114** (and therefore relative to the handle **112** of the garden implement).

[0089] The internal gear segment also referred to herein as the first curved rack segment **518***a*, may be concave semi-circular and may have a center coincident with a center of the boss bore center axis **512** of the boss bore **513**. In one aspect, the internal gear segment (e.g., a portion of an annular gear or a ring gear) may have minor arc (less than 180 degrees) that spans between outer edges of the first boss **506**. The plurality of second teeth of the internal gear segment may have crests that radiate toward the boss bore center axis **512** of the boss bore **513**. The plurality of second teeth may have roots between the crests. Adjacent pairs of crowns and roots form adjacent spaces between teeth that are arranged in a semi-circle, along the minor arc between the ends of the first boss **506**. In one example, the spaces between teeth (measured between crowns of teeth) may have a maximum height (measured along the z-axis of FIG. **5**) at a midpoint point equidistant from the ends of the minor arc and a minimum height at both edges of the minor arc. The minimum height may be achieved by gradually reducing the height of one or more tooth crests at both ends of the minor arc. In another example, the height (e.g., a dimension measured perpendicularly to that boss surface along the z-axis in FIG. **5**) of the plurality of second teeth may have a maximum at a midpoint point equidistant from the ends of the minor arc and may have minimum heights at both edges of the minor arc. The minimum tooth height may be achieved by a stepwise reduction in height of one or more tooth crests at both ends of the minor arc.

[0090] FIG. **5** also depicts the second flange **519***b* that includes a segment of a second pinion gear, referred to herein as the second curved pinion segment **516***b*. The second curved pinion segment **516***b* may include the first locking feature formed as a plurality of first teeth of the second curved pinion segment **516***b* with the given angular pitch (i.e., the same or complementary pitch as those of the plurality of second teeth of the second locking feature (not shown) on the hidden side of the first boss **506** of FIG. **5**). The second curved pinion segment **516***b* may also include a second flange bore **523** defined by an internal sidewall **524** of the second flange **519***b*. The center axis of the second flange bore **523** and the previously described flange bore center axis **532** may be collectively referred to as the flange bore center axis **532**.

[0091] In the example of FIG. **5**, the internal sidewall **522** defines a right circular cylinder, however any shape lies within the scope of the disclosure. The internal sidewall **524** defines a carriage-bolt style opening having a shape of a circle with two parallel segments of the circle truncated, however any shape lies within the scope of the disclosure. The internal sidewall **524** may receive a correspondingly shaped carriage bolt feature **526** of the second fixing shaft cover **528**. The carriage bolt feature **526** of the second fixing shaft cover **528**, when received in the second flange bore **523** serves to keep the fixing shaft sleeve **530** with internal female threads from rotating as the fixing

shaft male threaded member **534** is rotated to tighten or loosen the fixing shaft male threaded member **534** in the fixing shaft sleeve **530** with internal female threads. The first fixing shaft cover **106** and the second fixing shaft cover **528** with their integral components are only one example of a fixing shaft as described herein. Additional examples include a carriage bolt and a nut or a wing nut, both without cover features.

[0092] In the example of FIG. **5**, each of the first curved pinion segment **516***a* and the second curved pinion segment **516***b* of the first flange **519***a* and the second flange **519***b*, respectively, may be included in opposing parallel flange surfaces (e.g., opposing parallel flange surfaces **625***a*, **625***b* of FIG. **6**). In some examples, the respective opposing parallel flange surfaces (e.g., **625***a*, **625***b* of FIG. **6**) may be in slidable contact with corresponding respective spaced apart parallel boss surfaces **510***a*, **510***b*. Tolerances of manufacturing may provide for spaces between the opposing surfaces.

[0093] The flange bore center axis **532**, which may be perpendicular to the opposing parallel flange surfaces (e.g., **625***a*, **625***b* of FIG. **6**) and perpendicular to the spaced apart parallel boss surfaces **510***a*, **510***b* may be configured to coaxially align with the boss bore center axis **512** of the first fixing member **114** after the opposing parallel flange surfaces (e.g., **625***a*, **625***b* of FIG. **6**) slide parallel to and along the longitudinal axis **508** and between the spaced apart parallel boss surfaces **510***a*, **510***b* to where at least a portion of the plurality of first teeth of pinion segments mesh with at least a portion of the plurality of second teeth of the internal gear segments proximal to the body segment **504** of the first fixing member **114**.

[0094] Once the boss bore center axis **512** and the flange bore center axis **532** are in coaxial alignment, the fixing shaft, represented in the example FIG. **5** as fixing shaft sleeve **530** with internal female threads (integrally formed with the second fixing shaft cover **528**), may pass through the second flange bore **523** and into (or into and through) the boss bore **513** of the first boss **506** of the first fixing member **114**, thereby immobilizing the first toolhead **102** at the first angle **110** selected by the user.

[0095] Thereafter, according to the example of FIG. **5**, the fixing shaft male threaded member **534** of the first fixing shaft cover **106** may be threaded into the fixing shaft sleeve **530** with internal female threads. The first fixing shaft cover **106** may be rotated to secure the fixing shaft male threaded member **534** into the fixing shaft sleeve **530** with internal female threads. The carriage bolt feature **526**, and therefore the fixing shaft sleeve **530** with internal female threads may be prevented from rotating due to it having been received in the second flange bore **523**. A device, for example, such as a hex wrench (not shown) may be inserted into a device receiving feature **536** of the first fixing shaft cover **106**, to rotate the fixing shaft male threaded member **534** of the first fixing shaft cover **106** to either insert or withdraw the fixing shaft male threaded member **534** from the fixing shaft sleeve **530** with internal female threads. According to some aspects, the fixing shaft sleeve **530** with internal female threads and the carriage bolt feature **526** may be integrally formed with second fixing shaft cover **528**. According to some aspects, the fixing shaft male threaded member **534** may be integrally formed with the first fixing shaft cover **106**. Other hardware and/or different orientations and/or configurations of hardware, which may be used to fix a fixing shaft (e.g., like the fixing shaft sleeve **530** with internal female threads) in coaxial alignment with the flange bore center axis **532** and the boss bore center axis **512** are within the scope of the disclosure.

[0096] In overview, a garden implement, such as the garden implement **100** of FIG. **1**, may include a handle **112** having spaced apart handle ends (e.g., first handle end **502**) (at least one) a first toolhead **102** comprising a tool member **103** and a pair of flanges **519***a*, **519***b* coupled to and extending from the tool member **103**, each of the pair of flange **519***a*, **519***b* including a flange bore **521**, **523** defined by a flange internal sidewall **522**, **524** and a pinion segment **516***a*, **516***b* having a common first center with the flange bore, the pair of flanges **519***a*, **519***b* having opposing parallel flange surfaces (e.g., **625***a*, **625***b* of FIG. **6**) each including the pinion segment and having a flange bore center axis **532** intersecting the common first center and perpendicular to the opposing parallel

flange surfaces, the opposing parallel flange surfaces spaced apart by a predetermined first distance, at least the first fixing member **114** coupled between the pair of flanges **519***a*, **519***b* and a respective handle end (e.g., the first handle end **502**), the first fixing member **114** including: a first boss **506** projecting along a longitudinal axis **508** relative to the first fixing member **114**, the first boss **506** having parallel first boss surfaces **510***a*, **510***b* spaced apart by the predetermined first distance, a boss bore **513** defined by a first boss internal sidewall **515**, and a boss bore center axis **512** intersecting a first boss bore center (and perpendicular to the parallel first boss surfaces **510***a*, **510***b*), each respective first boss surface **510***a*, **510***b* having a first curved rack segment **518***a* (see also the pair of curved rack segments **618***a*, **618***b*) projecting perpendicularly therefrom and configured to mesh with at least a portion of the pinion segment **516***a*, **516***b*, and a fixing shaft (see, e.g., fixing shaft sleeve **530**) insertably received in at least one flange bore **521**, **523** and the boss bore **513** following coaxial alignment of the flange bore center axis **532** and the boss bore center axis **512**.

[0097] FIG. **6**A is a left side elevation view of the fixing member **614** and an interchangeable toolhead **602** of a garden implement in a spaced apart orientation according to some aspects of the disclosure. The garden implement may be similar to the garden implement **100** of FIG. **1** and/or the garden implement **200** of FIG. **2**. FIG. **6**B is a top plan view of the fixing member **614** and the interchangeable toolhead **602** of FIG. **6**A. FIG. **6**C is a top plan view of the fixing member **614** and the interchangeable toolhead of FIG. **6**A and FIG. **6**B according to some aspects of the disclosure. In FIG. **6**C, the fixing member **614** was longitudinally translated along the longitudinal axis **608** to slidingly engage the first boss **606** of the fixing member **614** between a pair of opposing parallel flange surfaces **625***a*, **625***b* of the interchangeable toolhead **602**. FIG. **6**C may represent one possible angular orientation (e.g., one possible angle of rotation) between the interchangeable toolhead **602** and the fixing member **614** (or, more particularly, between interchangeable toolhead **602** and a pair of flanges **619***a*, **619***b*). As depicted in FIG. **1**A, an angle (e.g., first angle **110**, second angle **128**) between the interchangeable toolhead **602** (e.g., a coupled assembly of the first toolhead **102** and flanges, or of the second toolhead **104** and flanges) and the fixing member (e.g., the first fixing member **114**, the second fixing member **120**) may be changeably fixed by a user. The angle (e.g., first angle **110**, second angle **128**) may be measured relative to a longitudinal axis (e.g., **508** of FIG. **5**, **608** of FIG. **6**B) extending from the fixing member. FIG. **6**A, FIG. **6**B, and FIG. **6**C may be referred to individually or collectively as FIG. **6** herein.

[0098] Each of FIG. **6**A, FIG. **6**B, and FIG. **6**C depicts a portion of the interchangeable toolhead **602**. The interchangeable toolhead **602** includes a tool member **603** that is drawn in dashed line to indicate that the tool member **603** could be any type of tool member. For example, the tool member **603** may be a working part (separate from its handle) of a hoe, a shovel, a trowel, or any other type of object or structure used for a particular purpose, including any type of gardening tool. The previous list is exemplary and non-limiting.

[0099] A pair of flanges (e.g., first flange **619***a* and second flange **619***b*) may extend from the tool member **603**. Generally, both flanges of the pair of flanges **619***a*, **619***b* extend from one side of the tool member **603** as shown in the exemplary illustration; however, subject to further spatial relationships described below, both flanges are not limited to extending from one side of the tool member **603**. The pair of flanges **619***a*, **619***b* may be coupled to the tool member **603** by, for example, welding or brazing.

[0100] Each of the pair of flanges **619***a*, **619***b* may include a respective flange bore. In the example of FIG. **6**, the first flange **619***a* incudes the first flange bore **621** and the second flange **619***b* includes the second flange bore **623**. The first flange bore **621** and the second flange bore **623** may collectively be referred to as the first pion gear segment bore herein. The first flange bore **621** and the second flange bore **623** may each be defined by internal sidewalls (not shown in FIG. **6**) of the first flange **619***a* and the second flange **619***b* (not identified in FIG. **6**). Furthermore, each of the pair of flanges **619***a*, **619***b* may include a pair of pinion segment **616***a*, **616***b*. The pair of pinion

segments **616***a*, **616***b* may be individually or collectively referred to as the pinion segment **616** herein.

[0101] In the example of FIG. **6**, the first curved pinion segment **616***a* may include a plurality of first teeth and the second curved pinion segment **616***b* may include a corresponding plurality of first teeth. The first curved pinion segment **616***a* and the second curved pinion segment **616***b* may be formed in the first flange **619***a* and the second flange **619***b*, for example, stamping, broaching, cold forging, or hot forging, among other techniques.

[0102] The first flange bore **621** and the first curved pinion segment **616***a* may have a first center **642**. The second flange bore **623** and its corresponding pinion segment **616***b* may have a common second center (not shown). A common flange bore axis (referred to herein as a flange bore center axis **632**) may intersect the first center **642** and the second center (not shown).

[0103] The pair of flanges **619***a*, **619***b* may have opposing parallel flange surfaces **625***a*, **625***b*, respectively. The opposing parallel flange surfaces **625***a*, **625***b* may include at least each respective one of the pair of pinion segments **616***a*, **616***b* and first flange bore **621** and second flange bore **623**. The flange bore center axis **632** may intersect the first center **642** and the second center (not shown), as described above, and may also be perpendicular to the opposing parallel flange surfaces **625***a*, **625***b*. The opposing parallel flange surfaces **625***a*, **625***b* may be spaced apart by a predetermined distance **644**.

[0104] A garden implement, such as the garden implement **100** of FIG. **1**, may include two fixing members, such as the first fixing member **114** and the second fixing member **120** of FIG. **1**. As illustrated herein, the first fixing member **114** may be coupled, between the pair of flanges **619***a*, **619***b* at respective handle ends (e.g., the first handle end **502** of FIG. **5**). FIG. **6** illustrates one fixing member, i.e., the fixing member **614**, without a handle **112**, to avoid cluttering the drawing.

[0105] The fixing member **614** may include a first boss **606** projecting along the longitudinal axis **608** relative to the fixing member **614**. The longitudinal axis **608** and translational directions of motion along the longitudinal axis **608** are both represented by the broad double headed arrow in FIG. **6**B.

[0106] The first boss **606** may have a first boss surface **610***a* and a second boss surface **610***b* spaced apart from and parallel to the first boss surface **610***a* (collectively referred to as the parallel pair of boss surfaces **610***a*, **610***b*). The first boss surface **610***a* and the second boss surface **610***b* may be spaced apart by the first boss width **645**. Clearance may be considered for manufacturing, such that the predetermined distance **644** and the first boss width **645** are substantially the same yet allow the first boss **606** to be slidingly received between the pair of flanges **619***a*, **619***b*.

[0107] The first boss **606** may have a boss bore **613** defined by an internal sidewall (not identified in FIG. **6**) of the first boss **606**. A boss bore center axis **612** may intersect a boss bore center **648** and may be perpendicular to the parallel pair of boss surfaces **610***a*, **610***b*. Each of the parallel pair of boss surfaces **610***a*, **610***b* may have a respective one of the pair of curved rack segments **618***a*, **618***b* extending perpendicularly from the respective one of the parallel pair of boss surfaces **610***a*, **610***b*. For ease of reference, the pair of curved rack segments **618***a*, **618***b* may be referred to individually as the first curved rack segment **618***a* and the second curved rack segment **618***b* herein.

[0108] FIG. **6**A also depicts a fixing shaft assembly **630**. The fixing shaft **631** may be insertably received in at least one of the first flange bore **621** or the second flange bore **623** and the boss bore **613** following coaxial alignment of the flange bore center axis **632** and the boss bore center axis **612** following a longitudinal translation of the first boss **606** along the longitudinal axis **608** between the opposing parallel flange surfaces **625***a*, **625***b* and following an engagement of the respective ones of the pair of pinion segments **616***a*, **616***b* with the respective one of the pair of curved rack segments **618***a*, **618***b*. The double headed dashed arrow **650** denotes a slideability of a first of the opposing parallel flange surfaces **625***a* over the first boss surfaces **610***a*. A similar double headed arrow denotes a slideability of a second of the opposing parallel flange surfaces

625*b* over the second boss surface **610***b* is omitted to avoid cluttering the drawing.

[0109] A pair of parallel dashed lines in FIG. **6**A represents a thickness **652** of the second curved pinion segment **616***b* (e.g., a thickness of the portion of the second flange **619***b*) that includes the second curved pinion segment **616***b*. The thickness **652** of the second curved pinion segment **616***b* may be equal to a thickness of the first curved pinion segment **616***a*; however, different thicknesses are within the scope of the disclosure. According to some aspects, the combined thicknesses of the first curved pinion segment **616***a*, the second curved pinion segment **616***b* and the first boss **606** may be approximately equal to a body segment width **647** of the body segment **604** of the fixing member **614**. According to some aspects, the first curved pinion segment **616***a* thickness measured between parallel opposing first curved pinion segment surfaces may be less than or equal to a maximum height (measured along the z-axis in FIG. **6**) between a boss surface (e.g., the first boss surface **610***a*) outer surface **654** of the first boss **606** or the body segment **604** adjacent to a respective handle end.

[0110] In FIG. **6**B and FIG. **6**C, each of the plurality of first teeth of the first curved pinion segment **616***a* are numbered from 1 to 8. Similarly, the outer boss surface **654** of the first boss **606** and/or the body segment **604** of the fixing member **614** are labeled with the letters B, C, and D, which correspond to a plurality of second teeth of the first curved rack segment **618***a*. As illustrated in FIG. **6**A and FIG. **6**B, the outer surface **654** of the first boss **606** may taper down to the first boss surface **610***a*. The taper may prevent interference between any of the plurality of first teeth of the first curved pinion segment **616***a* with any of the plurality of second teeth of the first curved rack segment **618***a*. As can be seen from the illustration, particularly in the locations to the left and right of the dashed lines **667** and **669**, respectively, if the first curved rack segment **618***a* had full height of the outer surface **654** of the first boss **606** throughout the second arc length **674** (see FIG. **6**C) available to the plurality of second teeth of the first curved rack segment **618***a*, then the outermost teeth (e.g., in positions corresponding to A, which are counter-clockwise from B and to E, which are clockwise from D), which are eliminated in FIG. **6** to reflect an aspect of the disclosure, would interfere with teeth 3 and 6 of the first curved pinion segment **616***a*. The interference would prevent the first of the opposing parallel flange surfaces **625***a* of the first curved pinion segment **616***a* from translating along the first boss surface **610***a* in a direction of the longitudinal axis **608** to a point where at least a portion of the first curved pinion segment **616***a* (e.g., a subset of the plurality of first teeth, labeled **3**, **4**, **5**, and **6**, of the first curved pinion segment **616***a*) from meshing with the at least a portion of the first curved rack segment **618***a* proximal to the body segment **604** (e.g., at least a subset of the plurality of second teeth, labeled B, C, D, of the first curved rack segment **618***a*). In this circumstance, due to the interference, coaxial alignment of the boss bore center axis **612** with the flange bore center axis **632** would be prevented and the fixing shaft **631** would be unable to be received within the at least one of the pair of flange bores **621**, **623** and the boss bore **613**. Accordingly, those teeth, which would have restricted a width of a path toward engagement of the first curved pinion segment **616***a* with the first curved rack segment **618***a* to an unacceptable width **670** are removed from the first curved rack segment **618***a*. Removal may be accomplished as a step function (e.g., an abrupt reduction in height of the eliminated teeth), or as a tapered function (e.g., as depicted in FIG. **6**), or as any function that prevents interference such as that shown and described herein.

[0111] According to some aspects, and as indicated above, each respective one of the pair of pinion segments **616***a*, **616***b* may be a segment of a first pinion gear or a first circular or non-circular curve having a first arc length **672** as depicted in FIG. **6**C. Each respective one of the pair of curved rack segments **618***a*, **618***b* may be a segment of an internal gear or a ring gear having teeth that face inward toward a center of the ring having the second arc length **674**, as depicted in FIG. **6**C. The first arc length **672** may be greater than the second arc length **674**. As used herein, the arc length is a distance along an arc, where an arc is part of the circumference of a circle (as illustrated in FIG. **6**C), or a distance along a part of any circular or non-circular curve.

[0112] In some examples, a subset of the plurality of second teeth (e.g., a number of plurality of second teeth that is less than a total number of the plurality of second teeth) of the first curved rack segment **618***a* along the second arc length **674** that would prevent any of the plurality of first teeth (denoted as tooth **1** to tooth **8**) of the pinion segment **616** along the first arc length **672** from translating in a direction along the longitudinal axis **608** to be received within troughs between the plurality of second teeth (e.g., between tooth B and tooth C, between tooth C and tooth D) may be removed (partially or completely) from along the second arc length **674** to avoid such interference. For illustrative purposes, three teeth (labeled B, C, D) along the second arc length **674** of the first curved rack segment **618** are identified in FIG. **6**B and FIG. **6**C. The teeth that would have been labeled A and E (not shown) lie within a zone of the first boss **606** that is depicted as tapering down from a maximum (e.g., widest point or substantially a widest point) of the outer surface **654** of the first boss **606** to a spaced apart edge **656** (e.g., a point) of that is adjacent to and lies on the first boss surface **610***a*. The tapering is shown in profile in FIG. **6**A (see diminishing width zone between ref. nos. **654** and **656**) and as a series of spaced apart horizontal lines above ref. no. **656** in FIG. **6**B.

[0113] In some examples, the first curved pinion segment **616***a* may have a plurality of first teeth (e.g., teeth 1 to 8) having a first angular pitch and the first curved rack segment **618***a* may be a segment of an internal gear (not explicitly identified as such in FIG. **6**, but represented as including tooth B, tooth C, and tooth D) having a plurality of second teeth (e.g., teeth B, C, and D) having the first angular pitch (i.e., the same pitch as the plurality of first teeth of the first curved pinion segment **616***a*), where the plurality of first teeth may be greater than the plurality of second teeth, and the engagement of the first curved pinion segment **616***a* with the first curved rack segment **618** comprises inserting (e.g., meshing to a complete or maximum available depth) at least some of the plurality of first teeth into troughs between at least some of the plurality of second teeth.

[0114] According to some aspects, a first angle (not shown, e.g., a reference or base line for the first angle) of the first curved pinion segment **616***a* relative to a point on a surface of the tool member **603**, where, for example, the first angle may be referenced to a line (not shown) intersecting the first center **642** and any point on a surface of the tool member **603**) is fixed and a second angle (e.g., first angle **110** of FIG. **1** or second angle **129** of FIG. **1**) between the first angle and the longitudinal axis **608** may be changed after removal of the fixing shaft **631** from the first boss **606** and the pair of flanges **619***a*, **619***b* (or any one of them if the fixing shaft **631** was received in only the one of them). In some aspects, the second angle (e.g., first angle **110** of FIG. **1** or second angle **129** of FIG. **1**) between the first angle and the longitudinal axis **608** may be changed after (e.g., only after) removal of the fixing shaft **631** from the first boss **606** and the pair of flanges **619***a*, **619***b* (or any one of them if the fixing shaft **631** was received in only the one of them), disengaging the pinion segment **616** from the first curved rack segment **618***a* by longitudinal translation of the first boss **606** along the longitudinal axis **608** between the opposing parallel flange surfaces **625***a*, **625***b*, rotating the pinion segment **616** relative to the first curved rack segment **618***a*, longitudinal translation of the first boss **606** along the longitudinal axis **608** between the opposing parallel flange surfaces **625***a*, **625***b* to reengage the pinion segment **616** with the first curved rack segment **618***a*, re-receiving (in the first boss **606** and the pair of flanges **619***a*, **619***b*, or any one of them) the fixing shaft assembly **630** to again coaxially algin the flange bore center axis **632** and the boss bore center axis **612** (with a center axis of the fixing shaft assembly **630** (shown as being coincident with flange bore center axis **632** in the exploded drawing of FIG. **6**A).

[0115] Returning to FIG. **1**, FIG. **5**, FIG. **6**, and FIG. **7** for reference, a garden implement **100** may include a handle **112** having spaced apart handle ends. The garden implement **100** may also include at least one toolhead including a tool member **103** and a pair of flanges (e.g., first flange **519***a* and second flange **519***b* of FIG. **5**, first flange **619***a* and second flange **619***b* of FIG. **6**) coupled to and extending from the tool member **103**, each of the pair of flanges **519***a*, **519***b* may include a flange bore **521**, **523** defined by the internal sidewall **522**, **524**, and a curved pinion segment **516***a*, **516***b*

(e.g., curved pinion segment **116***a* of FIG. **1**, first curved pinion segment **516***a* and second curved pinion segment **516***b* of FIG. **5**, first curved pinion segment **616***a* and second curved pinion segment **616***b* of FIG. **6**, and pinion segment **716** of FIG. **7**). The pinion segment **516***a*, **516***b* may have a common first center with the flange bore **521**, **523**. The pair of flanges **519***a*, **519***b* may have opposing parallel flange surfaces **625***a*, **625***b* of FIG. **6**, each including the pinion segment (identified above) and having a flange bore center axis **632** intersecting the common first center and perpendicular to the opposing parallel flange surfaces **625***a*, **625***b*. The opposing parallel flange surfaces **625***a*, **625***b* may be spaced apart by a predetermined distance **644**. The garden implement may also include at least the first fixing member **114**, **614**, **714** that may be coupled between the pair of flanges (as identified above) and a respective handle end.

[0116] According to some aspects, the first fixing member **114**, **614**, **714** may include a first boss **506**, **606** projecting along a longitudinal axis **508**, **608**, **708** relative to the first fixing member **114**, **614**, **714**, the first boss **506**, **606** having spaced apart parallel boss surfaces **510***a*, **510***b*, **610***a*, **610***b* spaced apart by the predetermined distance **644**. The first boss **506**, **606** may include a boss bore **513** defined by the internal sidewall **515**, and a boss bore center axis **512**, **612** intersecting a first boss bore center (and perpendicular to the spaced apart parallel boss surfaces **510***a*, **510***b*, **610***a*, **610***b*), each respective first boss surface having a curved rack segment (e.g., first curved rack segment **118***a*, first curved rack segment **518***a*, first curved rack segment **618***a*, second curved rack segment **618***b*, curved rack segment **718**) projecting perpendicularly therefrom and configured to mesh with at least a portion of the pinion segment (identified above).

[0117] The garden implement may also include a fixing shaft **631**, **731** (similar to fixing shaft sleeve **530** with internal female threads of FIG. **5**) insertably received in at least one flange bore (e.g., first flange bore **521**, second flange bore **523**, first flange bore **621**, second flange bore **623**), and the boss bore **513**, **613** following coaxial alignment of the flange bore center axis **532**, **632** and the boss bore center axis **512**, **612**.

[0118] Referring to FIG. **6**C, according to some aspects, the first curved pinion segment **616***a* may have a first arc length **672** and the curved rack segment **618***a* may have a second arc length **674**, where the first arc length **672** is greater than the second arc length **674**. According to some examples, the second arc length **674** may be free of any portion of a plurality of second teeth of the curved rack segment **618***a* that would prevent a slidable engagement of any of a plurality of first teeth of the first curved pinion segment **616***a* from translating along the longitudinal axis **608** on a respective one of the spaced apart parallel boss surfaces **610***a*, **610***b* and prevent the any portion of the plurality of first teeth from a meshed engagement with a whole depth of corresponding spaces between teeth (e.g., between any crowns B, C, D of FIG. **6** or adjacent to outboard portions of crowns B and D).

[0119] In some examples, the fixing shaft **631** that may be received in the at least one of the second flange bore **623** or the first flange bore **621** and the boss bore **613** may prevent a translation along the longitudinal axis **608** of the first boss **606** relative to the pair of flanges **619***a*, **619***b*. In some examples, the fixing shaft **631** that may be received in the at least one of the second flange bore **623** or that first flange bore **621** and the boss bore **613** fixedly maintains a meshed engagement of the curved rack segment **618** *a*, **618***b* and the at least the portion of the pair of pinion segments **616***a*, **616***b*. In still other examples, the fixing shaft **631** may be insertably received in the at least one flange bore of the pair of flange bores **623**, **621** and the boss bore **613** following coaxial alignment of the flange bore center axis **632** and the boss bore center axis **612** and following a meshed engagement of the curved rack segment **618***a*, **618***b* and the at least the portion of the pair of pinion segments **616***a*, **616***b*.

[0120] In some examples an angle of the tool member **603** relative to the longitudinal axis **608** may be fixed until after removal of the fixing shaft **631** from the boss bore **613**.

[0121] Returning to FIG. **1**, the handle **112** may be subdivided into at least three serially coupled handle segments including: a first segment **126** having the first fixed length **138** and a first end

coupled to the first fixing member **114** and a first opposing end distal to the first end, a second segment **130** having the fixed second length **142** and a second end coupled to a second fixing member **120** and a second opposing end distal to the second end, and a center segment **132** having the fixed center length **140** coupled between the first opposing end of the first segment **126** and the second opposing end of the second segment **130** at respective ends of the center segment **132**. In some aspects, a fixed third angle **134**, between the center segment **132** and the first segment **126** is a first acute angle and a fixed fourth angle **136**, between the center segment **132** and the second segment **130** is a second acute angle. In some examples, the first acute angle and the second acute angle result in the first segment **126** and the second segment **130** being angled toward one side of the center segment **132**. According to one aspect, the first segment **126**, the center segment **132**, and the second segment **130** may be formed as one continuous piece. Additionally, the fixed third angle **134** may be equal to the fixed fourth angle **136**.

[0122] Referring to FIG. **2**, in some aspects, at least two or more of the first segment **226**, the center segment **232**, and the second segment **230** may be formed as separate pieces, and coupling between the at least two or more of the first segment **226**, the center segment **232**, and the second segment **230** may also include first inter-segment angle fixing feature **207** and the second inter-segment angle fixing feature **209** configured to be fixed at any one of a plurality of angles provided within a range of the fifth angle **234**, the sixth angle **236** ranging at least between plus and minus 90 degrees relative to the center segment **232**, inclusive.

[0123] Returning to FIG. **1**, in some examples, each of the pair of fixing members (e.g., the first fixing member **114**, the second fixing member **120**) may also include a second boss **664** of FIG. **6** extending away from the first boss **606**. The second boss **664** may be configured to couple to the respective end of the handle **112** of FIG. **1**, for example. According to some aspects, the second boss **664** may be configured to fit into a hollow space in the handle **112**. The garden implement **100** may also include at least one fixing member (such as first rivet **306** and the rivet sleeve **307**) configured to be received in a through hole **607** formed in and through the handle **112** and the second boss **664**.

[0124] FIG. **7**A is a top plan view of a fixing member **714** (similar to fixing member **614** of FIG. **6**), a toolhead **702** (similar to the interchangeable toolhead **602** of FIG. **6**), and a portion a handle **712** (similar to handle **112** of FIG. **1**) of a garden implement (such as the garden implement **100** of FIG. **1**) according to some aspects of the disclosure. According to some aspects, the assemblage **700** may be considered a tool. According to some aspects the collected assemblage **700** plus a similar assemblage at and including a far end of the portion of the handle **712** may be considered a tool. Tools are not limited to these examples. A second boss **764** is shown in phantom view for scale and orientation. The second boss **764** projects from the body segment of the fixing member toward and into a hollow space in the handle **712**.

[0125] In FIG. **7**A the toolhead **702** is rotated from a nominal orientation shown in FIG. **7**B by a first predetermined angular distance **701** clockwise relative to a longitudinal axis **708**. A fixing shaft **731** is depicted as being received in coaxial alignment with a bore defined by internal sidewalls of the boss of the fixing member **714** and a bore defined by internal sidewalls of at least one flange of the toolhead **702**. The fixing shaft **731** received in the boss bore and the at least one flange bore prevents a translation along the longitudinal axis of the first boss relative to the pair of flanges. The lateral translation would involve the sliding of opposing parallel flange surfaces along adjacent boss surfaces. According to some aspects, the fixing shaft **731** received in the at least one flange bore and the boss bore fixedly maintains a meshed engagement of the curved rack segment **718** and at least the portion of the pinion segment **716**. According to some aspects, the fixing shaft **731** may be insertably received in the at least one flange bore and the boss bore following coaxial alignment of the flange bore center axis **532**, **632** and the boss bore center axis **512**, **612** following a meshed engagement of the curved rack segment **718** and the at least the portion of the pinion segment **716**.

[0126] In the example of FIG. **7**A, pinion segment **716** tooth **1** is received in the partial space width located counterclockwise from tooth B of the curved rack segment **718**. In the example of FIG. **7**A, the angular pitch between adjacent tooth crowns and adjacent tooth roots may be represented by the angular segment X **720** in degrees. In the example of FIG. **7**A, X is about 31 degrees. Other values of X are within the scope of the disclosure. Each reorientation of the pinion segment **716** by one pinion segment tooth position results in a corresponding orientation change of the toolhead **702**. Reorientation clockwise by X degrees from that depicted in FIG. **7**A may cause a portion of the flange to interfere with the fixing member **714**. Reorientation counterclockwise in by an X degree increment (i.e., by one tooth) allows for the pinion segment **716** tooth **2** to occupy the partial space counterclockwise from tooth B of the curved rack segment **718**. An additional reorientation counterclockwise by an X degree increment allows for the pinion segment **716** tooth **3** to occupy the partial space counterclockwise from tooth B of the curved rack segment **718**. This orientation is exemplified in FIG. **7**B.

[0127] FIG. **7**B is a top plan view of the fixing member **714** and the toolhead **702** of FIG. **7**A, where the toolhead **702** is in a “nominal” orientation. In the nominal orientation, tooth **3** of pinion segment **716** occupies the partial space counterclockwise from tooth B of the curved rack segment **718**. In the nominal orientation, a plane parallel to the tool member **703** of the toolhead **702** is perpendicular to the longitudinal axis **708** and perpendicular to a corresponding longitudinal axis (not shown) extending from the end of the handle; that is, from the end of the handle **712** where the second boss **764** is located. Various ways to describe the angular orientation of the toolhead **702** with respect to the handle **712**. It is noted that not all toolheads may extend perpendicularly from their flanges as does the toolhead **702** of FIG. **7**. Accordingly, consistency herein, and without any limitation, angles of the toolheads described herein may be based on angular distance of the tool member **703** of the toolhead **702** having a nominal orientation that is perpendicular to the longitudinal axis **708** extending from the boss of the fixing member **714**.

[0128] From the nominal orientation of FIG. **7**B, reorientation clockwise by an X degree increment (i.e., by one tooth) allows for tooth **4** of the pinion segment **716** to occupy the partial space counterclockwise from tooth B of the curved rack segment **718**. An additional reorientation counterclockwise by an X degree increment allows for tooth **5** of the pinion segment **716** to occupy the partial space counterclockwise from tooth B of the curved rack segment **718**. This orientation is exemplified in FIG. **7**C.

[0129] FIG. **7**C is a top plan view of the fixing member **714** and the toolhead **702** of FIG. **7**B, where the toolhead **702** is rotated from the nominal orientation of FIG. **7**B to a maximum angular displacement **705** counterclockwise. Further reorientation of the toolhead **702** in the counterclockwise direction would result in the flange interfering with the fixing member **714**. A different design of the flange, which may clear the fixing member if the toolhead was incremented, for example by another X degree increment counterclockwise from the position shown in FIG. **7**C, or clockwise from the position shown in FIG. **7**A is within the scope of the disclosure.

[0130] In the examples from FIG. **7**A to FIG. **7**C, the toolhead **702** having the pinion segment **716** in a meshed engagements with the exemplary curved rack segment **718** may be reoriented from a starting position angle clockwise relative to the longitudinal axis **708** through to the ending position angle counterclockwise relative to the longitudinal axis **708**. The example therefore depicts a total of 5 available orientations including the starting orientation for a total angular reorientation capability of about 124 degrees. The orientations and angular segment X **720** values are illustrative and non-limiting. Other angular segment X **720** values that are greater or lesser than the example of about 31 degrees provided herein are within the scope of the disclosure. An increase in the angular segment X **720** may result in a fewer number of teeth in both the pinion segment **716** and the curved rack segment **718**. A decrease in the angular segment X **720** may result in a greater number of teeth in both the pinion segment **716** and the curved rack segment **718**. A tradeoff between angular segment X **720** value (and corresponding numbers of teeth) and resistance to torque forces

about the pinion axis and the coaxial boss bore axis that may damage (e.g., strip) teeth may be considered.

[0131] FIG. **7**D is a top plan view of the fixing member **714** and the toolhead **702** of FIG. **7**C, where the toolhead **702** was removed from the fixing member, rotated about the longitudinal axis **708**, and reinstalled to the fixing member **714** according to some aspects of the disclosure. The reorientation of the toolhead was accomplished by rotating the toolhead from pointing toward the right, to pointing toward the left. Note that the orientation of the handle **712** is not changed in FIGS. **7**A, **7**B, **7**C, and **7**D. Only the toolhead **702** is rotated in FIG. **7**D. The ability to reorient the toolhead **702** according to this aspect provides for additional range of angular orientation capability relative to the handle **712**.

[0132] FIG. **8**A is a garden implement **800** (similar to garden implement **100** of FIG. **1**) with a first fixed orientation of a toolhead **802** relative to the handle **812** of the garden implement **800** according to some aspects of the disclosure. The angle of the toolhead **802** relative to the handle **812** may be fixed in a clockwise direction from a nominal orientation and used for a first purpose. For example, the toolhead **802** may be a hoe and the first purpose may be to scrape or rake a surface of a plot of soil **807** to level the surface. A human hand and forearm (e.g., a user's right hand and forearm) are illustrated. For example, a mound of soil to the right of the toolhead **802** may be scraped or raked into the depression to the right of the mound of soil by pulling on the handle **812** in the direction of the first force **811** (denoted as F**1**). An exerted effort **815** (denoted as E**1**) (e.g., a force) may be exerted downward on the midpoint of the handle **812**. The exerted effort **815** may be applied by the user's left hand (not shown). In this way, with the first orientation of the toolhead **802** relative to the handle **812** fixed, the garden implement **800** may be used as a third class lever. The fulcrum **813** of the third class lever is located at the illustrated user's right hand, the exerted effort **815** is exerted as a downward force at the midpoint of the handle **812**, and the load **817** (denoted as L) is moved downward at the end of the handle **812** (e.g., at the toolhead **802**) according to some aspects of the disclosure.

[0133] FIG. **8**B is the garden implement **800** of FIG. **8**A where the handle **812** was rotated (e.g., inverted) from the orientation shown in FIG. **8**A. That is, the user rotated the handle **812** about the axis (not shown) of the center segment of the handle **812** to flip or invert the handle **812** and the toolhead **802** by 180 degrees from the orientation shown in FIG. **8**A. The angle of the toolhead **802** relative to the handle **812** is maintained at the same first fixed orientation depicted in FIG. **8**A. The toolhead **802** has not changed; it is still a hoe. However, the garden implement **800** is now used for a second purpose; namely, the garden implement **800** of FIG. **8**B may be used as a lever to pry a rock **809** from the plot of soil **807**. The exerted effort **815** may be exerted against the end of handle **812** distal from the soil **807** in substantially the direction as shown. One or both of the user's hands may pull or push the end of handle **812** distal from the soil **807** to exert the effort **815**. The fulcrum **813** is now located at the end of the handle **812** proximal to the soil **807** (e.g., located at the toolhead **802**). The load **817** may now be lifted from the soil **807** in the direction shown by the application of the exerted effort **815** on the handle **812** as shown. In this way, with the first orientation of the toolhead **802** relative to the handle **812** fixed and maintained, the garden implement **800** may be used as a third class lever. An ability to utilize the toolhead **802** with a fixed or changed angle relative to the handle **812** of the garden implement **800**, as two distinct classes of a machine (e.g., a first class lever and a third class lever) is an unexpected benefit of the angular orientations of the center segment of the handle **812** relative to the first and second segments of the handle **812**.

[0134] FIG. **9**A is a first garden implement **900** having a first handle **912***a* with a first center segment **932***a* having a first center length, La, according to some aspects of the disclosure. The first handle **912***a* includes a first segment **926** and a second segment **930** in addition to the first center segment **932***a*. According to one example, the first center length, La, may be about 52 inches.

[0135] FIG. **9**B is a second garden implement **901** having a second handle **912***b* with a second

center segment **932***b* having a second center length, Lb, according to some aspects of the disclosure. The second handle **912***b* includes a first segment **926** and a second segment **930** in addition to the second center segment **932***b*. According to one example, the second center length, Lb, may be about 40 inches.

[0136] FIG. **9**C is a third garden implement **902** having a third handle **912***c* with a third center segment **932***c* having a third center length, Lc, according to some aspects of the disclosure. The third handle **912***c* includes a first segment **926** and a second segment **930** in addition to the third center segment **932***c*. According to one example, the third center length, Lc, may be about 23 inches.

[0137] FIG. **9**D is a fourth garden implement **903** having a fourth handle **912***d* with a fourth center segment **932***d* having a fourth center length, Ld, according to some aspects of the disclosure. The fourth handle **912***d* includes a first segment **926** and a second segment **930** in addition to the fourth center segment **932***d*. According to one example, the fourth center length, Lc, may be about 16 inches.

[0138] As depicted visually, and described in the examples, the first center length, La, is greater than the second center length, Lb. The second center length, Lb, is greater than the third center length, Lc. The third center length, Ld, is greater than the fourth center length, Ld. The lengths may vary. A selection of various lengths provides for garden implements **900**, **901**, **902**, **903** that can exert different forces on loads based on the center lengths of the handles of the garden implements. The exertion of different forces based on center lengths may become pertinent when, for example, the garden implements are used as levers. It is noted that even a rake is a lever; specifically, a rake is a third class lever. The first segment **926** and second segment **930** may each be the same structures (and respective same lengths) in the first garden implement **900**, the second garden implement **901**, the third garden implement **902** and the fourth garden implement **903**. According to one example, the first segment **926** may be about 3-5 inches and the second segment may be about 8-10 inches. The preceding examples are illustrative and non-limiting.

[0139] Examples of garden tools include, for example, a border spade having a flat rectangular blade that may be used for digging in spaces having cramped or restricted access; a bow rake having a bow-shaped frame that connects the teeth of the rake to a handle; a border fork having tines that are narrowly spaced and that may be used, for example, for weeding; a border spade that may be a specialized tool member that may be smaller than other types of spades and may have a flat blade, for example, for digging; a bulb planter that may be used to dig holes for bulbs and may subsequently be used to replace that soil to cover the planted bulb; a compost fork that may have spaced apart tines and may be used, for example, to turn over manure or to move mulch; a flat rake with strong teeth connected to a flat back that may be used, for example, for removing rocks and other unwanted material from soil and for spreading and leveling soil and mulch; a garden hoe that may have a small rectangular blade used, for example, to shape soil, remove weeds, clear soil, and harvest root crops; a garden shovel that may have a round, pointed or flat digging edge and may be used, for example, for digging, lifting, and/or moving soil; a hoe having a thin rectangular or square blade and that may be used, for example, to break up clumps of soil for weeding; a leaf rake having flat fan-shaped resilient tines that may radiate outward from a handle; a pick mattock having a pointed end and a spaced apart adze-like end distal from the pointed end that may be used, for example, for digging, carving, and/or chopping soil; a pitchfork or garden fork having a small number of spaced apart tines and that may be used, for example, to lift and toss loose material such as straw or hay; a planting dibble having a pointed tip that may be used, for example, to form holes in soil; a pointed shovel having a pointed tip that may be used, for example, as a digging shovel; a potato fork that may have curled tines and may be useful, as the name implies, for harvesting potatoes; a round point shovel that may have a curved blade with a tip that comes to a point and that may be used, for example, for scooping; a scoop shovel having a wide forward edge with a large flat surface with upward tending rear and side wall and that may be useful, for example, for

scooping up a large quantity of matter when digging or moving that matter; a scuffle hoe that has a flat broad blade used parallel to the surface of the soil with sharpened leading and trailing edges that may cut plant life (e.g., typically grass or weeds) from the surface of the soil during forward and backward motion of the flat broad blade; a soil scoop that may be a general purpose digging implement with a bowl-shaped body and pointed and/or serrated edges; a square point shovel that may be used to dig into and lift loose matter, such as sand, loose topsoil, and pebbles, for example; a step edger that may be a sharpened semi-circular disc at the end of a handle and that may be used, for example, straighten edges of lawns by, for example, trimming off the edges of the lawn that has grown over some boundary, such as a sidewalk; a transplant spade that may have a narrow, sometimes pointed digging edge and a long narrow bed that is the same width as the digging edge and may be used, for example, to deeply penetrate the soil and lift out large plants; a trench shovel (also called a clean out shovel or excavator shovel) having a long, narrow blade with a sharpened curved digging edge and may be used, for example, to dig or clean out trenches; a trowel, which in the context of gardening is typically a small curved scoop-like shovel-like implement that may be used, for example, for digging small holes to receive plants and/or for transferring small amounts of matter (e.g., soil, fertilizer) from a bag to a gardening pot or a garden bed, for example; a twist tiller configured with long twisted tines that may be used to simultaneously till soil and remove weeds by rotating the twist tiller within the soil; a warren hoe, also known as a ridging hoe, or drill hoe, which is a triangular or heart-shaped hoe designed for digging narrow furrows or shallow trenches for planting seeds or bulbs; a common weeder that is configured to remove weeds from soil; and a wheel edger that may be a sharpened circular disk on a transvers axis that is free to rotate about the axis as the wheel edger is pushed along, cutting away an edge, for example, of a lawn between the lawn and a sidewalk to establish a boundary therebetween. The preceding list is exemplary and non-limiting. Any tool member capable of being interchangeably fixed to the garden implement described herein is within the scope of the disclosure.

[0140] FIG. **10**A is an illustrative example of a first interchangeable toolhead **1002** according to some aspects of the disclosure. The first interchangeable toolhead **1002** may be referred to as a cultivator toolhead and may be used in association with tasks typically associated with cultivator-type tools.

[0141] FIG. **10**B is an illustrative example of a second interchangeable toolhead **1004** according to some aspects of the disclosure. The second interchangeable toolhead **1004** may be referred to as a push-pull rake toolhead and may be used in association with tasks typically associated with push-pull rake-type tools.

[0142] FIG. **10**C is an illustrative example of a third interchangeable toolhead **1006** according to some aspects of the disclosure. The third interchangeable toolhead **1006** may be referred to as a spade toolhead and may be used in association with tasks typically associated with spade-type tools.

[0143] The illustrative examples of FIGS. **10**A, **10**B, and **10**C are exemplary and non-limiting. any number of garden tools, such as those described above, may be fitted with flanges configured to receive a boss of a fixing member of a garden implement as described herein. The toolheads described herein are interchangeable toolheads.

[0144] The spaced apart flanges having respective flange bores defined by internal sidewalls of the respective flanges are exemplified in each of the first interchangeable toolhead **1002**, the second interchangeable toolhead **1004**, and the third interchangeable toolhead **1006**. In the examples, one of the flange bore is circular and the other flange bore has flattened or straight surfaces truncating the otherwise circular bore. The flattened or straight surface serve as stops against which a portion of a fixing shaft (not shown) might rest. The configuration may prevent the fixing shaft from rotating in configurations where, for example, a nut is screwed onto the fixing shaft, or a threaded male member is screwed into a female threaded portion of the fixing shaft. Other shapes that may serve as stops against which the portion of the fixing shaft might rest are within the scope of the

disclosure.

[0145] According to some aspects, an interchangeable toolhead **1002**, **1004**, **1006** may include a tool member **1003**, **1005**, **1007**. The interchangeable toolhead **1002**, **1004**, **1006** may also include a pair of flanges **1008**, **1009**, **1010** extending from the tool member **1003**, **1005**, **1007**. Each flange may include a flange bore **1011**, **1012**, **1013** defined by a flange internal sidewall **1014**, **1015**, **1017** and a curved pinion segment **1016***a*, **1016***b*, **1016***c* having a common first center with the flange bore **1011**, **1012**, **1013**, the pair of flanges **1008**, **1009**, **1010** having opposing parallel flange surfaces (e.g., **625***a*, **625***b* of FIG. **6**) including at least the respective curved pinion segment **1016***a*, **1016***b*, **1016***c* and a having a flange bore center axis (e.g., flange bore center axis **532** of FIG. **5**, flange bore center axis **632** of FIG. **6**) intersecting the common first centers and perpendicular to the opposing parallel flange surfaces, the opposing parallel flange surfaces spaced apart by a predetermined distance (e.g., **644** of FIG. **6**). According to some examples, the predetermined first distance may correspond to a width (e.g., first boss width **645**) of a boss (e.g., first boss **606**) coupled to and extending from a handle **112** of a garden implement **100**.

[0146] In some examples, the curved pinion segment **1016***a*, **1016***b*, **1016***c* may have a plurality of first teeth **1020***a*, **1020***b*, **1020***c* having a first angular pitch (e.g., angular segment X **720** of FIG. **7**A). The first teeth of the pinion segment may be configured to mesh with a curved rack segment (e.g., **718** of FIG. **7**) having a plurality of second teeth (e.g., **721** of FIG. **7**) having the first angular pitch, where the plurality of first teeth **1020***a*, **1020***b*, **1020***c* is greater than the plurality of second teeth **721** of FIG. **7**. Furthermore, an angle of the toolhead **702** of FIG. **7** relative to the handle **712** may be determined based on which of the plurality of first teeth **1020***a*, **1020***b*, **1020***c* may be in a meshed engagement with the plurality of second teeth **721**. The determination may be made when the flange bore center axis **532**, **632** is coaxially aligned with the boss bore center axis **512**, **612**. In some examples, at least a portion of first teeth **1020***a*, **1020***b*, **1020***c* of the curved pinion segment **1016***a*, **1016***b*, **1016***c* may be configured to mesh with second teeth **721** of the curved rack segment **718** coupled to a handle **112** of a garden implement **100**. In some examples, the curved pinion segment **616***a*, **616***b*, **1016***a*, **1016***b*, **1016***c* may have a first arc length (e.g., first arc length **672** of FIG. **6**C) and the curved rack segment **618** may have a second arc length (e.g., second arc length **674** of FIG. **6**), where the first arc length **672** is greater than the second arc length **674**.

[0147] FIG. **11** is a graphical representation of plurality of articles of manufacture packaged as a garden implement set **1100** according to some aspects of the disclosure. The plurality of articles of manufacture include a handle **1102** having spaced apart handle ends, at least two toolheads (e.g., a first toolhead **1108** and a second toolhead **1110**) each having a tool member and a pair of flanges coupled to and extending from the tool member, the pair of flanges including opposing parallel flange surfaces spaced apart by a predetermined first distance, at least two fixing members (e.g., a first fixing member **1104** and a second fixing member **1106**) each fixed to respective handle ends and configured to couple the handle **1102** to a respective one of the at least two toolheads (e.g., the first toolhead **1108** and the second toolhead **1110**), and at least two fixing shafts (e.g., a first fixing shaft **1112** and a second fixing shaft **1114**), each configured to be insertably received in a first fixing shaft receiver of a respective toolhead (e.g., the first toolhead **1108** and the second toolhead **1110**) and a second fixing shaft receiver of a respective fixing member (e.g., the first fixing member **1104** and the second fixing member **1106**) when the fixing shaft, first fixing shaft receiver, and second fixing shaft receiver are coaxially aligned.

[0148] According to some aspects, the first fixing shaft receiver of the respective toolhead may include a flange bore defined by a respective flange internal sidewall of each respective flange, each respective flange may further include a pinion segment having a common center with the flange bore and a pinion segment center axis. Each of the at least two fixing members (e.g., the first fixing member **1104** and the second fixing member **1106**) may further include a respective boss having a curved rack segment configured to mesh with at least a portion of the pinion segment. Still further the second fixing shaft receiver of the respective fixing member may include a boss

bore defined by a respective boss internal sidewall, and a boss bore center axis.
[0149] In some examples, the at least two fixing members (e.g., the first fixing member **1104** and the second fixing member **1106**) may each include a first boss projecting along a longitudinal axis relative to the respective fixing member, the first boss having parallel first boss surfaces spaced apart by the predetermined first distance, a first boss bore defined by a first boss internal sidewall, and a first boss bore center axis intersecting a first boss bore center and perpendicular to the parallel first boss surfaces, each respective first boss surface having a curved rack segment projecting perpendicularly therefrom and configured to mesh with at least a portion of a pinion segment of the pair of flanges. The pinion segment may have a first arc length, and the curved rack segment may have a second arc length, where the first arc length is greater than the second arc length. Still further, the second arc length may be free of any portion of a plurality of second teeth of the curved rack segment that would prevent a slidable engagement of any of a plurality of first teeth of the pinion segment from translating along the longitudinal axis on a respective parallel boss surface, and prevent the any portion of the plurality of first teeth from a meshed engagement with spaces between any crowns of the plurality of second teeth.
[0150] FIG. **12** is a left-top exploded perspective view of a portion of a tool according to some aspects of the disclosure. The tool may be, for example, and without limitation, a garden implement. Similar tools may be exemplified by the portion **500** of the garden implement **100** (e.g., the tool) as shown and described in connection with FIGS. **1** and **5**, the assemblage **700** of FIGS. **7**A-**7**D (e.g., a tool with one toolhead), and the implements (e.g., a tools with two toolheads) of FIGS. **8**A-**8**B and FIGS. **9**A-**9**D. As depicted, the portion of the tool **1200** may include a portion of a tool handle **1202** that includes a fixing member **1214** formed integrally with the tool handle **1202**. In the example of FIG. **12**, the tool handle **1202** and the fixing member **1214** are formed of solid (not hollow) metal or other strong and resilient solid material. According to some aspects, the solid material may be formed as one uniform piece or may be formed as solid core of one material and a solid outer covering, such as a sold metal core with a fiberglass shell. Other ways to form the tool handle **1202** are within the scope of the disclosure.
[0151] As illustrated in the example of FIG. **12**, the fixing member **1214** of FIG. **12** may be formed integrally with the tool handle **1202**. In contrast, the first fixing member **114** (of FIG. **5**) is depicted as a distinct component that may be coupled to a first handle end **502** as shown and described in connection with FIG. **5**. Ultimately, the tool **1200** of FIG. **12** and the portion **500** of the garden implement **100** (e.g., the tool) of FIG. **5** may be used for the same purpose. However, their forms may be distinguishable. It is within the scope of the disclosure to form the fixing member **1214** of FIG. **12** as a distinct component that may be coupled to the tool handle **1202** (as exemplified in FIGS. **5** and **7**) or as an integral part of the tool handle **1202** (as shown in FIG. **12**).
[0152] In some examples, the fixing member **1214** may project along a longitudinal axis **1208** (where, the longitudinal axis **1208** (e.g., the X axis) is represented by a double headed arrow) from an end of the tool handle **1202**. The fixing member **1214** may include a portion having a total fixing member width **1245** (measured along the Z axis) that is greater than a boss width **1247**. The portion of the fixing member **1214** that encompasses the boss width **1247** may be referred to as a boss **1206** herein. In some examples, the tool **1200** may be described as having the boss **1206** projecting along the longitudinal axis **1208** relative to the end of the tool handle **1202**.
[0153] The boss **1206** may include a first boss surface **1210***a* and a second boss surface **1210***b* spaced apart from and parallel to the first boss surface **1210***a*. The first boss surface **1210***a* and the second boss surface **1210***b* are spaced apart by the boss width **1247**. The boss width **1247** may correspond to a predetermined distance **1244** between opposing parallel flange surfaces **1225***a*, **1225***b* of the first flange **1219***a* and the second flange **1219***b*, respectively. As used herein, the opposing parallel flange surfaces **1225***a*, **1225***b* of the respective first flange **1219***a* and second flange **1219***b* are referred to collectively as “the opposing parallel flange surfaces **1225***a*, **1225***b*.” They are referred to individually as the flange surface **1225***a* of the first flange **1219***a* and the

flange surface **1225***b* of the second flange **1219***b*. The predetermined distance **1244** may be selected to facilitate a sliding (e.g., sliding engagement/sliding disengagement) along the longitudinal axis **1208** of the boss **1206** between the opposing parallel surfaces of the first flange **1219***a* and the second flange **1219***b*, within tolerance limits of manufacture.

[0154] The boss **1206** may further include a boss bore **1213** defined by the boss internal sidewall **1215**, and a boss bore center axis **1212** (depicted a long-dash dot line parallel to the Z-ais) intersecting a boss bore center (**1648** of FIG. **16**). The boss bore center axis **1212** may be perpendicular to the first boss surface **1210***a* and the second boss surface **1210***b*. Each respective boss surface (i.e., the first boss surface **1210***a* and the second boss surface **1210***b*) may have a respective curved rack segment **1218***a*, **1218***b* having a first plurality of teeth projecting therefrom (e.g., the first plurality of teeth including B, C, D, the partial tooth counterclockwise from B, and the partial tooth clockwise from D) toward the boss bore center axis **1212**. As used herein a tooth includes a partial or complete crest/crown and, if present, adjacent partial or complete trough/root. In some examples, the first plurality of teeth may form a first compound surface **1701** (FIG. **17**) spanning all crests and troughs or portions thereof of the first plurality of teeth partially surrounding the boss bore center axis **1212**. In some examples the first compound surface **1701** (FIG. **17**) may be continuous along the curved rack segment. In some examples, the first compound surface **1701** (FIG. **17**) may be interrupted as it spans along the curved rack segment.

[0155] The tool **1200** may include an interchangeable toolhead **1204** (a portion of which is shown in FIG. **12**). The interchangeable toolhead **1204** may be representative of one of a plurality of interchangeable toolheads. By way of example and not limitation, a sampling of interchangeable toolheads **2204**, **2204**, **2206** configured to couple to the fixing member **1214** of FIG. **12** is depicted in FIGS. **20**A, **20**B, and **20**C, respectively. The interchangeable toolhead **1204** includes a pair of flanges, exemplified by a first flange **1219***a* and a second flange **1219***b*. The pair of flanges **1219***a*, **1219***b* may be respectively fixed to and extend from the tool member **1203**. The pair of flanges **1219***a*, **1219***b* may have opposing parallel flange surfaces **1225***a*, **1225***b* fixedly spaced apart by the predetermined distance **2144**.

[0156] Each respective one of the pair of flanges **1219***a*, **1219***b* may have a flange bore **1221**, **1223** defined by a flange internal sidewall **1222**, **1224**. All shapes (e.g., circular, square, with key, without key) for the perimeter of the flange bore **1221**, **1223** are within the scope of the disclosure. Furthermore, the first flange **1219***a* may have the flange bore **1221** of one shape (e.g., square) while the second flange **1219***b* may have the second flange bore **1223** that is a different shape (e.g., circular) or the same shape (e.g., square). Each respective one of the pair of flanges **1219***a*, **1219***b* may have and may share a flange bore center axis **1232** (depicted a long-dash dot line parallel to the Z-axis) intersecting a flange bore center **1842** (FIG. **18**) and perpendicular to the opposing parallel flange surfaces **1225***a*, **1225***b*.

[0157] The first flange **1219***a* may have a first curved pinion segment **1216***a*. The second flange **1219***b* may have a second curved pinion segment **1216***b*. The first curved pinion segment **1216***a* and the second curved pinion segment **1216***b* may collectively be referred to as the pair of curved pinion segments **1216***a*, **1216***b*. Each of the first curved pinion segment **1216***a* and the second curved pinion segment **1216***b* may include a respective second plurality of teeth projecting therefrom. Each of the second plurality of teeth may have a second compound surface **1901** (FIG. **19**) that includes, in association with the first curved pinion segment **1216***a*, a pinion first face **1241***a* and a pinion second face **1243***a*, and in association with the second curved pinion segment **1216***b*, a pinion first face **1241***b* and a pinion second face **1243***b*. The first flange **1219***a* and the second flange **1219***b* share the flange bore center axis **1232**.

[0158] In the example, the pair of flanges (i.e., the first flange **1219***a* and the second flange **1219***b*) are respectively fixed to and extend from the tool member **1203**. The pair of flanges have opposing parallel flange surfaces **1225***a*, **1225***b* fixedly spaced apart by the predetermined distance **1244**. Each respective one of the pair of flanges **1219***a*, **1219***b* has the flange bore **1221**, **1223** defined by

a flange internal sidewall **1222**, **1224**, and the flange bore center axis **1232** intersecting the flange bore center (**1842** of FIG. **18**) and perpendicular to the opposing parallel flange surfaces **1225***a*, **1225***b*.

[0159] Each respective one of the pair of flanges **1219***a*, **1219***b* has a respective curved pinion segment **1216***a*, **1216***b* having a second plurality of teeth projecting therefrom, the second plurality of teeth having a second compound surface and sharing the flange center axis,

[0160] FIG. **13** is a plan view, observed in the X-Y plane, of the second flange **1219***b* according to some aspects of the disclosure. The pinion first face **1241***b* of the second curved pinion segment **1216***b* is visible. The second curved pinion segment **1216***b* forms a sloped face that partially surrounds the second flange bore **1223** and is centered on the flange bore center **1642** (FIG. **16**). Angular pitch between teeth was described in connection with FIG. **7** and will not be repeated for the sake of brevity.

[0161] FIG. **14** is a side view, observed in the X-Z plane, of the second curved pinion segment **1216***b* of FIG. **13** according to some aspects of the disclosure. The pinion first face **1241***b* and the pinion second face **1243***b*, both of the second curved pinion segment **1216***b* are visible. A flange first plane (**2101**, FIG. **21**) coincident with the lower horizontal surface of the second curved pinion segment **1216***b*, a flange second plane (**2102**, FIG. **21**) coincident to the juncture between the pinion first face **1241***b* and the pinion second face **1243***b* and parallel to the flange first plane, and the flange third plane (**2103**, FIG. **21**) coincident with the flange surface **1225***b* are not shown in FIG. **14** to avoid cluttering the drawing; however, these planes are illustrated and described in connection with FIG. **21**. The second flange bore **1223** is shown in phantom view within the second flange **1219***b*. Also illustrated are the total thickness **1402** of the second flange **1219***b*. In the example of FIG. **14**, the total thickness **1402** of the second flange **1219***b* may be equal to a pinion first face thickness (not referenced explicitly on the drawing to avoid cluttering the drawing) plus a pinion second face thickness **1404**. A ratio of the pinion first face thickness to the pinion second face thickness **1404** is depicted at about 2:1 for ease of illustration and not limitation. Other ratios in which the pinion first face thickness (or height) is greater than the pinion second face thickness **1404** (or height) are within the scope of the disclosure.

[0162] FIG. **15** is a comparative illustration of variable lengths of a hypotenuse and base of a triangle, where an interior angle between the hypotenuse and the base is changed while a side of the triangle perpendicular to the base is maintained at a value of unity (**1**) (e.g., as a reference unit value, such as 1 mm) according to some aspects of the disclosure. In FIG. **15**(*a*), the interior angle between the hypotenuse and the base is 90 degrees, effectively collapsing the triangle into a vertical segment having a length of 1. The interior angle between the hypotenuse and the base is reduced in each of FIGS. **15**(*b*), (*c*), and (*d*) relative to the 90 degree angle shown in FIG. **15**(*a*).

[0163] The triangle represented in FIGS. **15**(*b*), (*c*), and (*d*) could each be superimposed on the interior angle (a) shown in FIG. **14**. In such a superposition, the interior angle (a) formed between the pinion first face **1241***b* (e.g., the hypotenuse of the triangle of FIGS. **15**(*b*), (*c*), and (*d*)) and a plane parallel to the X-Y plane in FIG. **14**, where the plane bisects the contiguous joint between the pinion first face **1241***b* and the pinion second face **1243***b*, represents the angle of the pinion first face **1241***b*. A length of the pinion first face **1241***b* corresponds to the length of the hypotenuse of the triangle of FIGS. **15**(*b*), (*c*), and (*d*), where the length is measured in a plane parallel to the X-Z plane in FIG. **14**.

[0164] In FIG. **15**(*b*), the hypotenuse of the triangle (e.g., a 30-60-90 degree triangle), is tipped from 90 degrees (shown in FIG. **15**(*a*)) to 60 degrees relative to the plane that bisects the contiguous joint between the pinion first face **1241***b* and the pinion second face **1243***b*. The length of the hypotenuse (i.e., the length of the pinion first face **1241***b*) increases from 1 to 1.55. The length of the base increases from zero to 0.5774.

[0165] In FIG. **15**(*c*), the hypotenuse of the triangle (now an equilateral triangle), is tipped from 60 degrees to an angle of 45 degrees relative to the plane that bisects the contiguous joint between the

pinion first face **1241***b* and the pinion second face **1243***b*. The length of the hypotenuse (i.e., the length of the pinion first face **1241***b*) increases from 1.155 to 1.414. The length of the base increases from 0.5774 to 1.

[0166] In FIG. **15**(*d*), the hypotenuse of the triangle (now again a right triangle where the base is longer than the side), is tipped from 45 degrees to an angle of 30 degrees relative to the plane that bisects the contiguous joint between the pinion first face **1241***b* and the pinion second face **1243***b*. The length of the hypotenuse (i.e., the length of the pinion first face **1241***b*) increases from 1.414 to 2. The length of the base increases from 1 to the square root of 3 (i.e., 1.732).

[0167] When comparing FIGS. **15**(*a*)-(*d*) to FIGS. **13** and **14**, it may be observed that decreasing the interior angle (α) (while maintaining the side at unity) increases the length of the pinion first face **1241***b* and also increases a total surface area of the collection of eight teeth that make up the segment of the internal gear that corresponds to the second curved pinion segment **1216***b* (of FIGS. **12**, **13**, and **14**, for example). This observation can be extended to the other pinion and rack segments.

[0168] Accordingly, it may be observed that decreasing the interior angle between the pinion first face **1241***a* and the contiguous joint between the pinion first face **1241***a* and the pinion second face **1243***a* (while maintaining the side at unity) increases the length of the pinion first face **1241***a* and also increases a total surface area of the collection of eight teeth that make up the segment of the internal gear that corresponds to the first curved pinion segment **1216***a* (of FIGS. **12**, for example).

[0169] Similarly, the interior angle between the rack first face **1240***a* of the first curved rack segment **1218***a* of FIG. **12** and the first boss surface **1210***a* effectively determines a surface area of the collection of five teeth that make up the first curved rack segment **1218***a* of FIG. **12**, for example. Finally, the interior angle between the rack first face **1240***b* of the second curved rack segment **1218***b* of FIG. **12** and the second boss surface **1210***b* effectively determines a surface area of the collection of five teeth that make up the second curved rack segment **1218***b* of FIG. **12**, for example.

[0170] Returning to FIG. **12** and considering the pinion first face **1241***b* of the second curved pinion segment **1216***b* and its opposing rack first face **1240***b* of the second curved rack segment **1218***b*, it may be observed that decreasing the angle (α) (of FIG. **14**) of the pinion first face **1241***b* and the rack first face **1240***b*, increases the surface area of the opposing faces. The greater the surface area, the greater the resistance to sliding forces (when the opposing faces are pressed against each other). Thus, it would appear that the smaller the angle (e.g., the interior angle (α) of FIG. **14**), the better the resistance to an unwanted slipping (e.g., a slipping of an interchangeable toolhead **1204**, mated to and fixed relative to the boss **1206**, from one angular setting relative to the tool handle **1202** to a next angular setting relative to the tool handle **1202**). In other words, it may appear that the smaller the angle (e.g., the interior angle (α) of FIG. **14**) the better the resistance of the tool to at least a slipping type of failure.

[0171] However, according to the aspects and examples described herein, a use of an angle (interior angle (α) associated with the second flange **1219***b* as shown in FIG. **14** and the interior angle (α) associated with the first flange **1219***a* in FIG. **21**) that is greater than an angle that maximizes the surface area between opposing faces of the rack and pinion features may provide optimal manufacturability and optimal performance of the tool **1200** of FIG. **12**, for example. Accordingly, as shown and described in connection with FIGS. **13-15**, an interior angle (α) relative to a horizontal axis or plane (e.g., the X-Y plane of FIGS. **13-15**, the rack first plane **2001** and the rack second plane **2002** of FIG. **20**, the flange first plane **2101** and the flange second plane **2102** of FIG. **21**) may be between about 78 and 42 degrees, or more particularly between about 65 and 47 degrees, or more particularly between about 60 and 52 degrees. In one example, the interior angle (α) may be about 56 or 56.2 degrees.

[0172] FIG. **16** is a top plan view of the fixing member **1214** as shown and described in connection with FIG. **12** according to some aspects of the disclosure.

[0173] FIG. **17** is a cross section of FIG. **16** taken in the plane **17-17** according to some aspects of the disclosure.
[0174] FIG. **18** is a top plan view of the first flange **1219***a* as shown and described in connection with FIG. **12**, except the first flange bore **1221** is presented with a circular perimeter instead of a square perimeter for ease of illustration, according to some aspects of the disclosure.
[0175] FIG. **19** is a cross section of FIG. **18** taken in the plane **19-19** according to some aspects of the disclosure.
[0176] Aspect of FIGS. **16**, **17**, **18**, and **19** are similar to those as shown and described in connection with FIGS. **6**A, **6**B, and **6**C. The concepts of FIGS. **6**A, **6**B, and **6**C are equally applicable to FIGS. **16**, **17**, **18**, and **19** and will not be repeated for the sake of brevity.
[0177] According to some aspects, the first flange **1219***a* as shown in FIGS. **18** and **19** may be longitudinally translated along the longitudinal axis **1908** relative to the boss **1206** to slidingly engage the boss **1206** of the fixing member **1214** between the first flange **1219***a* and the second flange (not shown in FIG. **16**, **17**, **18**, or **19**). The first flange **1219***a* may include a first flange bore **1221** and a first curved pinion segment **1216***a*. The second flange **1219***b* (not shown) may include the second flange bore **1223** and a second curved pinion segment **1216***b*.
[0178] In the example of FIG. **18**, the first curved pinion segment **1216***a* may include a plurality of first teeth. The first flange bore **1221** and the first curved pinion segment **1216***a* may have a flange bore center **1842**. The second flange bore **1223** and its corresponding second curved pinion segment **1216***b* may have a common second center (not shown). A flange bore center axis **1232** (sometimes referred to as a flange bore center axis) may intersect the flange bore center **1842** (a first center) and a second center (not shown).
[0179] The boss **1206** may have a boss bore **1213** defined by a boss internal sidewall **1215** of the boss **1206**. A boss bore center axis **1212** may intersect a boss bore center **1648** and may be perpendicular to the parallel pair of boss surfaces **1210***a*, **1210***b* (**1210***b* hidden from view). Each of the parallel pair of boss surfaces **1210***a*, **1210***b* may have a respective curved rack segment **1218***a*, **1218***b* (**1218***b* hidden from view) extending perpendicularly from the respective one of the parallel pair of boss surfaces **1210***a*, **1210***b*.
[0180] In FIG. **16**, a plurality of second teeth of the first curved rack segment **1218***a* are labeled with the letters B, C, and D. In FIG. **18**, the plurality of first teeth of the first curved pinion segment **1216***a* are numbered from 1 to 8. The outer surfaces of the boss **1206** may taper down to the first boss surface **1210***a*. The taper may prevent interference between any of the plurality of first teeth of the first curved pinion segment **1216***a* with any of the plurality of second teeth of the first curved rack segment **1218***a*. As can be seen from the illustration, particularly in the locations identified with dashed lines **1667** and **1669**, if the first curved rack segment **1218***a* had full height of the outer surface **1254** of the boss **1206** throughout the second arc length **1674** available to the plurality of second teeth of the first curved rack segment **1218***a*, then the outermost teeth (e.g., in positions counter-clockwise from B and clockwise from D), which are partially eliminated in FIG. **16** to reflect an aspect of the disclosure, would interfere with teeth 3 and 6 of the first curved pinion segment **1216***a*. The interference would prevent the flange surface **1225***a*, of the first curved pinion segment **1216***a*, from completely translating along the first boss surface **1210***a* in a direction of the longitudinal axis **1908** because at least a portion of the first curved pinion segment **1216***a* (e.g., a subset of the plurality of first teeth, labeled **3**, **4**, **5**, and **6**, of the first curved pinion segment **1216***a*) would be unable to mesh with the at least a portion of the first curved rack segment **1218***a* proximal to the at least a subset of the plurality of second teeth, labeled B, C, D, of the first curved rack segment **1218***a*. In this circumstance, due to the interference, coaxial alignment of the boss bore center axis **1212** with the flange bore center axis **1232** would be prevented and the fixing shaft (not shown) would be unable to be received within the at least one flange bore (e.g., the first flange bore **1221***a* or the second flange bore **1223**) and the boss bore **1213**. Accordingly, those teeth, outside of the width **1670** between dashed lines **1667** and **1669**, may be reduced in height (and/or

width) to prevent interference such as that described above. The reduction may be accomplished as a step function (e.g., abrupt incremental reductions) or as a tapered function (e.g., gradual, and continuous reductions).

[0181] FIG. **20** is a cross section of a tooth of the first curved rack segment **1218***a* of the boss **1206** of FIGS. **12** and **16** taken in a plane looking away from the plane **17-17** in FIG. **16** (i.e., looking along a negative Y axis at the X-Z plane).

[0182] FIG. **21** is a cross section of trough between teeth 4 and 5 of the first curved pinion segment **1216***a* of the first flange **1219***a* of FIGS. **12** and **18** taken in the plane looking away from the plane **19-19** in FIG. **18** (i.e., looking along a negative Y axis at the X-Z plane).

[0183] With reference to FIGS. **12**, **16**, and **18**, a tool may include a handle having a first handle end spaced apart from a second handle end. The tool may also include the fixing member **1214** integrally formed with the first handle end. The fixing member **1214** may include the boss **1206** projecting along a longitudinal axis (**508** of FIG. **5**, **608** of FIG. **6**, **1208** of FIG. **12**, **1908** of FIG. **19**) relative to the first handle end, the boss **1206** having the first boss surface **1210***a* and the second boss surface **1210***b* spaced apart from and parallel to the first boss surface **1210***a* by a predetermined distance (**644** of FIG. **6***a*, **1244** of FIG. **12**), a boss bore **1213** defined by a boss internal sidewall **1215**, and a boss bore center axis **1212** (perpendicular to the first boss surface **1210***a* and the second boss surface **1210***b*), each respective boss surface having the first curved rack segment **1218***a* (e.g., in FIGS. **12** and **16**) having a first plurality of teeth (e.g., teeth labeled B, C, D in FIG. **16**) projecting therefrom toward and partially surrounding the boss bore center axis **1212**, the first plurality of teeth forming the first compound surface **1701** of FIG. **17** and FIG. **20** spanning the first plurality of teeth. The tool may also include a toolhead. The toolhead may include a tool member (**1203** of FIG. **12**) and the pair of flanges **1219***a*, **1219***b* respectively fixed to and extending from the tool member and having opposing parallel flange surfaces **1225***a*, **1225***b* fixedly spaced apart by the predetermined distance **1244**. Each respective flange may have a flange bore **1221**, **1223** defined by a flange internal sidewall **1222**, **1224**, respectively, and a flange bore center axis **1232**. The flange bore center axis **1232** may be perpendicular to the opposing parallel flange surfaces **1225***a*, **1225***b*. Each respective one of the pair of flanges **1219***a*, **1219***b* having a respective curved pinion segment **1216***a*, **1216***b* having a respective second plurality of teeth (e.g., teeth labeled **1-8** in FIG. **18**) projecting therefrom away from and partially surrounding the flange bore center axis **1232**. The second plurality of teeth forming a second compound surface (**1901** of FIGS. **19** and **21**) spanning the second plurality of teeth. The pair of flanges **1219***a*, **1219***b* configured to slidingly receive the boss **1206** therebetween and engage fewer than all of the second plurality of teeth with the first plurality of teeth.

[0184] The tool may also include a fixing shaft (e.g., fixing shaft **731**) insertably received in at least one flange bore (e.g., the first flange bore **1221** or the second flange bore **1223**) and the boss bore **1213** and configured to maintain a coaxial alignment of the flange bore center axis **1232** and the boss bore center axis **1212**. Once the fixing shaft is insertably received in the at least one flange bore, the fixing shaft is also configured to maintain the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.

[0185] With reference to FIG. **20**, the first compound surface **1701** may include the rack first face **1240***a* extending from the first boss surface **1210***a* and away from the boss bore center axis **1212** and forming a rack interior angle (α-rack) relative to a rack first plane **2001** coincident with the first boss surface **1210***a*. As known to persons having skill in the art, interior angles are those angles that lie in an area enclosed between two parallel lines that are intersected by a transversal. In the example of FIG. **20**, there are two identical rack interior angles (a). A first lies in the area enclosed between the parallel lines formed by the rack first plane **2001** and the rack second plane **2002** and the transverse line **2004**. The second lies in the area enclosed between the parallel lines formed by the rack second plane **2002** and the rack third plane **2003** and the transverse line **2004**.

[0186] The rack first face **1240***a* extends from the rack first plane **2001** to the rack second plane

2002, parallel with and spaced apart from the rack first plane **2001**. The rack first face **1240***a* lies on the imaginary transverse line **2004**. The first compound surface **1701** may also include a rack second face **1242***a* extending from the rack first face **1240***a* and the rack second plane **2002** toward the rack third plane **2003**, parallel with and spaced apart from the rack second plane **2002**.
[0187] By way of example, for purposes of user safety or manufacturing tolerances, the rack second face **1242***a* may not lie on the transverse line **2004**. That is, the rack second face **1242***a* may not be a straight extension of the rack first face **1240***a* along the transverse line **2004**. When utilizing a compound surface (e.g., first compound surface **1701**), because the rack second face **1242***a* may not lie on the transverse line **2004**, the rack second face angle may not be equal to the rack interior angle (α). Instead, the rack second face **1242***a* may form a rack second face angle (B) relative to the rack second plane **2002** that is greater than the rack interior angle (α-rack) and less than or equal to 90 degrees (e.g., 90 degree reference line **2005**).
[0188] With reference to FIG. **21**, the second compound surface **1901** may include a pinion first face **1241***a* extending from a flange surface **1225***a* of the opposing parallel flange surfaces **1225***a*, **1225***b* and away from the flange bore center axis **1232** and may form a flange interior angle (α-flange) relative to a flange first plane **2101** coincident with the flange surface **1225***a*. An explanation of interior angles will not be repeated for the sake of brevity.
[0189] The pinion first face **1241***a* may extend from the flange first plane **2101** to a flange second plane **2102**, parallel with and spaced apart from the flange first plane **2101**. The second compound surface **1901** may include a pinion second face **1243***a* extending from the pinion first face **1241***a* and the flange second plane **2102** toward a third plane **2103**, parallel with and spaced apart from the flange second plane **2102**.
[0190] Similar to the rack second face **1242***a*, the pinion second face may not be a straight extension of the pinion first face **1241***a* along the transverse line **2104**. Also, by way of example, the pinion second face **1243***a* may not lie on the transverse line **2104** for purposes of user safety (e.g., to blunt an otherwise sharp edge that could form at the juncture of the pinion second face **1243***a* and the third plane **2103**) or manufacturing tolerances. That is, the pinion second face **1243***a* may not be a straight extension of the pinion first face **1241***a* along the transverse line **2104**. Because the pinion second face **1243***a* may not lie on the transverse line **2104**, the pinion second face **1243***a* may form a pinion second face angle (γ) relative to the flange second plane **2102** that, according to some aspects, may be greater than or equal to the rack second face angle (β). However, according to some aspects, the pinion second face angle (γ) may be less than or equal to the rack second face angle (β). In a case where the pinion second face angle (γ) is less than the rack second face angle (β), interference may occur between the pinion second face **1243***a* and the rack second face **1242***a*. However, the interference may provide a benefit, such as a haptic type of feedback given to a user once the user mates the second compound surface **1901** against the first compound surface **1701** and establishes the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.
[0191] According to some aspects, the rack interior angle (α-rack) and the flange interior angle (α-flange) may each be between about 78 and 42 degrees, or more particularly between about 65 and 47 degrees, or more particularly between about 60 and 52 degrees.
[0192] In one example, the rack interior angle (α-rack) and the flange interior angle (α-flange) may be equal. For example, α-rack=α-flange=about 56° (for ease of reference, under the condition where α-rack=α-flange, the rack interior angle (α-rack) and the flange interior angle (α-flange) will be collectively referred to as the "interior angle (α)"). According to the example in which α-rack=α-flange=interior angle (α) and in which interference between the rack second face **1242***a* and the pinion second face **1243***a* is not desired, referring to FIG. **20**, the rack second face angle (β) may be greater than the interior angle (α) (e.g., greater than) 56° and less than or equal to 90° (e.g., 90 degree reference line **2005**). That is, for interior angle (α)=56°: interior angle (α)<rack second face angle (β)≤90°. Using the same example, with reference to FIG. **21**, according to an aspect in which

the rack second face **1242***a* again avoids interference with the pinion second face **1243***a*, the pinion second face angle (γ) may be greater than or equal to the rack second face angle (β). That is, the pinion second face angle (γ)≥rack second face angle (β).
[0193] However, as described above, according to some aspects, the rack second face **1242***a* may interfere with the pinion second face **1243***a*; accordingly, the disclosure supports the case where the pinion second face angle (γ)<rack second face angle (β), as well as the case where the pinion second face angle (γ)≤rack second face angle (β).
[0194] Still further, the disclosure supports cases in which the rack first face **1240***a* lies parallel to the pinion first face **1241***a* (i.e., rack interior angle (α-rack)=flange interior angle (α-flange)), cases in which the rack first face **1240***a* avoids interference with the pinion first face **1241***a* (i.e., rack interior angle (α-rack)<flange interior angle (α-flange)), and cases in which the rack first face **1240***a* interferes with the pinion first face **1241***a* (i.e., rack interior angle (α-rack)>flange interior angle (α-flange)). Therefore, according to some aspects, the rack interior angle (α-rack) may be less than or equal to the flange interior angle (α-flange), and according to some aspects, the rack interior angle (α-rack) may be greater than or equal to the flange interior angle (α-flange).
[0195] As with cases where the rack second face **1242***a* interferes with the pinion second face **1243***a*, there may be aspects in which it may be desirable to have interference between the rack first face **1240***a* and the pinion first face **1241***a*. For example, the interference may provide a benefit, such as a haptic type of feedback given to a user once the user mates the second compound surface **1901** against the first compound surface **1701** and establishes the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth. In some examples, interference may resist a tightening of the fixing shaft, as the user sandwiches the boss **1206** (FIG. **12**) between the first flange **1219***a* and the second flange **1219***b* (FIG. **12**). According to some examples, the interference may provide a force to the fixing shaft that may be similar to a force applied to the fixing shaft by a split lock washer (e.g., a force that tends to prevent a counter-rotation (unscrewing) of the fixing shaft). The preceding examples are illustrative and not limiting.
[0196] According to some aspects, with reference to FIG. **20**, a ratio of: a first distance between the rack first plane **2001** and the rack second plane **2002**; and a second distance between the rack second plane **2002** and the rack third plane **2003** may be between about 2:1 and 2.5:1. However, this range of ratios is exemplary and non-limiting; other ratios are within the scope of the disclosure. In the preceding determinations of the first distance and the second distance, both distances may be measured perpendicularly to the first boss surface **1210***a*. In other words, referring to FIG. **20** and the Z-axis for reference, the distance between the rack first plane **2001** and the rack second plane **2002**, and the distance between the rack second plane **2002** and the rack third plane **2003** may vary. Similarly, referring to FIG. **21** and the Z-axis for reference, the distance between the flange first plane **2101** and the flange second plane **2102**, and the distance between the flange second plane **2102** and the flange third plane **2003** may vary. Furthermore, the distance between the rack first plane **2001** and the rack second plane **2002**, and the distance between the flange first plane **2101** and the flange second plane **2102** may or may not be equal. Furthermore, the distance between the rack second plane **2002** and the rack third plane **2002**, and the distance between the flange second plane **2102** and the flange third plane **2103** may or may not be equal.
[0197] According to some aspects, with reference to FIG. **21**, as the first flange **1219***a* is associated with the curved rack segment of FIG. **20**, a ratio of a first distance between the flange first plane **2101** and the flange second plane **2102** and a second distance between the flange second plane **2102** and the flange third plane **2103**, both the first distance and the second distance measured perpendicularly to the flange surface **1225***a* (of the pair of opposing parallel flange surfaces **1225***a*, **1225***b*), may be between about 2:1 and 2.5:1.
[0198] According to some aspects, the first curved pinion segment **1216***a* may have a first arc length **1672** (FIG. **16**) and the first curved rack segment **1218***a* may have a second arc length **1674** (FIG. **16**), and the first arc length **1672** may be greater than the second arc length **1674**.

[0199] In some examples, the first curved rack segment **1218***a* outside of the second arc length **1674** (FIG. **16**) (e.g., the portions to the left of the dashed line **1667** and to the right of the dashed line **1669**) may be free of any portion of the first plurality of teeth of the first curved rack segment **1218***a* that would prevent engagement of any of the fewer than all of the second plurality of teeth with the first plurality of teeth.
[0200] According to some aspects, the fixing shaft that may be insertably received in the first flange bore **1221** and the boss bore **1213** may be further configured to prevent a translation along the longitudinal axis **1908** (FIG. **19**) of the boss **1206** relative to the pair of flanges **1219***a*, **1219***b*.
[0201] According to some aspects, the fixing shaft that may be insertably received in the first flange bore **1221** and the boss bore **1213** may be configured to maintain a meshed engagement of the first plurality of teeth of the first curved rack segment **1218***a* and the fewer than all of the second plurality of teeth of the first curved pinion segment **1216***a*.
[0202] According to some aspects, the fixing shaft may be insertably received in the first flange bore **1221** and the boss bore **1213** following coaxial alignment of the flange bore center axis **1232** and the boss bore center axis **1212** and following a meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.
[0203] Similar to the examples of FIGS. **9**A-**9**D, according to some aspects, the tool handle **1202** of FIG. **12** may be subdivided into at least three serially coupled handle segments including: a first segment having a first length and the first integrally formed fixing member at the first handle end spaced apart from a first intermediate handle end, a second segment having a second length and the second integrally formed fixing member at the second handle end spaced apart from a second intermediate handle end, and a center segment having a center length coupled between the first intermediate handle end of the first segment and the second intermediate handle end of the second segment at respective ends of the center segment, where a first angle, between the center segment and the first segment is a first acute angle and a second angle, between the center segment and the second segment is a second acute angle, and the first acute angle and the second acute angle result in the first segment and the second segment being angled toward one side of the center segment.
[0204] In some examples, the first segment having the first integrally formed fixing member, the second segment having the first integrally formed fixing member, and the center segment are integrally formed as one piece. In some examples, the first acute angle may be equal to the second acute angle.
[0205] FIGS. **22**A, **22**B, and **22**C are illustrative examples of a fourth interchangeable toolhead **2202**, a fifth interchangeable toolhead **2204**, and a sixth interchangeable toolhead **2206**. Each interchangeable toolhead **2202**, **2204**, **2206** may include a tool member **2203**, **2205**, **2207**. The illustrative examples of FIGS. **22**A, **22**B, and **22**C are exemplary and non-limiting. The curved pinion segments of FIGS. **22**A, **22***b*, and **22**C are as shown and described in connection with FIG. **12**. Those curved pinion segments are configured to mesh with curved rack segments as shown and described in connection with FIG. **12**. The names and functions of the fourth interchangeable toolhead **2202**, the fifth interchangeable toolhead **2204**, and the sixth interchangeable toolhead **2206** are similar to the first interchangeable toolhead **1002**, the second interchangeable toolhead **1004**, and the third interchangeable toolhead **1006** as shown and described in connection with FIGS. **10**A, **10**B, **10**C. The descriptions will not be repeated for the sake of brevity.
[0206] Similar to the garden implement set **1100** as shown and describe in connection with FIG. **11**, the tool **1200** of FIG. **12** may be offered for sale, for example, as plurality of articles of manufacture packaged as a tool set. The tool set may include a handle having a first integrally formed fixing member at a first handle end and an identical second integrally formed fixing member at a second handle end, distal from the first handle end. Each of the first integrally formed fixing member and the second integrally formed fixing member may include a boss projecting along a longitudinal axis relative to the first handle end, the boss having a first boss surface and a parallel second boss surface spaced apart from the first boss surface by a predetermined distance, a

boss bore defined by a boss internal sidewall, and a boss bore center axis (perpendicular to the first boss surface and the second boss surface), each respective boss surface having a curved rack segment having a first plurality of teeth projecting therefrom toward and partially surrounding the boss bore center axis, the first plurality of teeth forming a first compound surface spanning the first plurality of teeth.

[0207] The plurality of articles of manufacture may include one or more toolheads. Each toolhead may include a tool member, and a pair of flanges respectively fixed to and extending from the tool member and having opposing parallel flange surfaces fixedly spaced apart by the predetermined distance. Each respective flange may have a flange bore defined by a flange internal sidewall and a flange center axis perpendicular to the opposing parallel flange surfaces, each respective flange having a curved pinion segment having a respective second plurality of teeth projecting therefrom away from and partially surrounding the flange bore center axis, the second plurality of teeth forming a second compound surface spanning the second plurality of teeth, the pair of flanges configured to receive the boss therebetween and slidingly and engage fewer than all of the second plurality of teeth with the first plurality of teeth.

[0208] The plurality of articles of manufacture may include one or more fixing shafts, each fixing shaft may be configured to be insertably received in at least one flange bore and the boss bore and configured to maintain a coaxial alignment of the flange bore center axis and the boss bore center axis while the fewer than all of the second plurality of teeth are engaged with the first plurality of teeth. In other words, the fixing shaft may be configured to maintain the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.

[0209] In some examples, the first compound surface **1701** of the curved rack segment may include the rack first face **1240***a* extending from the first boss surface **1210***a* and away from the boss bore center axis **1212** and forming an interior angle (α) relative to a rack first plane **2001** coincident with the first boss surface **1210***a*, the rack first face **1240***a* extending from the rack first plane **2001** to a rack second plane **2002**, parallel with and spaced apart from the rack first plane **2001**, and a rack second face **1242***a* extending from the rack first face **1240***a* and the rack second plane **2002** toward a rack third plane **2003** parallel with and spaced apart from the rack second plane **2002**, the rack second face **1242***a* forming a rack second face angle (β) relative to the rack second plane **2002** that is greater than the interior angle (α) and less than or equal to 90 degrees (e.g., 90 degree reference line **2005**).

[0210] In some examples, the second compound surface of the curved pinion segment may include a pinion first face **1241***a* extending from a flange surface **1225***a* of the opposing parallel flange surfaces and away from the flange bore center axis **1232** and forming an interior angle (α) relative to a flange first plane **2101** coincident with the flange surface **1225***a*, the pinion first face **1241***a* extending from the flange first plane **2101** to a flange second plane **2102**, parallel with and spaced apart from the flange first plane **2101**, and a pinion second face **1243***a* extending from the pinion first face **1241***a* and the flange second plane **2102** toward a flange third plane **2103** parallel with and spaced apart from the flange second plane **2102**, the pinion second face **1243***a* forming the pinion second face angle (γ) relative to the flange second plane **2102** that is greater than or equal to the rack second face angle (β).

[0211] In some examples, the interior angle may be between about 78 and 42 degrees, or more particularly between about 65 and 47 degrees, or more particularly between about 60 and 52 degrees. In some examples, the interior angle may be about 56 degrees.

[0212] According to some examples, a ratio of a first distance between the rack first plane and the rack second plane and a second distance between the rack second plane and the rack third plane, both the first distance and the second distance measured perpendicularly to the boss surface is between about 2:1 and 2.5:1.

[0213] According to some aspects, the handle of the plurality of articles of manufacture packaged as the tool set may be subdivided into at least three serially coupled handle segments including: a

first segment having a first length and the first handle end integrally formed with the fixing member and the second handle end, a second segment having a second length and a third handle end spaced apart from a fourth handle end integrally formed with the fourth handle end, and a center segment having a center length coupled between the second handle end of the first segment and the third handle end of the second segment at respective ends of the center segment. According to some aspects, a first angle, between the center segment and the first segment is a first acute angle and a second angle, between the center segment and the second segment is a second acute angle, and the first acute angle and the second acute angle result in the first segment and the second segment being angled toward one side of the center segment. According to some aspects, the first acute angle may be equal to the second acute angle.

[0214] In some examples, the fixing member of the plurality of articles of manufacture packaged as the tool set may be referred to as a first fixing member, and the first segment, the first fixing member, the center segment, the second segment, and the second fixing member are integrally formed as one piece.

[0215] FIG. **23** is an illustrative example of a fixing member assembly **2300** at an end of a tool handle **2302** according to some aspects of the disclosure. The fixing member assembly **2300** may include a first fixing member plate **2314***a* and a second fixing member plate **2314***b*. A boss **2306** may be sandwiched between the first fixing member plate **2314***a* and the second fixing member plate **2314***b*. The tool handle **2302** may be similar to the tool handle **1202** as shown and described in connection with FIG. **12**. However, according to some aspects, the scope of the disclosure may include any handle/shaft-like feature as the tool handle **1202** of FIG. **12** or the tool handle **2302** of FIG. **23**.

[0216] Each of the first fixing member plate **2314***a* and the second fixing member plate **2314***b* includes a boss bore **2313** (similar to the boss bore **1213** as shown and described in connection with FIG. **12**) defined by the boss internal sidewall **2315** (similar to the boss internal sidewall **1215** as shown and described in connection with FIG. **12**). In the examples of the first fixing member plate **2314***a* and the second fixing member plate **2314***b*, each boss bore **2313** extends through a first protrusion **2304** extending from a surface parallel to and spaced apart from the first boss surface **2310***a* and the second boss surface **2310***b* (similar to the first boss surface **1210***a* and the second boss surface **1210***b* as shown and described in connection with FIG. **12**). At least one second protrusion **2308** may extend from the surface parallel to and spaced apart from the first boss surface **2310***a* and the second boss surface **2310***b*. According to some aspects, the first protrusion **2304** and/or, if present, the at least one second protrusion **2308** may be received in corresponding recesses (not shown to avoid cluttering the drawings) in the boss **2306** projecting along a longitudinal axis (parallel to the X-axis) relative to the tool handle **2302**. According to some examples, the first protrusion **2304** and/or, if present, the at least one second protrusion **2308** may be received in an interference fit within their corresponding recesses in the boss **2306**.

[0217] Each of the first fixing member plate **2314***a* and the second fixing member plate **2314***b* includes a curved rack segment **2318***a*, **2318***b*. This pair of curved rack segments may be similar to the pair of curved rack segments **118***a*, **118***b* of FIG. **1**, **618***a*, **618***b* of FIG. **6**, and **1218***a*, **1218***b* as shown and described in connection with FIGS. **1**, **6**, and **12**.

[0218] Use of the fixing member assembly **2300** at the end of the tool handle **2302** may provide an opportunity to utilize a first type of material for the handle **2302** (or the boss **2306** at an end of the handle **2302**) and utilize a second type of material for each of the first fixing member plate **2314***a* and the second fixing member plate **2314***b*. The second type of material may be, for example, harder than the first type of material. The second type of material may, for example, have greater hardness, strength, durability, and/or resistance to deformation in comparison to the first type of material. Utilizing the second type of material for one or both of the first fixing member plate **2314***a* and the second fixing member plate **2314***b* may permit greater torque to be applied to an interface between the fixing member assembly **2300** and any one of a plurality of interchangeable

toolheads, such as but not limited to the illustrative examples of the fourth interchangeable toolhead **2202**, the fifth interchangeable toolhead **2204**, and the sixth interchangeable toolhead **2206** as shown and described in connection with FIGS. **22**A, **22**B, and **22**C, respectively. By way of example and not limitation, the first type of material may be wood, fiberglass, aluminum, or a first quality of steel (any of which may be in solid or hollow tubular forms) and the second type of material may be a higher quality of steel or a high-quality steel alloy (e.g., chromium-vanadium steel or chromium-molybdenum steel).

[0219] One or more of the components, features, and/or functions illustrated in FIGS. **1**-**23** may be rearranged and/or combined into a single component, feature or function or embodied in several components, features, or functions. Additional elements, components, and/or features may also be added without departing from the disclosure.

[0220] The word “exemplary” is used herein to mean “serving as an example, instance, or illustration.” Any implementation or aspect described herein as “exemplary” is not necessarily to be construed as preferred or advantageous over other implementations or aspects described herein.

[0221] Likewise, the term “aspects” does not require that all aspects of the disclosure include the discussed feature, advantage, or mode of operation.

[0222] The term “coupled” is used herein to refer to the direct or indirect coupling between two objects. For example, if object A physically touches object B, and object B touches object C, then objects A and C may still be considered coupled to one another—even if they do not directly physically touch each other.

[0223] The construct of “at least one of A or B” is intended to cover A, B, and A and B. The construct of “A and/or B” is likewise intended to cover A, B, and A and B.

[0224] While the foregoing disclosure shows illustrative embodiments, it should be noted that various changes and modifications could be made herein without departing from the scope of the disclosure as defined by the appended claims. The functions, steps and/or actions described herein or represented in any method claims in accordance with the embodiments described herein need not be performed in any particular order. Furthermore, although elements of embodiments may be described or claimed in the singular, the plural is contemplated unless limitation to the singular is explicitly stated.

[0225] The previous description of the disclosed aspects is provided to enable any person skilled in the art to make or use those aspects as presented above and in the claims that follow. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects without departing from the spirit or scope of the invention. Thus, the present disclosure is not intended to be limited to the aspects shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

[0226] Although the present disclosure and its advantages have been described in detail, it should be understood that various changes, substitutions, and alterations can be made herein without departing from the spirit and scope of the disclosure as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present disclosure, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present disclosure. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

Claims

1. A tool, comprising: a handle having a first handle end spaced apart from a second handle end; a fixing member integrally formed with the first handle end, the fixing member comprising: a boss projecting along a longitudinal axis relative to the first handle end, the boss having a first boss surface and a second boss surface spaced apart from and parallel to the first boss surface by a predetermined distance, a boss bore defined by a boss internal sidewall, and a boss bore center axis, each respective boss surface having a curved rack segment having a first plurality of teeth projecting therefrom toward and partially surrounding the boss bore center axis, the first plurality of teeth forming a first compound surface spanning the first plurality of teeth; a toolhead comprising: a tool member, and a pair of flanges respectively fixed to and extending from the tool member and having opposing parallel flange surfaces fixedly spaced apart by the predetermined distance, each respective flange having a flange bore defined by a flange internal sidewall and a flange bore center axis, each respective flange having a curved pinion segment having a respective second plurality of teeth projecting therefrom away from and partially surrounding the flange bore center axis, the second plurality of teeth forming a second compound surface spanning the second plurality of teeth, the pair of flanges configured to slidingly receive the boss therebetween and enter into a meshed engagement between fewer than all of the second plurality of teeth and the first plurality of teeth; and a fixing shaft configured to be insertably received in at least one flange bore and the boss bore and configured to maintain a coaxial alignment of the flange bore center axis and the boss bore center axis.

2. The tool of claim 1, wherein the first compound surface comprises: a rack first face extending from the first boss surface and away from the boss bore center axis and forming a rack interior angle (α-rack) relative to a rack first plane coincident with the first boss surface, the rack first face extending from the rack first plane to a rack second plane, parallel with and spaced apart from the rack first plane; and a rack second face extending from the rack first face and the rack second plane toward a rack third plane parallel with and spaced apart from the rack second plane, the rack second face forming a rack second face angle (β) relative to the rack second plane.

3. The tool of claim 2, wherein the second compound surface comprises: a pinion first face extending from a flange surface of the opposing parallel flange surfaces and away from the flange bore center axis and forming a flange interior angle (α-flange) relative to a flange first plane coincident with the flange surface, the pinion first face extending from the flange first plane to a flange second plane, parallel with and spaced apart from the flange first plane; and a pinion second face extending from the pinion first face and the flange second plane toward a flange third plane parallel with and spaced apart from the flange second plane, the pinion second face forming a pinion second face angle (γ) relative to the flange second plane, wherein the rack interior angle (α-rack) is less than or equal to the flange interior angle (α-flange).

4. The tool of claim 2, wherein the rack interior angle (α-rack) is between about 78 and 42 degrees, or more particularly between about 65 and 47 degrees, or more particularly between about 60 and 52 degrees.

5. The tool of claim 2, wherein a ratio of a first distance between the rack first plane and the rack second plane and a second distance between the rack second plane and the rack third plane, both the first distance and the second distance measured perpendicularly to the boss surface is between about 2:1 and 2.5:1.

6. The tool of claim 1 wherein the curved pinion segment has a first arc length, and the curved rack segment has a second arc length, wherein the first arc length is greater than the second arc length.

7. The tool of claim 6 wherein the curved rack segment outside of the second arc length is free of any portion of the first plurality of teeth of the curved rack segment that would prevent the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of

teeth.
8. The tool of claim 1, wherein the fixing shaft insertably received in the flange bore and the boss bore is further configured to prevent a translation along the longitudinal axis of the boss relative to the pair of flanges.
9. The tool of claim 1, wherein the fixing shaft insertably received in the flange bore and the boss bore maintains the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.
10. The tool of claim 1, wherein the fixing shaft is insertably received in the flange bore and the boss bore following the coaxial alignment of the flange bore center axis and the boss bore center axis and following the meshed engagement between the fewer than all of the second plurality of teeth and the first plurality of teeth.
11. The tool of claim 1, wherein the handle is subdivided into at least three serially coupled handle segments including: a first segment having a first length and a first integrally formed fixing member at the first handle end spaced apart from a first intermediate handle end; a second segment having a second length and a second integrally formed fixing member at the second handle end spaced apart from a second intermediate handle end; and a center segment having a center length coupled between the first intermediate handle end of the first segment and the second intermediate handle end of the second segment at respective ends of the center segment, wherein a first angle, between the center segment and the first segment is a first acute angle and a second angle, between the center segment and the second segment is a second acute angle, and the first acute angle and the second acute angle result in the first segment and the second segment being angled toward one side of the center segment.
12. The tool of claim 11, wherein: the first acute angle is equal to the second acute angle.
13. The tool of claim 11, wherein: the first segment having the first integrally formed fixing member, the second segment having the first integrally formed fixing member, and the center segment are integrally formed as one piece.
14. A plurality of articles of manufacture packaged as a tool set, comprising: a handle having a first integrally formed fixing member at a first handle end and a second integrally formed fixing member at a second handle end, distal from the first handle end, each of the first integrally formed fixing member and the second integrally formed fixing member comprising: a boss projecting along a longitudinal axis relative to the first handle end, the boss having a first boss surface and a second boss surface spaced apart from and parallel to the first boss surface by a predetermined distance, a boss bore defined by a boss internal sidewall, and a boss bore center axis perpendicular to the first boss surface and the second boss surface, each respective boss surface having a curved rack segment having a first plurality of teeth projecting therefrom toward and partially surrounding the boss bore center axis, the first plurality of teeth forming a first compound surface spanning the first plurality of teeth; one or more toolheads, each toolhead comprising: a tool member, and a pair of flanges respectively fixed to and extending from the tool member and having opposing parallel flange surfaces fixedly spaced apart by the predetermined distance, each respective flange having a flange bore defined by a flange internal sidewall and a flange bore center axis, each respective flange having a curved pinion segment having a respective second plurality of teeth projecting therefrom away from and partially surrounding the flange bore center axis, the second plurality of teeth forming a second compound surface spanning the second plurality of teeth, the pair of flanges configured to slidingly receive the boss therebetween and enter into a meshed engagement between fewer than all of the second plurality of teeth and the first plurality of teeth; and one or more fixing shafts, each fixing shaft configured to be insertably received in at least one flange bore and the boss bore and configured to maintain a coaxial alignment of the flange bore center axis and the boss bore center axis.
15. The plurality of articles of manufacture packaged as the tool set of claim 14, wherein the first compound surface comprises: a rack first face extending from the first boss surface and away from

the boss bore center axis and forming a rack interior angle (α-rack) relative to a rack first plane coincident with the first boss surface, the rack first face extending from the rack first plane to a rack second plane, parallel with and spaced apart from the rack first plane; and a rack second face extending from the rack first face and the rack second plane toward a rack third plane parallel with and spaced apart from the rack second plane, the rack second face forming a rack second face angle (β) relative to the rack second plane.

16. The plurality of articles of manufacture packaged as the tool set of claim 15, wherein the second compound surface comprises: a pinion first face extending from a flange surface of the opposing parallel flange surfaces and away from the flange bore center axis and forming a flange interior angle (α-flange) relative to a flange first plane coincident with the flange surface, the pinion first face extending from the flange first plane to a flange second plane, parallel with and spaced apart from the flange first plane; and a pinion second face extending from the pinion first face and the flange second plane toward a flange third plane parallel with and spaced apart from the flange second plane, the pinion second face forming a pinion second face angle (γ) relative to the flange second plane, wherein the rack interior angle (α-rack) is less than or equal to the flange interior angle (α-flange).

17. The plurality of articles of manufacture packaged as the tool set of claim 15, wherein the rack interior angle (α-rack) is between about 78 and 42 degrees, or more particularly between about 65 and 47 degrees, or more particularly between about 60 and 52 degrees.

18. The plurality of articles of manufacture packaged as the tool set of claim 15, wherein a ratio of a first distance between the rack first plane and the rack second plane and a second distance between the rack second plane and the rack third plane, both the first distance and the second distance measured perpendicularly to the boss surface is between about 2:1 and 2.5:1.

19. The plurality of articles of manufacture packaged as the tool set of claim 14, wherein the handle is subdivided into at least three serially coupled handle segments including: a first segment having a first length and the first integrally formed fixing member at the first handle end spaced apart from a first intermediate handle end; a second segment having a second length and the second integrally formed fixing member at the second handle end spaced apart from a second intermediate handle end; and a center segment having a center length coupled between the first intermediate handle end of the first segment and the second intermediate handle end of the second segment at respective ends of the center segment, wherein a first angle, between the center segment and the first segment is a first acute angle and a second angle, between the center segment and the second segment is a second acute angle, and the first acute angle and the second acute angle result in the first segment and the second segment being angled toward one side of the center segment.

20. The plurality of articles of manufacture packaged as the tool set of claim 19, wherein: the first segment having the first integrally formed fixing member, the second segment having the first integrally formed fixing member, and the center segment are integrally formed as one piece.