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McCoy

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(54) **ADAPTABLE INTEGRATED WRENCH SYSTEM**

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(51) **Int. Cl.**

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B25G 1/04	(2006.01)
B25G 1/06	(2006.01)
B25B 23/00	(2006.01)

(52) **U.S. Cl.**

CPC ***B25G 1/043*** (2013.01); ***B25B 13/481*** (2013.01); ***B25B 23/0021*** (2013.01); ***B25G 1/063*** (2013.01)

(58) **Field of Classification Search**

CPC B25G 1/043; B25G 1/063; B25B 13/481; B25B 23/0035

See application file for complete search history.

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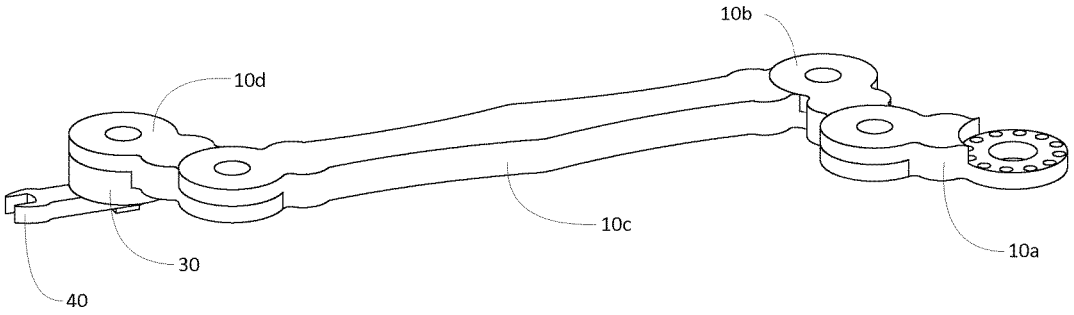
(57) **ABSTRACT**

An adaptable integrated wrench apparatus includes at least two segments that may be fixedly positioned at an angle relative to each other of within a range of 80 to 280 degrees to form an integrated torque-capable grasping component and at least one adapter to extend the integrated torque-capable grasping component and to receive an interchangeable wrench head.

19 Claims, 13 Drawing Sheets



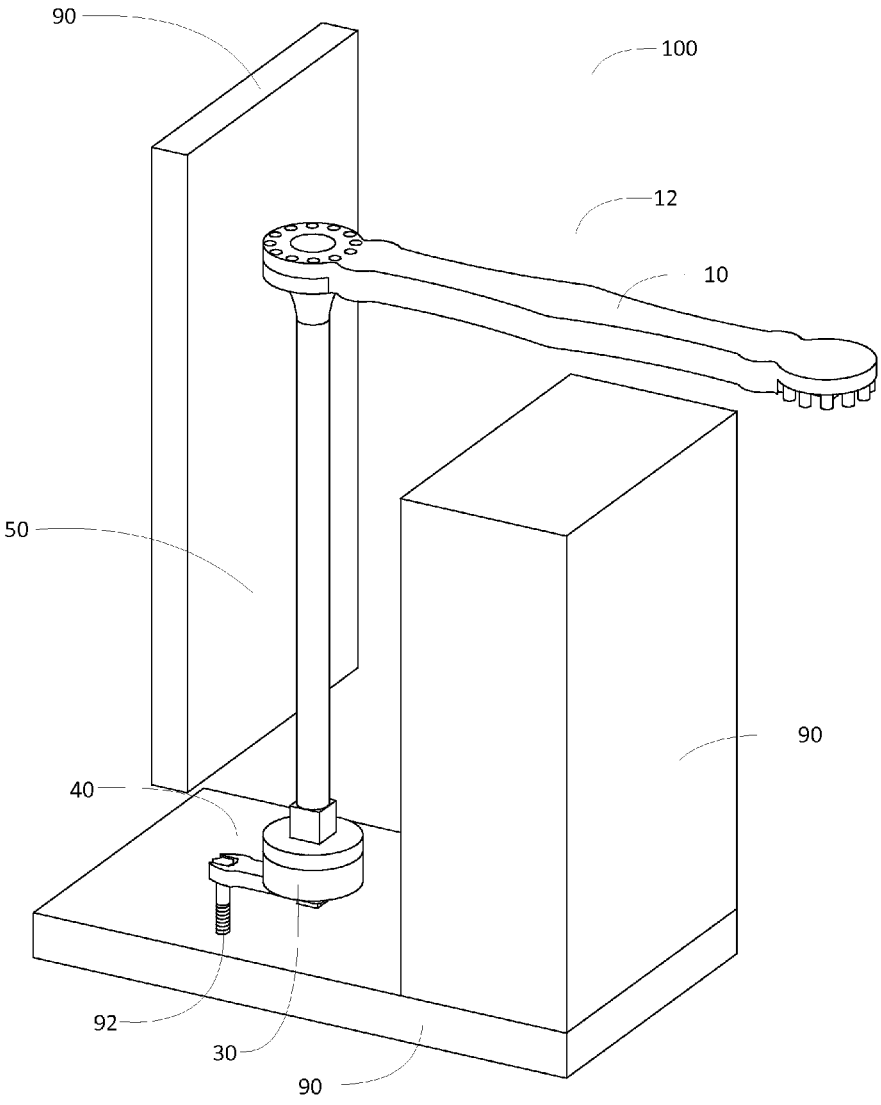


FIG. 1

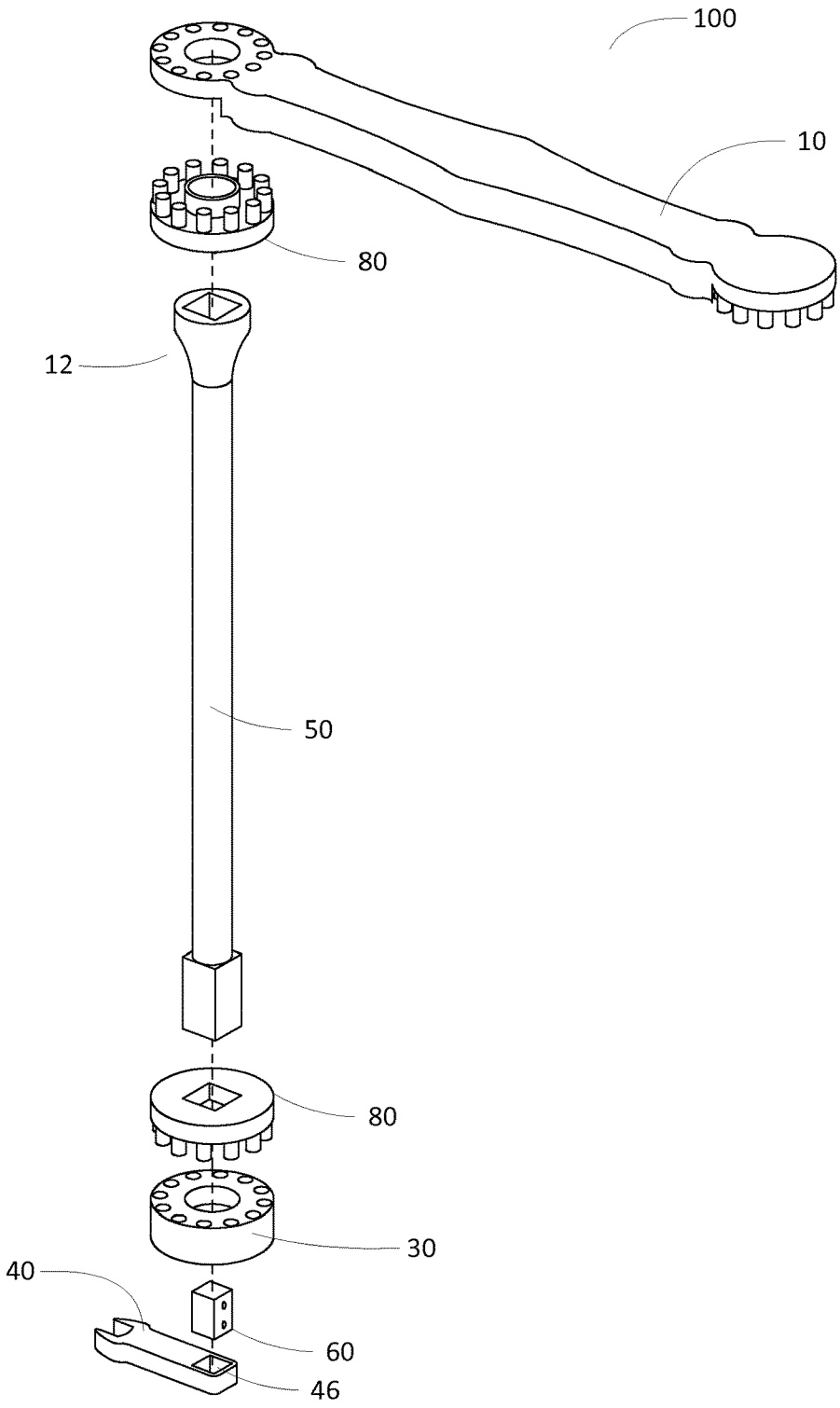


FIG. 2

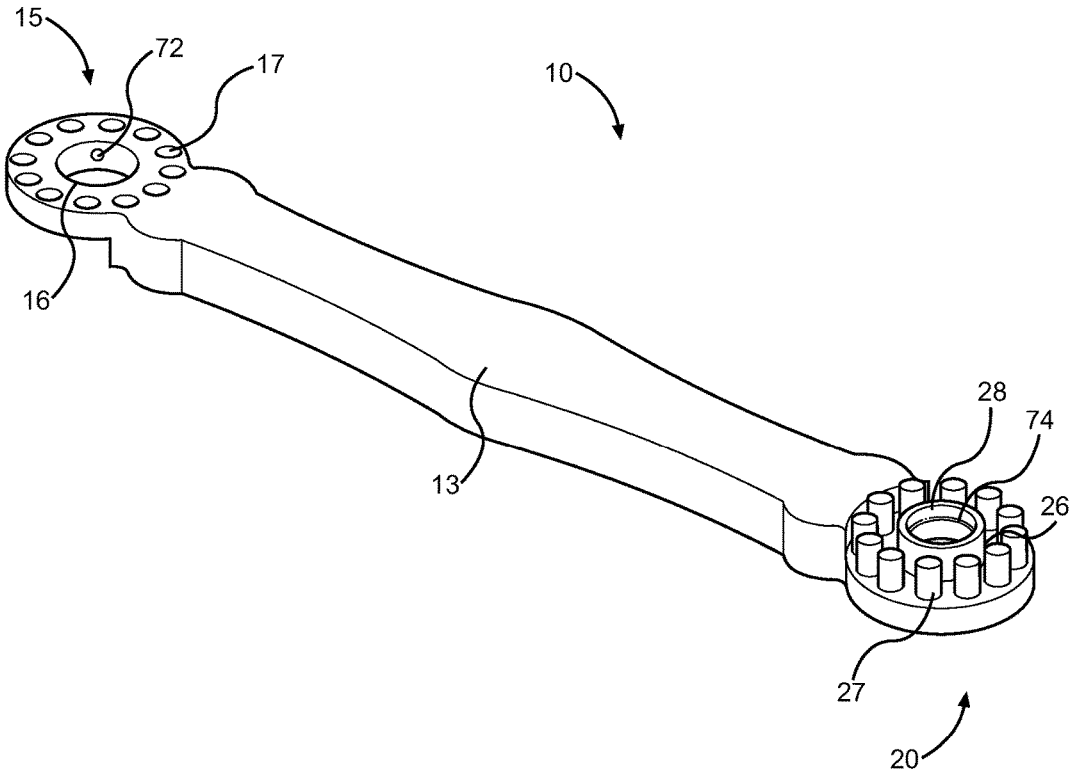


FIG. 3A

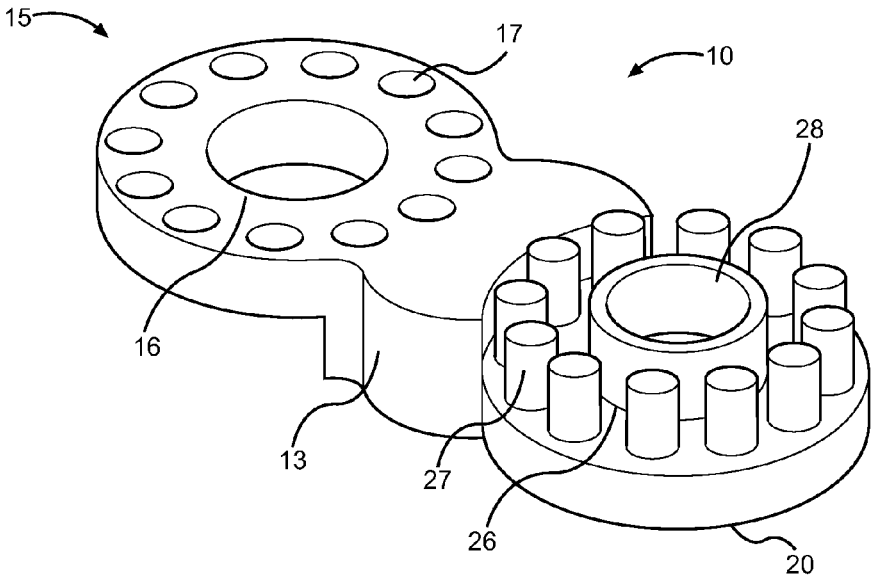


FIG. 3B

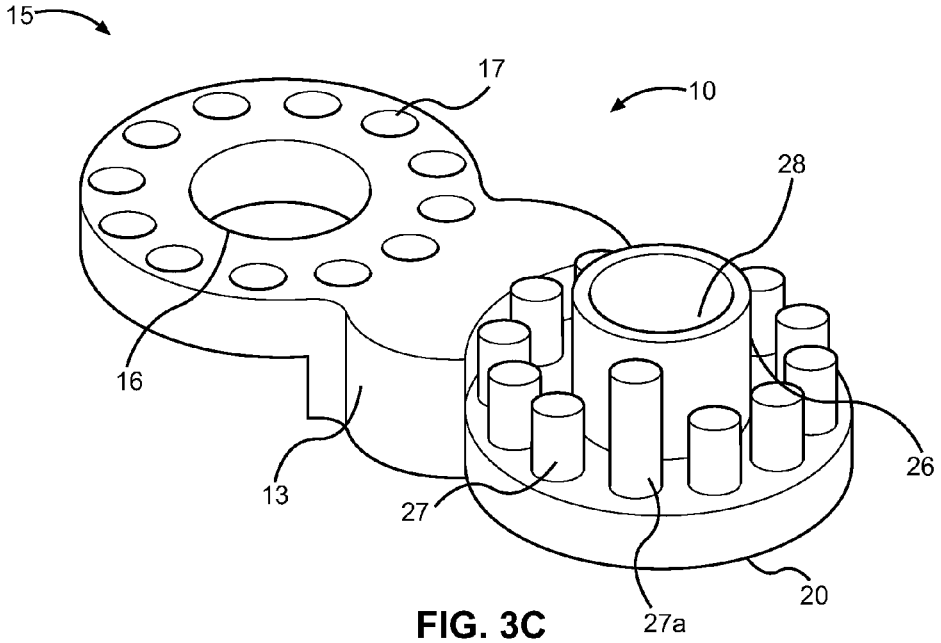


FIG. 3C

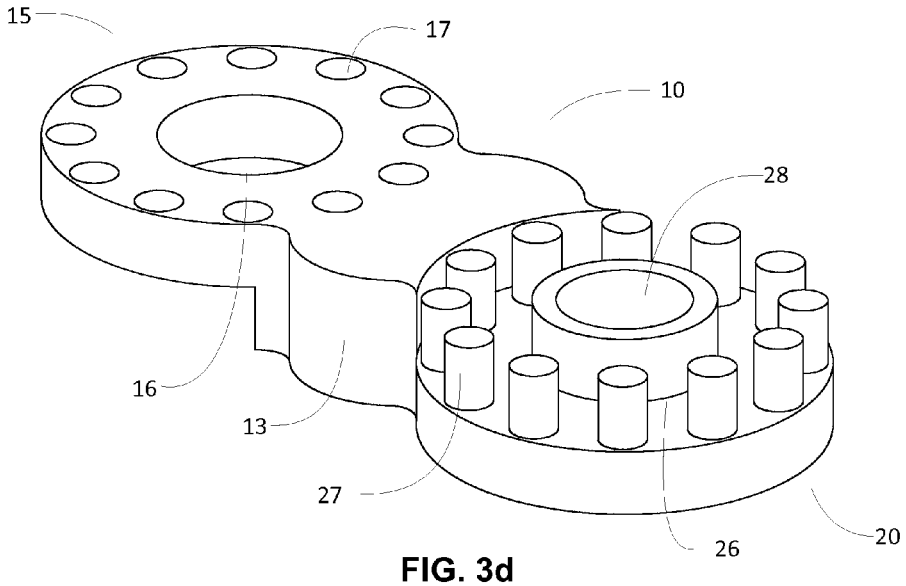


FIG. 3d

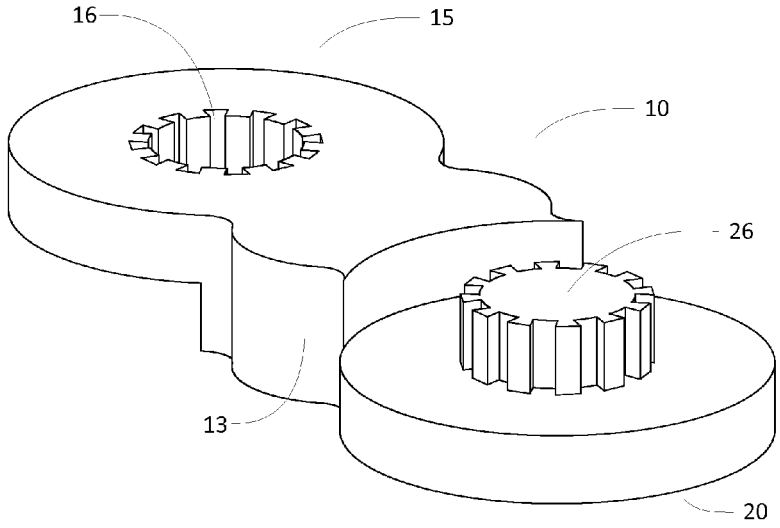


FIG. 3e

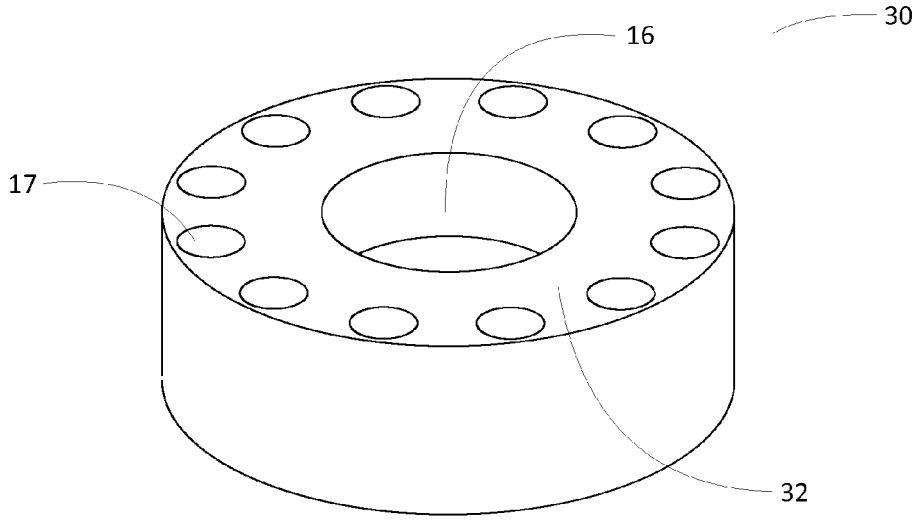


FIG. 4a

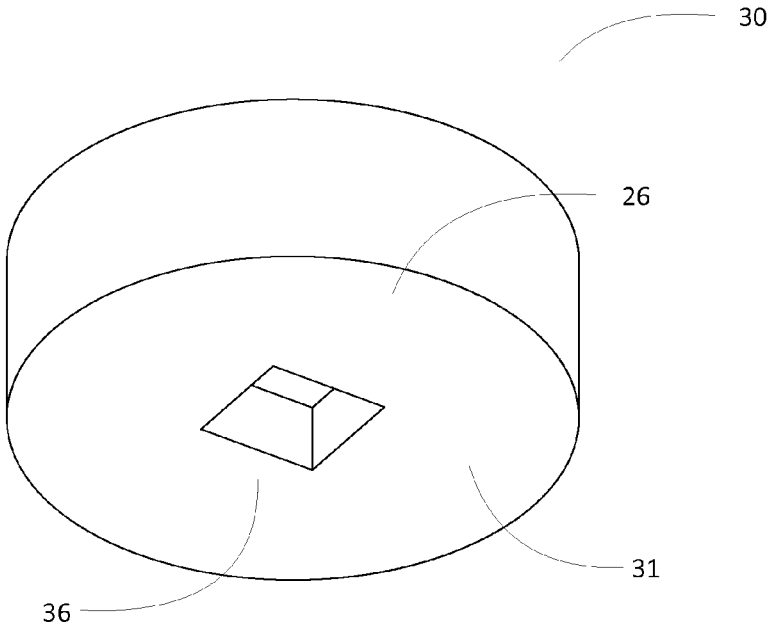


FIG. 4b

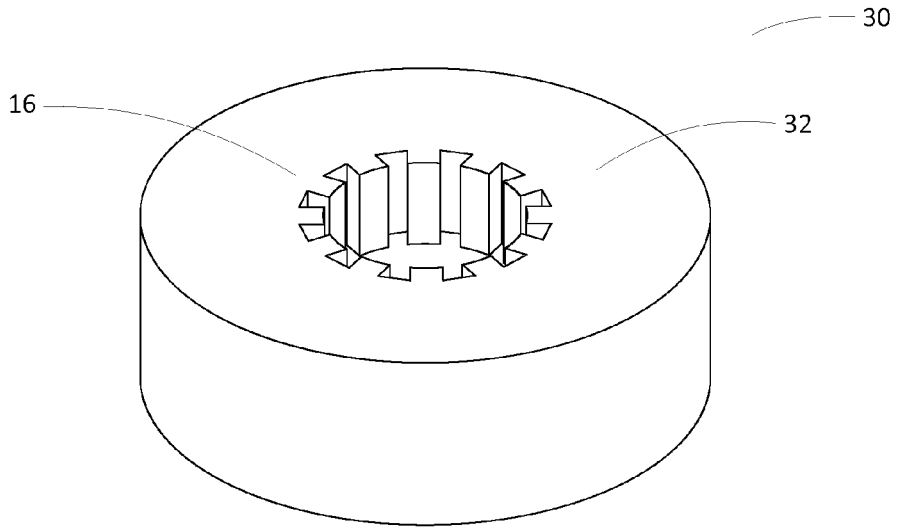


FIG. 4c

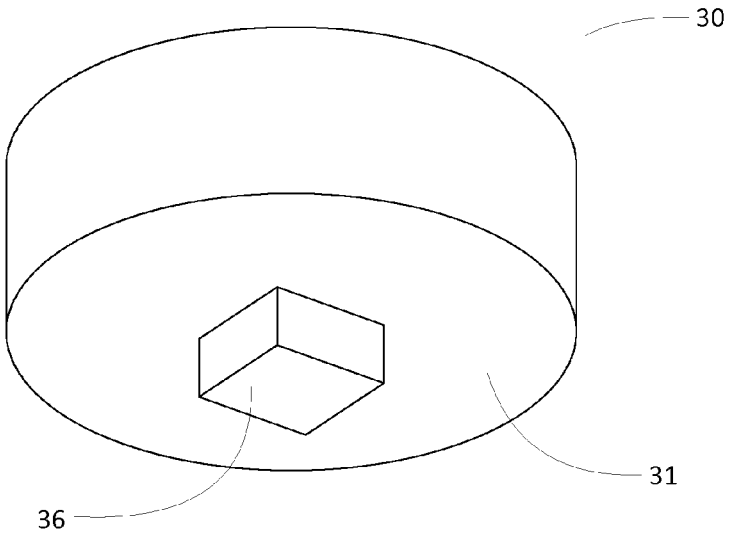


FIG. 4d

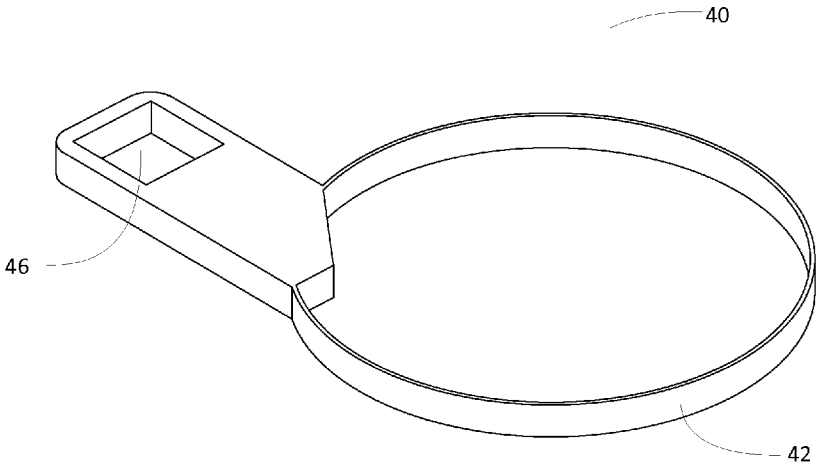


FIG. 5a

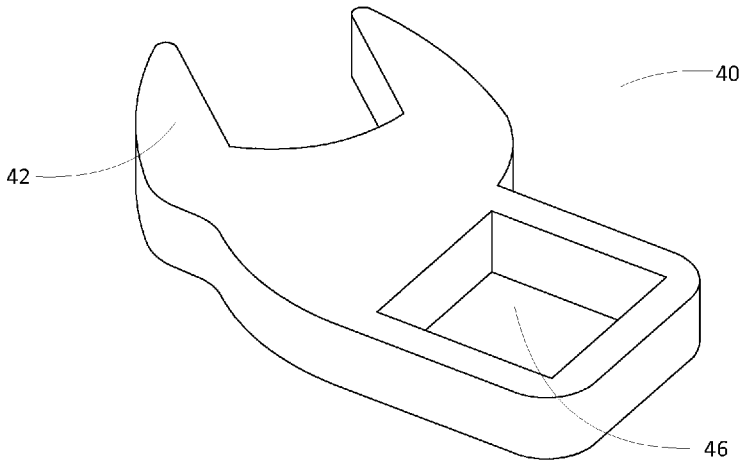


FIG. 5b

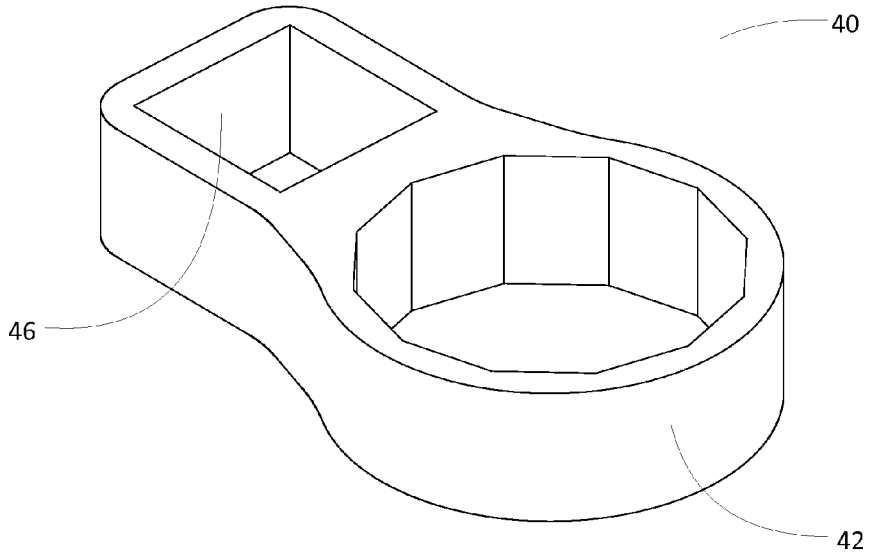


FIG. 5c

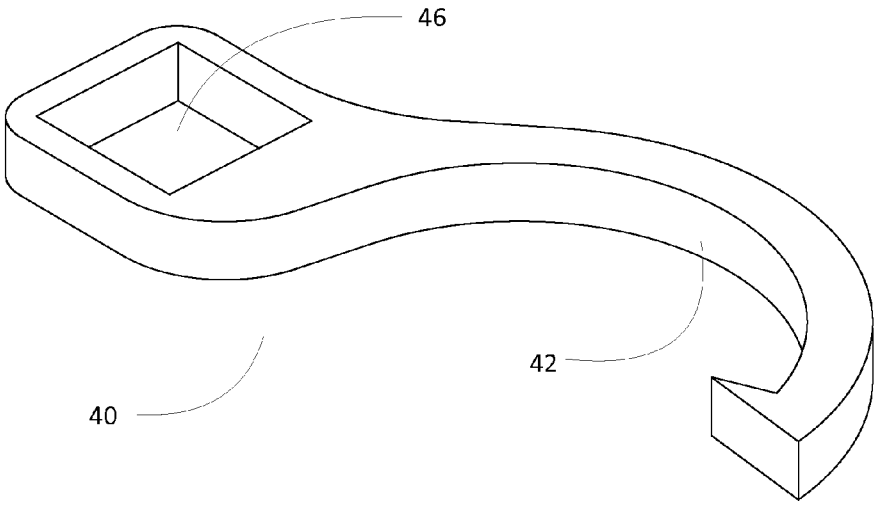


FIG. 5d

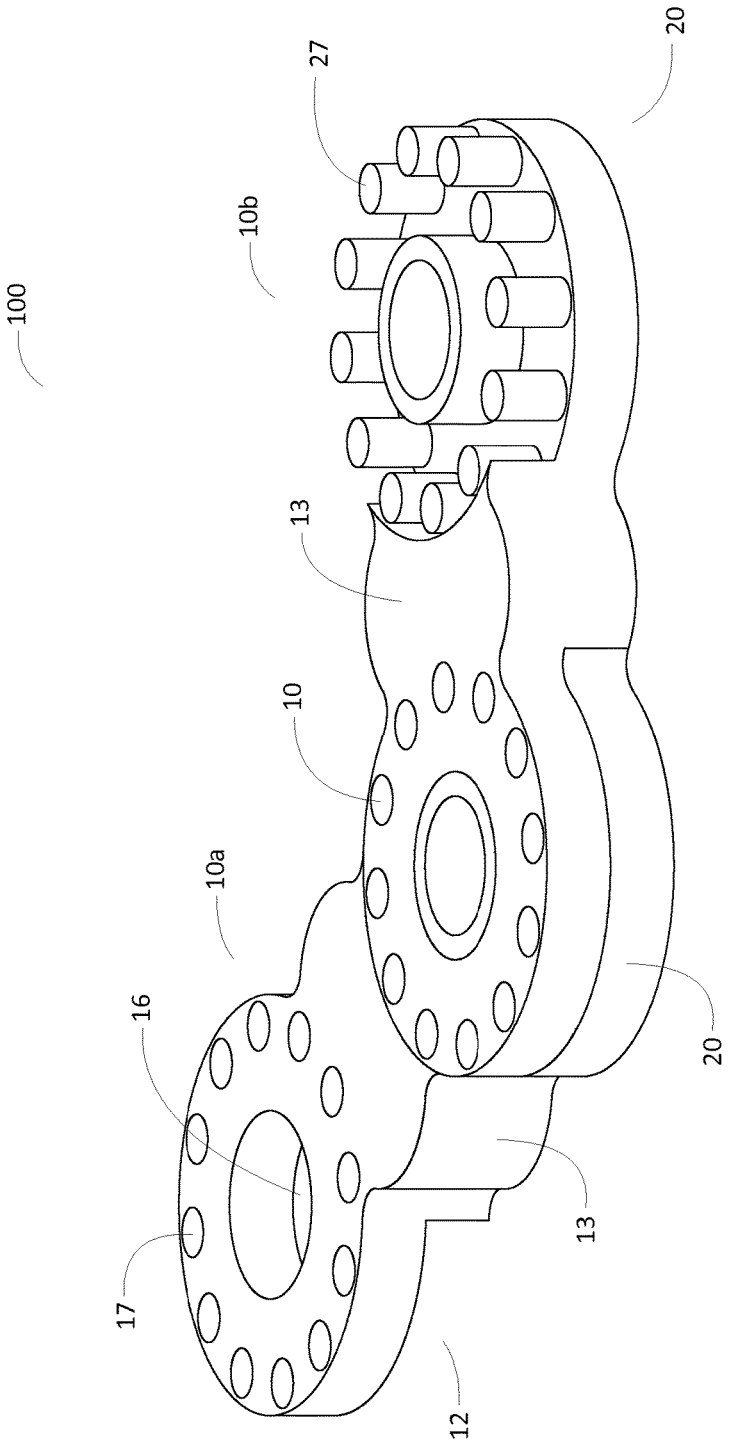


FIG. 6a

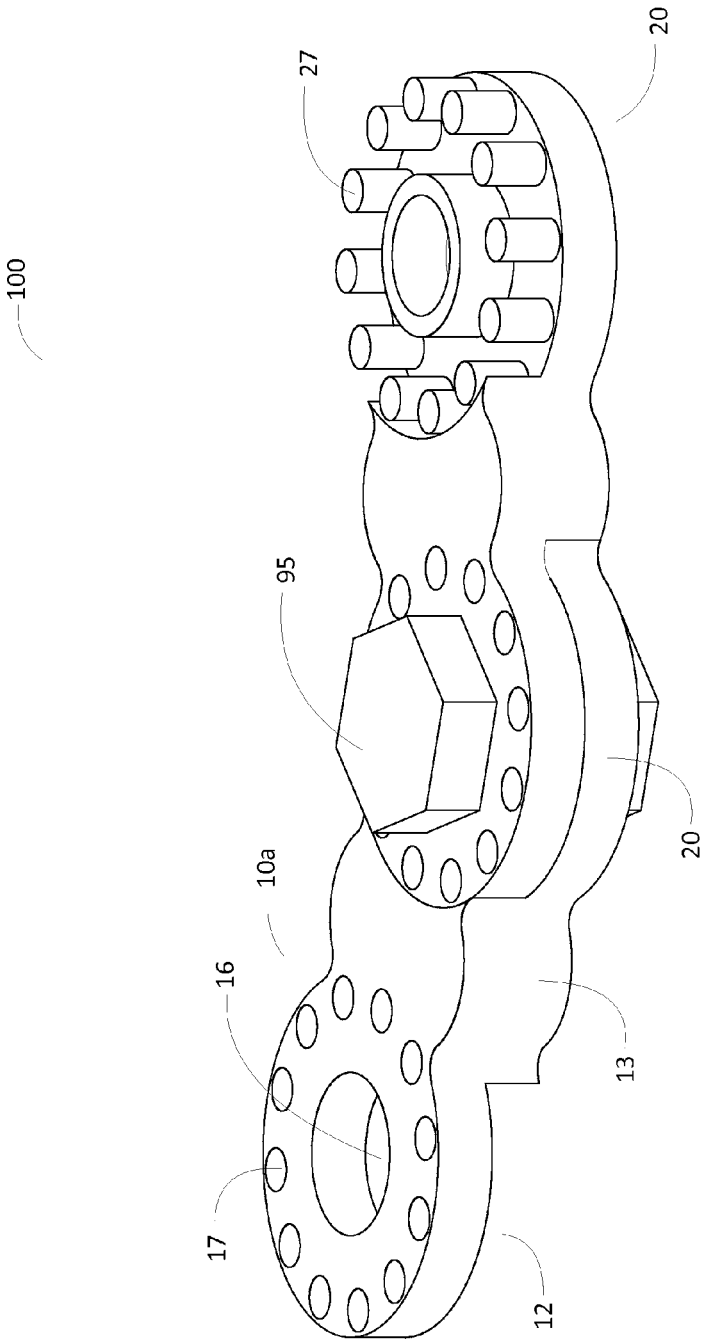


FIG. 6b

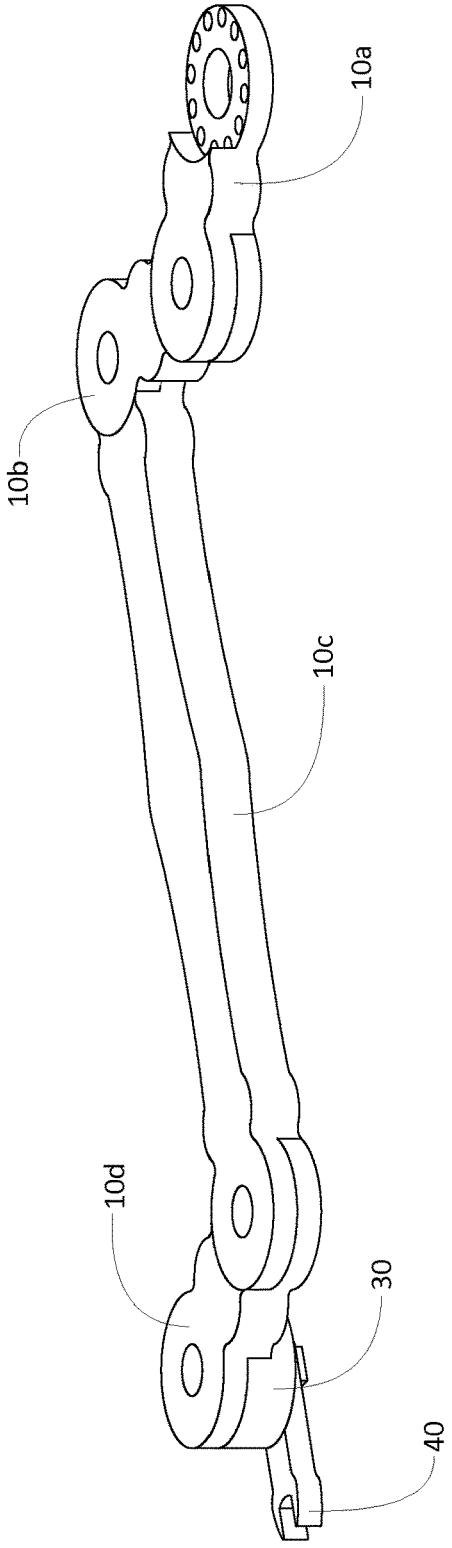


FIG. 7a

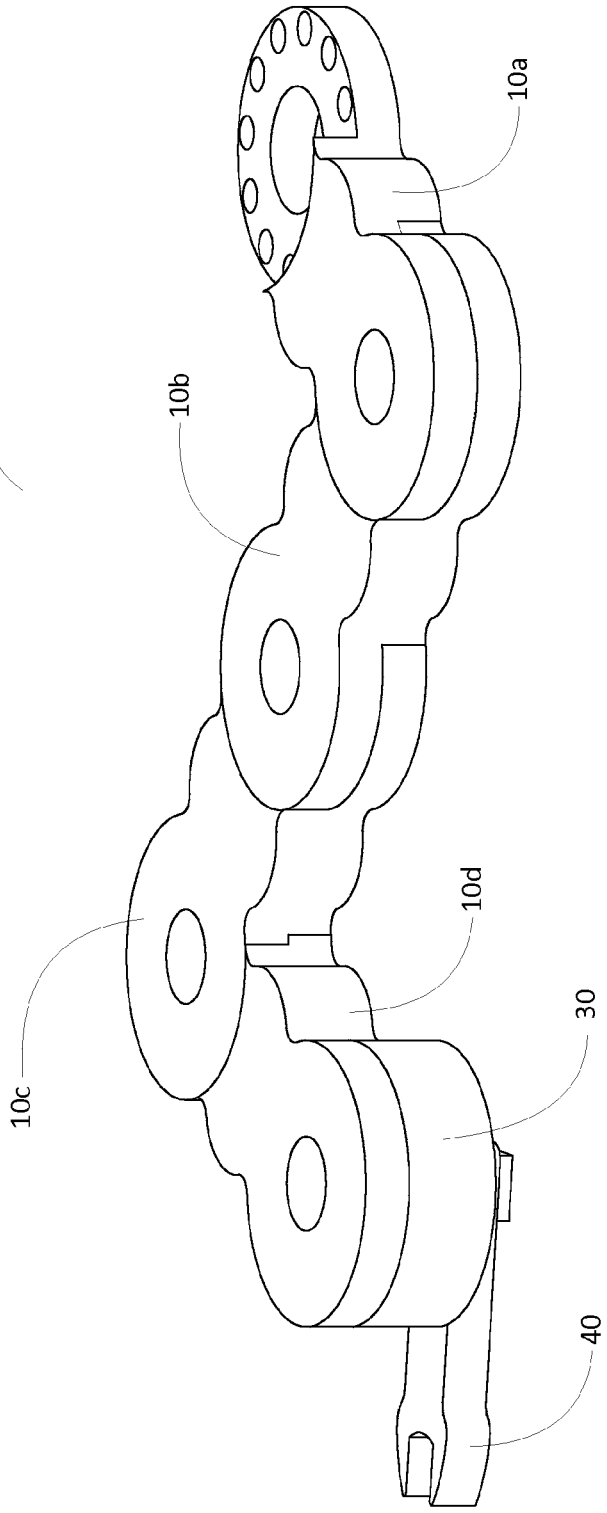


FIG. 7b

ADAPTABLE INTEGRATED WRENCH SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims the benefit of U.S. Provisional Application No. 62/001,788 filed May 22, 2014. The above application is incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates to the field of tools and more specifically to a wrench with a socket and boss type connecting means.

2. Description of Related Art

Wrenches must conform to specific parts and the space available. A typical professional or consumer will have multiple wrenches of varying head configurations. In addition to carrying multiple types of wrenches, professionals and consumers often have multiple wrenches having the same wrench head with a varying body or handle shape. Despite the multiple wrenches available on the market, however, a typical professional or consumer often will not have an optimal wrench available for a specific job. Having the optimal wrench available adds efficiency to a project and relieves physical and mental stress.

Wrenches usually have a forged construction, relying on molds for manufacture. The cost associated with making various molds is one factor contributing to the lack of variation of wrenches available in the market. Wrenches also undergo treatments to ensure they withstand the pressures and forces experienced when performing a given job.

One disadvantage to needing multiple wrenches is the large storage space required. A professional may require multiple toolboxes when transporting wrenches to a job site, or may need to choose a limited number of wrenches. Often professionals need to choose a limited set of wrenches without having knowledge of the job site or what specific obstacles they will encounter.

Selecting wrenches and limiting a working collection, whether for a specific job or in whole, also limits the number of operations that a user can perform with the tools available. Wrenches are specialized tools, and require a different wrench, or wrench head, to perform each task. Workers are limited to a finite number of wrenching jobs based on the wrenches available.

A further disadvantage to needing multiple wrenches is the weight of transporting even a portion of the wrenches needed. Wrenches are usually solid to withstand the forces generated when tightening or loosening components and are therefore heavy. Carrying multiple wrenches unnecessarily increases the physical demands of an already physically intensive job.

Existing modular wrench systems known in the art have limited positions for which wrench heads may be varied. Modular system handles are constructed as single segments having a single fixed position.

It is desirable to expand and exponentially increase the operations that may be performed using one or more of the wrenches known in art.

It is further desirable to develop a wrench system that may be manufactured using alternative processes, such as polymer-based 3-D printing, for low-torque or low-force applications, or sintered metal 3-D printing for higher torque applications.

BRIEF SUMMARY OF THE INVENTION

The present invention is a wrench system including at least one interchangeable wrench head, at least one detachable, interchangeable torque segment and at least one adapter component. The detachable, interchangeable torque segment forms a planar extension and is positioned at a critical head angle relative to the interchangeable wrench head. The torque segment includes a first rounded joining component having at least one interlocking structural member and a second rounded joining component having at least one interlocking structural member. A center member separates the first and second rounded joining components. The first rounded joining component has a first radius. The second rounded joining component has a second radius. The adapter component includes an upper rounded surface having at least one interlocking structural member that conforms to at least one interlocking structural member of the torque segment. The adapter component further includes a lower rounded surface having a squared connector.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWING(S)

FIG. **1** illustrates an exemplary assembled adaptable integrated wrench system in use around obstructions.

FIG. **2** illustrates an exploded view of an exemplary adaptable integrated wrench system.

FIGS. **3***a*-**3***e* illustrate exemplary segments for an adaptable integrated wrench system.

FIGS. **4***a*-**4***d* illustrate exemplary connectors for an adapted integrated wrench system.

FIGS. **5***a*-**5***d* illustrate exemplary wrench heads for an adapted integrated wrench system.

FIGS. **6***a* and **6***b* illustrate exemplary joined segments for an adaptable integrated wrench system.

FIGS. **7***a* and **7***b* illustrate alternates assembled adaptable integrated wrench systems.

TERMS OF ART

As used herein, the term "fixedly positioned" means able to be secured, permanently or temporarily, in a position for a desired operation.

As used herein, the term "integrated torque capable component" means comprised of multiple components sufficient to withstand and apply a sufficient amount of torque force for the given wrench application.

As used herein, the term "interchangeable wrench head" means a wrench head known in the art that is selectively attachable.

As used herein, the term "Interlocking structural members" means structures, contours, protuberances or any other geometric adaptation to engage, secure or attach another component.

As used herein, the term "modular handle" means a grasping component comprised of two or more handle segments.

As used herein, the term "operatively coupled" refers to components coupled or joined in a manner to perform a desired operation.

As used herein, the term "planar" means a structure where all components are contained within a measureable top plane and a measurable bottom plane.

As used herein, the term "rounded" means circular, polygonal and other structures having at least five sides.

As used herein, the term "selectively attached" means a component that may be attached or detached.

As used herein, the term "spline" refers to a component having ridges that interlock with grooves on a second component to transfer torque.

As used herein, the term "torque segment" means a segment positioned at an angle or other measurable position relative to a wrench head that turns to exert a torque force.

As used herein, the term "wrench application" means a specific use for a wrench, including the type and size of fastener being worked with, the torque required to tighten or loosen a fastener, any obstructions around a fastener or fastening site, and any other environmental condition contributing to the decision of what type of wrench and handle are needed.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates an exemplary assembled adaptable integrated wrench (AIWR) system **100** in use around obstructions **90**. In the exemplary embodiment shown, handle **12** is comprised of a single detachable, interchangeable torque segment **10** operatively coupled with vertical extension component **50**. Certain embodiments may include more than one torque segment **10**. Adapter component **30** secures interchangeable wrench head **40**, which is selected based on the shape of a bolt **92** or other component. By using a combination of torque segment **10** and vertical extension component **50**, a user can easily build an AIWR system **100** that extends around obstructions **90** to perform the required task.

In the exemplary embodiment shown, handle **12** is comprised of torque segment **10**, which acts as a graspable component. However, in other embodiments, handle **12** may be comprised of any number of torque segments **10** or a vertical extension component **50**. Torque segments **10** and vertical extension components **50** may be of any length to overcome a given series of obstructions **90**.

Adapter component **30** provides a structure to mount interchangeable wrench head **40**, to secure to adapter component **30**. In the exemplary embodiment, interchangeable wrench head **40** is a commercially available crow's foot head having a standard square opening. However, in other embodiments, interchangeable wrench head **40** may be any wrench head known in the art, including, but not limited to, a box-end wrench, an open-ended wrench, a flare-nut wrench, a ratcheting box wrench, a Saltus wrench, a spanner wrench, a striking face box wrench, an adjustable wrench, a monkey wrench, a pipe wrench, a socket wrench, a breaker bar wrench, a ratchet wrench, a torque wrench, an Allen wrench, a Bristol wrench, a Torx wrench, an alligator wrench, a cone wrench, a die wrench, a drum key, a drum wrench, a fire hydrant wrench, a curb key, a head nut wrench, a lug wrench, an oil-filter wrench, a spud wrench, a chain whip, a strap wrench, a tuning wrench, a wing nut wrench, a spark plug wrench, a combination wrench, a tube wrench, a line wrench, a speed handle, a sink wrench, a spoke wrench, a chain wrench, a tap wrench and combinations of these and other wrenches.

FIG. **2** illustrates an exploded view of exemplary AIWR system **100**. Handle **12** is comprised of torque segment **10**. Vertical extension component **50** is a standard socket extension known in the art and connects to torque segment **10** and adapter component **30** with transition segments **80**, which convert torque segment **10** and adapter component **30** to have squared connections corresponding to those of vertical extension component **50**. In further exemplary embodiments, vertical extension component **50** may connect to adapter component **30** and torque segment **10** through any structure or combination of structures known in the art, including, but not limited to, interlocking components, pin assemblies, splines, snap on assemblies, and combinations of these and other connections.

Interchangeable wrench head **40** is a commercially available crow's foot head with a squared connection aperture **46**. Interchangeable wrench head **40** selectively secures to adapter component **30** using a removable socket adapter **60**. Socket adapter **60** is a standard adapter component known in the art used to secure interchangeable wrench head **40**, having a female connection end, to adapter component **30**, also having a female connection end. Socket adapter **60** protrudes from connection aperture **46** in interchangeable wrench head **40** for insertion into another component of AIWR system **100**, thereby joining interchangeable wrench head **40** to AIWR system **100**. In further exemplary embodiments, interchangeable wrench head **40** may secure to adapter component **30** using any structure or combination of structures known in the art, including, but not limited to, interlocking components, pin assemblies, splines, snap on assemblies, and combinations of these and other connections.

FIGS. **3***a*-**3***e* illustrate exemplary torque segments **10** for AIWR system **100**. In the exemplary embodiment shown in FIG. **3***a*, torque segment **10** is substantially planar, extending from a first rounded joining component **15** to a second rounded joining component **20**. In other embodiments, torque segment **10** is curved. First rounded joining component **15** has a first radius and at least one interlocking structural member. Second rounded joining component **20** has a second radius and at least one interlocking structural member. In the exemplary embodiment shown in FIG. **3***a*, the first radius equals the second radius. The interlocking structural members of first rounded joining component **15** are central securing aperture **16** and a plurality of smaller pin receiving apertures **17**. The interlocking structural members of second rounded joining component **20** are central securing protuberance **26** and a plurality of connecting pins **27**.

Center member **13** separates first and second rounded joining components **15**, **20**. Center member **13** is planar, having at least one contoured horizontal surface conforming to a curvature of first and second rounded joining components **15**, **20**. The configuration of center member **13** keeps first and second rounded joining components **15**, **20** in the same plane. As a result, when multiple torque segments **10** are connected, all torque segments **10** are in the same plane.

In the exemplary embodiment shown, center member **13** is longer and may function as a grasping component for handle **12**. However, in other embodiments, such as in FIG. **3***b*, center member **13** may be shorter. In such embodiments, multiple torque segments **10** may create handle **12**. In still other embodiments, center member **13** may be any length, width, size or configuration to provide various options to a user for AIWR system **100**. Center member **13** has a length ranging from approximately one-quarter of one of the first or second radius to approximately twenty times one of the first or second radius.

In some embodiments, multiple connected torque segments **10** may act together as a modular handle and form a

grasping component. In other exemplary embodiments, a designated grasping component may be provided and include grasping or ergonomic contours. In still further exemplary embodiments, multiple connected torque segments **10** that create a grasping component may join in such a way as to provide grasping contours.

FIG. **3***a* also shows locking pin **72** with groove **74**. In the exemplary embodiment shown, locking pin **72** is a spring-loaded pin disposed in the wall of central securing aperture **16**. As central securing aperture **16** engages around a central securing protuberance **26**, locking pin **72** moves back into central securing aperture wall until aligned with groove **74**. When aligned with groove **74** in central securing protuberance **26**, locking pin **72** releases into groove **74** to provide a more secure connection between torque segments **10**.

In still further embodiments, torque segments **10** may include other structures or assemblies in addition to central securing aperture **16** and central securing protuberance **26** to provide a more secure connection, including, but not limited to, engaging contours, clasps, pins, bolts, spines, fasteners, magnets and combinations of these structures.

In the exemplary embodiments shown in FIGS. **3***a* and **3***b*, connecting pins **27** and central connecting protuberance **26** have a height corresponding to that of center member **13**. However, one or more connecting pins **27** may extend beyond the height of center member **13**. As illustrated in the alternate embodiment of FIG. **3***c*, connecting pin **27***a* is taller than the surrounding connecting pins **27** and acts as a guide pin for connecting torque segments **10** and other components of AIWR system **100**. In still further alternate embodiments, central connecting protuberance **26** may also have a height greater than that of center member **13**, as illustrated in embodiment of FIG. **3***c*.

In the exemplary embodiments shown in FIGS. **3***a*-**3***c*, first rounded joining component **15** has 12 symmetrically arranged pin receiving apertures **17** that correspond to the 12 symmetrically arranged connecting pins **27** of second rounded joining component **20**. When joined, torque segments **10** can be placed in any orientation permitted by aligning connecting pins **27** with pin receiving apertures **17**.

Because there are equally spaced **12** connecting pins **27** and **12** spaced pin receiving apertures **17**, connecting pins **27** and corresponding pin receiving apertures **17** are positioned at every 30 degree interval around second and first rounded joining components **20** and **15**, respectively. The positioning of torque segments **10** relative to each other is therefore limited to the positions offered by connecting pins **27** and pin receiving apertures **17**.

As illustrated in FIG. **3***d*, however, additional torque segments **10** may be provided with offset pin receiving apertures **17** and connecting pins **27**. In the alternate embodiment shown in FIG. **3***d*, pin receiving apertures **17** and connecting pins **27** are offset approximately 15 degrees relative to the embodiments illustrated in FIGS. **3***a*-**3***c*. In further exemplary embodiments, pin receiving apertures **17** and connecting pins **27** may be offset at multiples of 10, 15 or 20 degrees, or at any position within the range of 0 to 30 degrees. In still further exemplary embodiments, pin receiving apertures **17** and connecting pins **27** may have different positions on the same torque segment **10**.

By providing different torque segments **10** having various center members **13** of differing lengths, as well as pin receiving apertures **17** and connecting pins **27** located at different angular positions around first and second rounded joining components **15** and **20**, respectively, it is possible to create a critical angle between torque segments **10**. This critical angle ranges from approximately 80 degrees to approximately 280 degrees, providing an approximately 200-degree range of positioning options. The total 200 degree range of positionability is critical in order to allow a user to appropriately position interchangeable wrench head **40** and other torque segments **10** at the desired angle relative to each other in order to achieve the desired result and perform a given wrench application. In some embodiments, however, the total positional capabilities offered by a single first torque segment **10** may be limited to between 90 and 270 degrees relative to a single second torque segment **10**.

The large range of positionability offered by offset pins also allows a user to join sections to create a handle **12** optimized for a given situation. In addition to placing torque segments **10** at a critical angle, interchangeable wrench head **40** may be placed at a desired critical head angle necessary to achieve the desired objective, relative to the remainder of AIWR system **100**. An optimizable handle **12** also allows creation of a desired wrench configuration both prior to reaching a job site and on site.

In the exemplary embodiments shown in FIGS. **3***a*-**3***d*, connecting pins **27** are cylindrical pins projecting away from second rounded joining component **20** and having a diameter of approximately 3/16 of an inch, resulting in approximately 0.332 square inch of surface area total available to contact a second torque segment **10**. By comparison, commercially available 3/8 drive offers 0.14 square inches and a 1/2 drive offers 0.25 square inches. The amount of surface area in contact along connecting pins **27** and pin receiving apertures **17**, is directly proportional to the amount of force, or torque, torque segments **10** are able to withstand. AIWR system **100** can deliver 137% more torque than a 3/8 drive and 33% more than a 1/2 inch drive. Similarly, AIWR system **100** is able to withstand and apply significant amounts of torque when there is a significant amount of total surface area in contact between torque segments **10**.

In the exemplary embodiments shown in FIGS. **3***a*-**3***d*, connecting pins **27** have a circular cross-section with correspondingly shaped pin receiving apertures **17**. In other embodiments, connecting pins **27** are may have any geometrical cross-section, such as, but not limited to elliptical, triangular, rectangular, square, trochoid, pentagonal or hexagonal. Cross-sections of connecting pins **27** (and correspondingly shaped pin receiving apertures **17**) may or may not have parallel sides or symmetry.

In the exemplary embodiments shown in FIGS. **3***a*-**3***d*, central securing aperture **16** has an inner diameter corresponding to the outer diameter of central securing protuberance **26**. When torque segments **10** join, central securing protuberance **26** of one torque segment **10** engages the central securing aperture **16** of a second torque segment **10**.

Certain embodiments of central securing protuberance **26** also contain an aperture **28** running through central securing protuberance **26**. Joined torque segments **10** may further secure into a position by tightening a securing bolt **95** (shown in FIG. **6***b*) or other fastener in aperture **28**. In other embodiments, a particular torque segment **10** configuration may permanently secures by welding, soldering, adhesion or otherwise permanently joining the torque segments **10** at central securing aperture **16** and central securing protuberance **26**.

In still further exemplary embodiments, torque segments **10** may include other structures or assemblies in addition to central securing aperture **16** and central securing protuberance **26** to provide a more secure connection, including, but not limited to, engaging contours, clasps, pins, bolts, spines, fasteners, magnets and combinations of these structures.

FIG. **3***e* illustrates a torque segment **10** having splined interlocking structural members. In the embodiment shown, central securing aperture **16** has 12 dovetailed channels and central securing protuberance **26** has 12 dovetailed protuberances to create the interlocking splines. The embodiment illustrated in FIG. **3***e* omits pin receiving apertures **17** and connecting pins **27**. Torque segments **10** join using only splined central securing aperture **16** and splined central securing protuberance **26**. However, in further embodiments, splines may be used in combination with pin receiving apertures **17** and connecting pins **27** on the same torque segment **10**.

Like pin receiving apertures **17** and connecting pins **27**, offset splines may accommodate various orientations of torque segments **10** relative to each other. Further, for a single torque segment **10**, the position of splines on a central securing aperture **16** may differ from the position of splines on a central securing protuberance **26**.

In the alternate embodiment illustrated, interactions between a plurality of corresponding dovetailed channels and dovetailed protuberances create splines. In further embodiments, splines may be any configuration or shape of selectively attachable mating male and female structures. However, in still further embodiments, splines may be any structure or configuration known in the art. Splined connections in a three-dimensional plane may also connect torque segments **10** without requiring vertical extension component **50**.

As illustrated in FIGS. **3***a*-**3***e*, interlocking structural members (e.g., splines of central securing aperture **16** and central securing protuberance **26**, pin receiving apertures **17** and connecting pins **27**) are symmetrically arranged in sets of 12. In further exemplary embodiments, more or fewer interlocking components may be used. Increased interlocking components results in AIWR system **100** able to withstand, and therefore apply, more force because of the increased contacting surface area between torque segments **10**.

While the interlocking structural members illustrated in FIGS. **3***a*-**3***e* have a primarily circular arrangement, in further exemplary embodiments interlocking structural members may arranged in other configurations, such as linear, square, oval or any other symmetric arrangement. In still further embodiments, transition segments **80** may be used to convert, or transition, a torque segment **10** having a circular arrangement to having a different arrangement of interlocking structural members.

In some embodiments, torque segments **10** are configured such that first rounded joining component **15** is female and second rounded joining component **20** is male. In other embodiments, first rounded joining component **15** may be male, while second rounded joining component **20** is female. In still further exemplary embodiments, torque segments **10** may include two female rounded joining components or two male rounded joining components. Further embodiments provide additional transition segments **80** to serve as male/female adapters.

FIGS. **4***a* through **4***d* illustrate exemplary adapter components **30** for AIWR system **100**. Adapter components **30** each have a first rounded surface **32** containing interlocking structural members adapted to connect to torque segment **10** or transition segment **80**, and a second rounded surface **31** containing interlocking structural members adapted to connect to interchangeable wrench head **40**.

In the exemplary embodiment shown in FIGS. **4***a* and **4***b*, first rounded surface **32** has interlocking structural members of central securing aperture **16** with pin receiving apertures **17**. In the exemplary embodiment shown in FIGS. **4***c* and **4***d*, first rounded surface **32** has interlocking structural members of central securing aperture **16** with splines. These interlocking structural members correspond to interlocking structural members of segment **10**.

In the embodiments shown in FIGS. **4***a* through **4***d*, both first rounded surfaces **32** are female connections. Using a female connection at first rounded surface **32** (e.g., central securing aperture **16** with pin receiving apertures **17** or central securing aperture **16** with splines) allows users of AIWR system **100** to easily manufacture adapter components **30** using a punch, rather than having to machine male interlocking structural components.

For example, a user may require an AIWR system **100** with adapter components **30** with very specific dimensions. The user may simply punch central securing aperture **16** with pin receiving apertures **17** or central securing aperture **16** with splines to connect any interchangeable wrench head **40** to an existing AIWR system **100** without having to purchase additional components. A user can also create a specific interchangeable wrench head **40** with female interlocking structural components to connect interchangeable wrench head **40** directly to a torque segment **10**. However, in further embodiments, first rounded surface **32** may contain male interlocking structures (e.g., central securing protuberance **26** with or without splines and/or connecting pins **27**).

As illustrated in FIGS. **4***a* through **4***d*, second rounded surface **31** of adapter component **30** has a structural interlocking component that is a squared connector **36**. As illustrated in FIG. **4***a* squared connector **36** is a square aperture designed to be used with existing square socket connections known in the art, while in FIG. **4***c* has a squared connector **36** which is a square protuberance designed to directly secure interchangeable wrench head **40**.

Squared connector **36** allows adapter components **30** to be compatible with existing and commercially available wrench heads and connections known in the art. Socket adapters **60**, are squared peg-like structures known in the art and may be used to attach interchangeable wrench head **40**, having a squared aperture, to squared aperture **36** of adapter component **30**. Squared connector **36** may be of a size known in the art, such as ¼", ⅜", ½", ¼", or 1". However, in further exemplary embodiments, squared connector **36** may be any shape or size known in the art to secure a wrench head.

In further embodiments, however, AIWR system **100** may include adapter components **30** and interchangeable wrench heads **40** using a specific or proprietary connection structure of any shape or configuration designed to secure wrench heads and transfer torque.

In the embodiments shown in FIGS. **4***a* through **4***d*, a thickness separates first and second rounded surfaces **32**, **31**. The thickness of adapter component **30** may depend on whether squared connector **36** is a protuberance or aperture. When squared connector **36** is an aperture, adapter component **30** must be thick enough that a socket adapter **60** can securely engage squared connector **36**.

FIGS. **5***a*-**5***d* illustrate exemplary interchangeable wrench heads **40** for AIWR system **100**. Each exemplary interchangeable wrench head **40** illustrated in FIGS. **5***a*-**5***d* includes a wrench component **42** and a connection aperture **46**. As illustrated, connection aperture **46** is square and allows interchangeable wrench head **40** to join to an adapter component **30** containing a squared connector **36** that is a protuberance without any additional structures, or to a squared connector **36** that is an aperture with the help of a

socket adapter **60**. Interchangeable wrench heads **40** having square connection apertures **46** are commercially available and known in the art. However, in further embodiments, interchangeable wrench heads **40** (as well as corresponding adapter components **30**) may be specifically manufactured to securely connect using any structure or combination of structures known in the art.

In the embodiments shown FIGS. **5***a*-**5***d*, wrench component **42** is a strap wrench, striking face box wrench, box-end wrench, and spanner wrench, respectively. In further embodiments, wrench component **42** may be any wrench known in the art.

FIGS. **6***a* and **6***b* illustrate exemplary joined torque segments **10***a*, **10***b* for AIWR system **100**. The exemplary embodiments shown in FIGS. **6***a* and **6***b* both include two torque segments **10***a*, **10***b*, with torque segments **10***a*, **10***b* connected at different angles in each figure. In the exemplary embodiment shown in FIG. **6***b*, securing bolt **95** provides additional stabilization in securing segments **10***a*, **10***b*.

As illustrated in FIGS. **6***a* and **6***b*, torque segments **10***a*, **10***b* each include first and second rounded joining components **15**, **20**, respectively, with second rounded joining component **20** of torque segment **10***a* engaging first rounded joining component **15** of torque segment **10***b*. Interlocking structural components (e.g., connecting pins **27** and central securing protuberance **26**) of torque segment **10***a* engage interlocking structural components (e.g. pin receiving apertures **17** and central securing aperture **16**) of torque segment **10***b*.

FIGS. **7***a* and **7***b* illustrate exemplary assembled AIWR systems **100**. AIWR system **100** as illustrated in FIG. **7***a* includes four torque segments **10***a*-**10***d*, one adapter component **30** and one interchangeable wrench head **40**. Torque segments **10***a*-**10***d* have center members **13** of different lengths and are joined at different angles to provide a custom modular handle **12** to meet a specific job function and overcome obstructions.

In the exemplary embodiment shown in FIG. **7***a*, AIWR system **100** is designed to be gripped at torque segments **10***a* and **10***b*, but, in further exemplary embodiments, may be gripped using any of torque segments **10***a*-**10***d*. In the exemplary embodiment shown in FIG. **7***b*, handle **12** is comprised entirely of shorter torque segments **10***a*-**10***d*. Arranging shorter torque segments **10***a*-**10***d* at alternating angles creates a handle **12** having an ergonomic grasping portion.

When used in conjunction with vertical extension components **50**, AIWR system **100** may create a wrench conforming to any application required. Components of AIWR system **100**, including torque segments **10**, adapter components **30**, interchangeable wrench heads **40**, vertical extension components **50**, and transition segments **80** may have multiple configurations to create modular and versatile wrenches.

In the exemplary embodiments described, components of AIWR system **100** are machined from metal and sized for use with standard fasteners, such as bolts, used and known in the art. However, the size and material of AIWR system **100** components may vary depending on a specific application. For example, components of AIWR system **100** may be generated using a 3-D printer or additive machining for low-torque application. Components may be scaled down for micro applications or scaled up to handle larger or high-torque jobs. AIWR system **100** components may also be made out of non-magnetic material when use of magnetic materials would be problematic (e.g., repairing an MRI machine).

In still further embodiments, multiple variations of torque segments **10**, adapter components **30**, interchangeable wrench heads **40**, vertical extension components **50** and transition segments **80** have a specifically selected and manufactured material, size, and thickness, as well as any necessary specific treatment, based on the torque necessary to complete a given job.

It will be understood that many additional changes in the details, materials, procedures and arrangement of parts, which have been herein described and illustrated to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

It should be further understood that the drawings are not necessarily to scale; instead, emphasis has been placed upon illustrating the principles of the invention. Moreover, the terms "substantially" or "approximately" as used herein may be applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related.

What is claimed is:

1. A wrench system comprised of:

at least one interchangeable wrench head;

a plurality of torque segments which are detachable and interchangeable;

wherein each of said plurality of torque segments is positioned at a critical head angle of approximately 80 to 280 degrees relative to an interchangeable wrench head;

wherein each of said plurality of torque segments is a single piece which has surfaces on two different planar levels, wherein a first planar level includes a center member and a first rounded joining component having a first interlocking structural member and a second planar level includes said center member and a second rounded joining component having a second interlocking structural member, and wherein said first and second rounded joining components are separated by said center member;

wherein said center member of each of said plurality of torque segments has a curved recess configured to receive a rounded joining component of another of said plurality of torque segments to form a singular planar surface when two or more of said plurality of torque segments are joined; and

wherein said first interlocking structural member is not retractable with said first rounded joining component and said second interlocking structural member is not retractable with said second rounded joining component;

wherein said first rounded joining component has a first radius and said second rounded joining component has a second radius; and

at least one adapter component comprising an upper rounded surface having said at least one first interlocking structural member which conforms to said at least one second interlocking structural member of said at least one detachable, interchangeable torque segment, said at least one adapter component further comprising a lower rounded surface having a squared connector.

2. The apparatus of claim **1** wherein said interlocking structural members are selected from the group consisting of a central securing aperture, a splined central securing aperture, a central securing protuberance, a splined central securing protuberance, a plurality of connecting pins, a plurality of connecting pin apertures, a locking pin, a groove and combinations thereof.

3. The apparatus of claim 1 wherein said center member has a length ranging from approximately one-quarter of one of said first and second radius to approximately twenty times one of said first and second radius.

4. The apparatus of claim 1 wherein said first and second radius are equal.

5. The apparatus of claim 1 wherein said at least one first interlocking structural member of said first rounded joining component comprises a central securing aperture and said at least one second interlocking structural member of said second rounded joining component comprises a central securing protuberance.

6. The apparatus of claim 5 wherein said at least one first interlocking structural member of said first rounded joining component further comprises a plurality of connecting pin apertures and said at least one second interlocking structural member of said second rounded joining component further comprises a plurality of connecting pins.

7. The apparatus of claim 6 wherein at least one of said connecting pins extends beyond a plane created by said torque segment.

8. The apparatus of claim 5 wherein said central securing aperture and said central securing protuberance are splined.

9. The apparatus of claim 1 wherein said center member is planar having at least one contoured horizontal surface conforming to a curvature of said first and second rounded joining components.

10. The apparatus of claim 1 wherein said at least one detachable wrench head is selected from the group consisting of a box-end wrench, an open-ended wrench, a flare-nut wrench, a ratcheting box wrench, a flex head wrench, a spanner wrench, a striking face box wrench, an adjustable wrench, a monkey wrench, a pipe wrench, a socket wrench, a breaker bar wrench, a ratchet wrench, a torque wrench, a multiple spline driver wrench, a hex wrench, an alligator wrench, a cone wrench, a die wrench, a drum key, a drum wrench, a fire hydrant wrench, a curb key, a head nut wrench, a lug wrench, an oil-filter wrench, a spud wrench, a chain whip, a strap wrench, a tuning wrench, a wing nut wrench, a spark plug wrench, a combination wrench, a tube wrench, a line wrench, a speed handle, a sink wrench, a spoke wrench, a chain wrench, a tap wrench and combinations thereof.

11. The apparatus of claim 1 wherein said at least one detachable, interchangeable torque segment is curved.

12. The apparatus of claim 1 wherein said at least one detachable, interchangeable torque segment may be combined with at least one other detachable, interchangeable torque segment to form a critical angle.

13. The apparatus of claim 12 wherein said critical angle ranges from approximately 80 degrees to approximately 280 degrees.

14. The apparatus of claim 1 wherein said at least one first interlocking structural member of said first rounded joining component comprises a plurality of connecting pins and said at least one second interlocking structural member of said second rounded joining component comprises a plurality of connecting pins.

15. The apparatus of claim 1 wherein said at least one first interlocking structural member of said first rounded joining component comprises a plurality of pin receiving apertures and said at least one second interlocking structural member of said second rounded joining component comprises a plurality of pin receiving apertures.

16. The apparatus of claim 1 wherein said at least one first interlocking structural member of said first rounded joining component comprises a plurality of pin receiving apertures and said at least one second interlocking structural member of said second rounded joining component comprises a plurality of connecting pins.

17. The apparatus of claim 1 wherein said at least one first interlocking structural member of said first rounded joining component comprises a plurality of connecting pins and said at least one second interlocking structural member of said second rounded joining component comprises a plurality of pin receiving apertures.

18. The apparatus of claim 1 further comprising a removable socket adapter, wherein said socket adapter protrudes from a connection aperture in said at least one interchangeable wrench head.

19. The apparatus of claim 1 further comprising at least one vertical extension component located between said at least one adapter component and said at least one detachable, interchangeable torque segment.

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