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(54) **CLUTCH SOCKET ADAPTER FOR A TOOL**

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CPC ***B25B 13/06*** (2013.01); ***B25B 23/141*** (2013.01); ***B25B 23/1427*** (2013.01)

(58) **Field of Classification Search**
CPC B25B 13/06; B25B 13/48; B25B 13/481; B25B 23/141; B25B 23/1427; F16D 7/044
See application file for complete search history.

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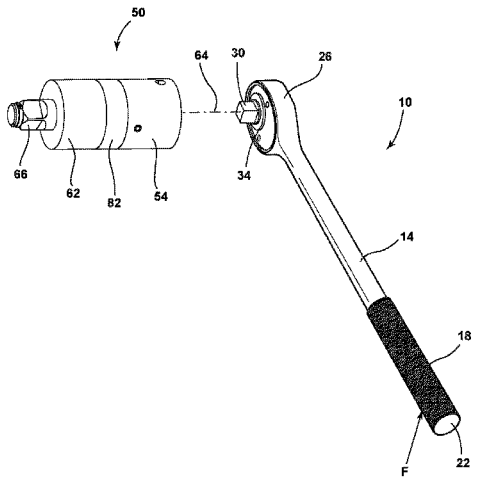
(57) **ABSTRACT**

A socket adapter for limiting torque delivered from a tool to a socket piece. The socket adapter includes a female receiver that is coupleable to and driven by the tool, and a male drive that is coupled to and driven by the female receiver for transferring torque to the socket piece. The socket adapter further includes a clutch mechanism having a first clutch surface, a second clutch surface that engages the first clutch surface, and an adjustment mechanism for adjusting a clamping force between the first clutch surface and the second clutch surface. The second clutch surface slides relative to the first clutch surface when a reaction torque exerted on the clutch mechanism exceeds a predetermined torque limit.

19 Claims, 4 Drawing Sheets



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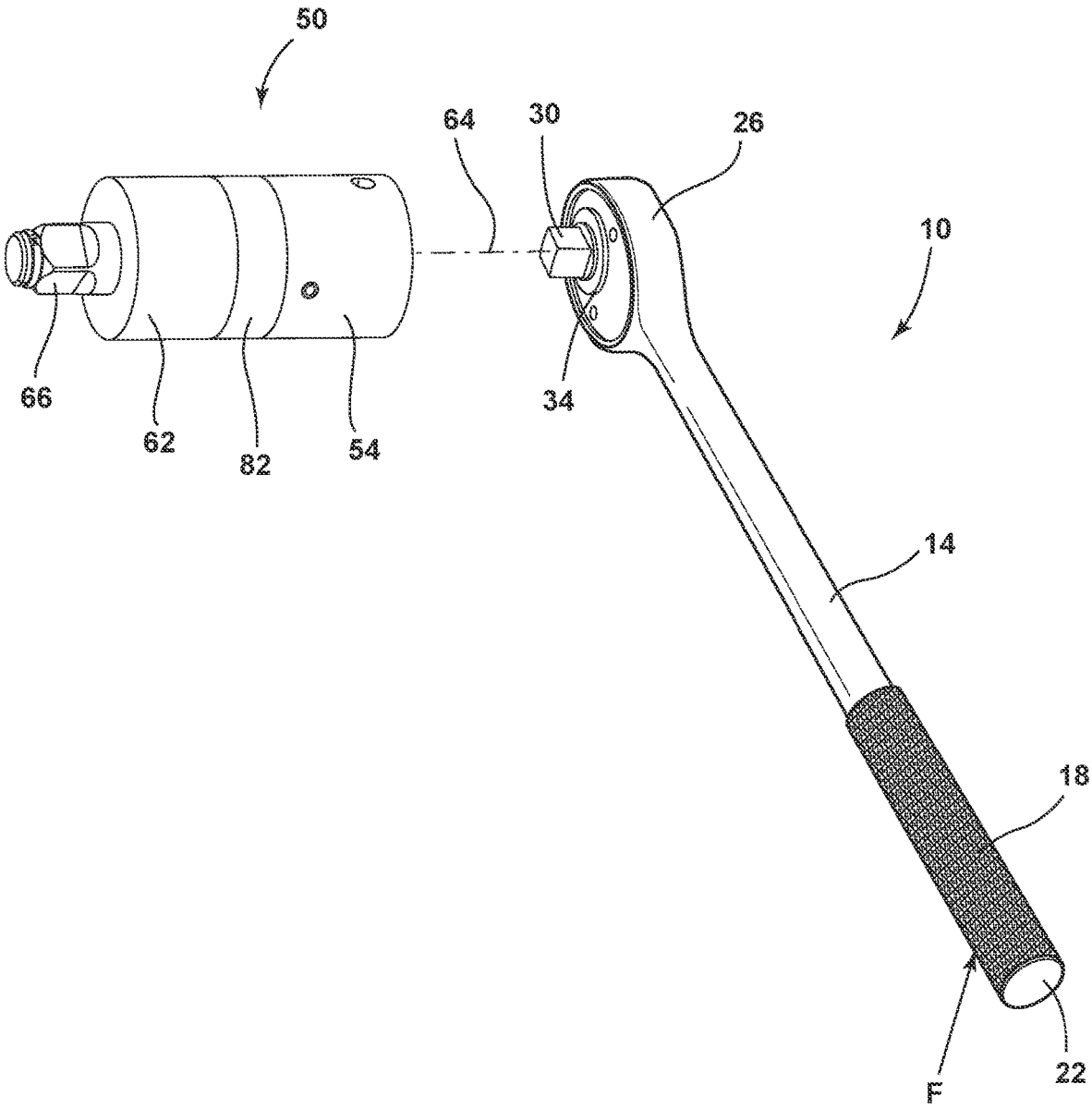

FIG. 1

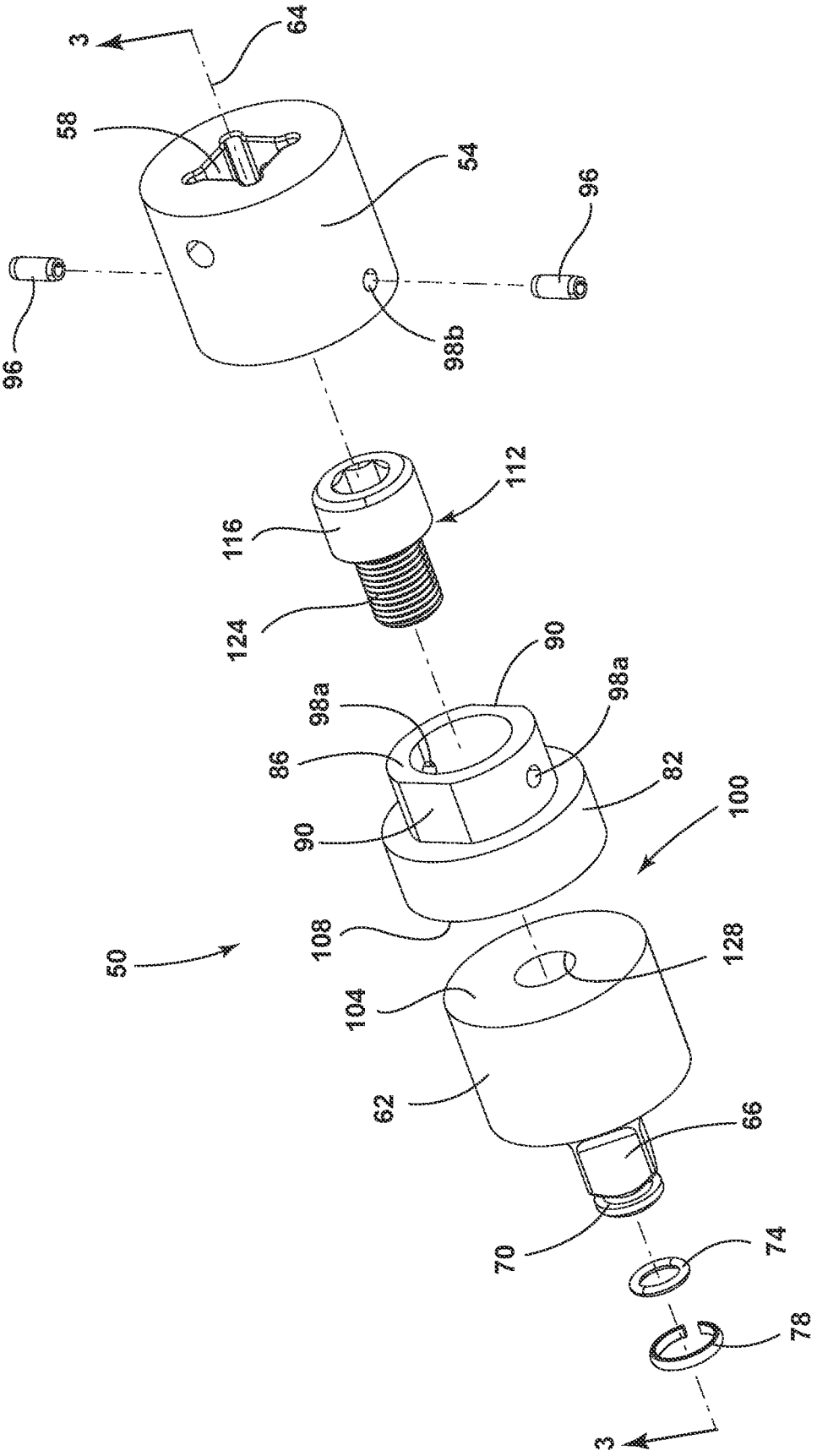
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FIG. 2

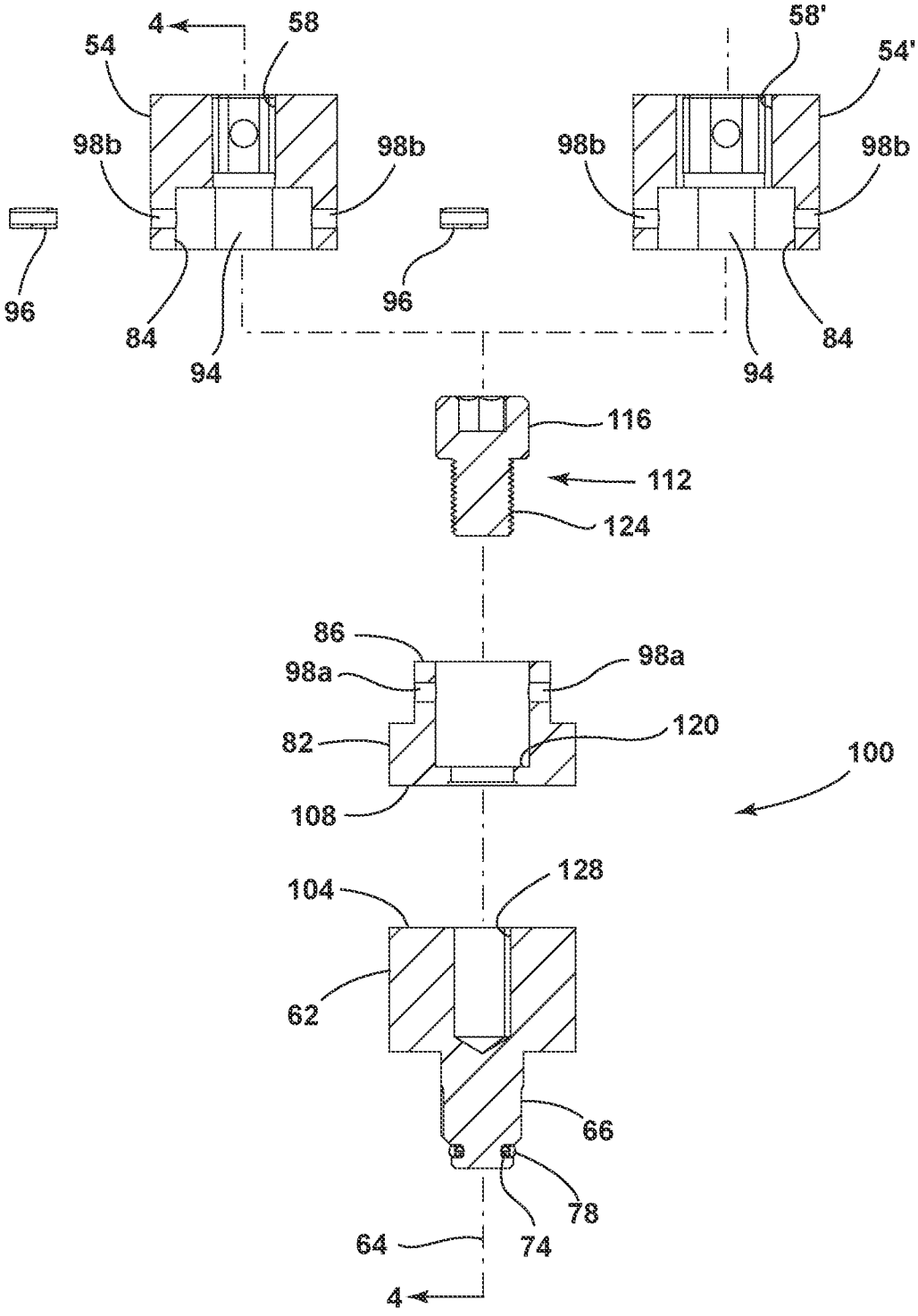
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FIG. 3

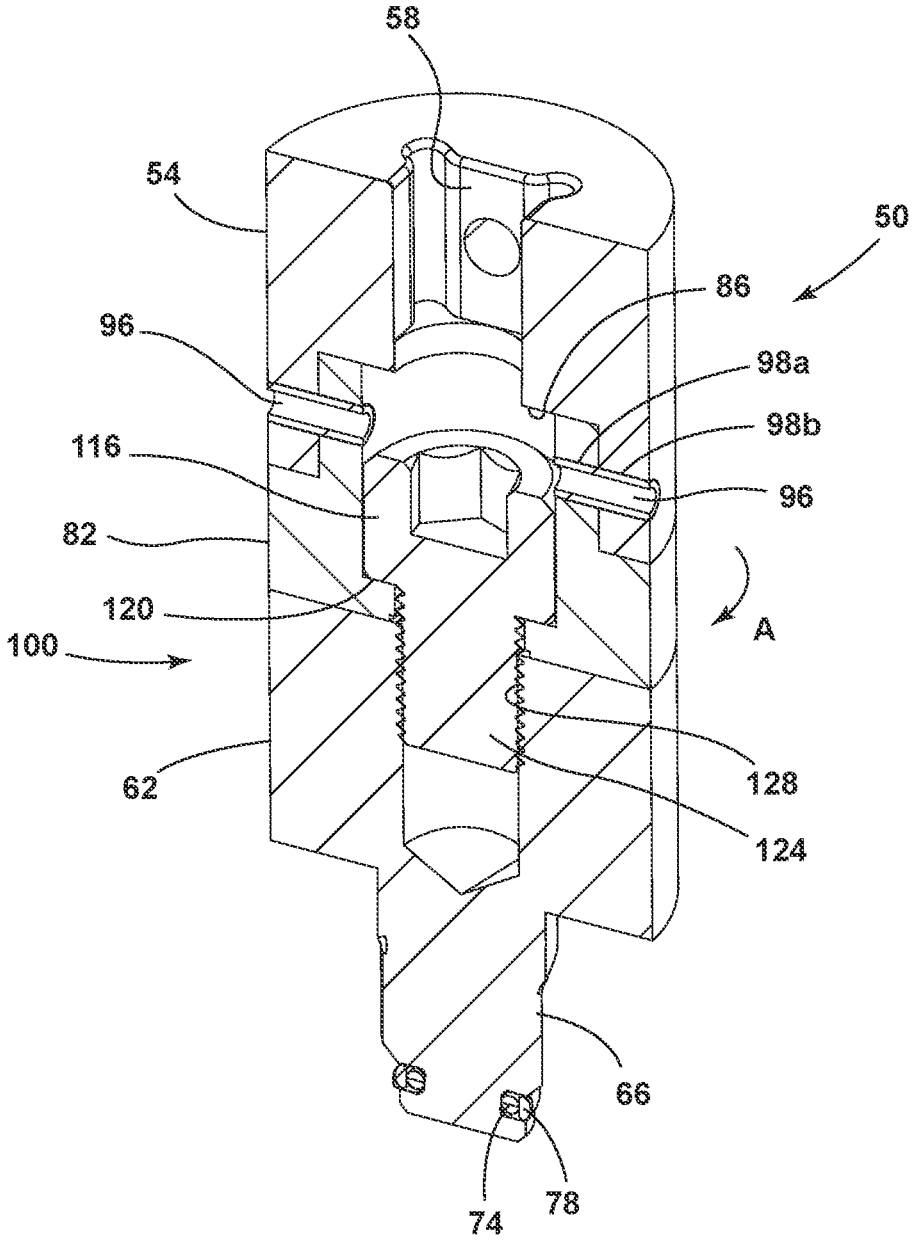

FIG. 4

CLUTCH SOCKET ADAPTER FOR A TOOL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a national stage filing under 35 U.S.C. § 371 of International Application No. PCT/US2021/054284, filed on Oct. 8, 2021, which claims priority to U.S. Provisional Patent Application No. 63/089,997, filed on Oct. 9, 2020, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to tools, and more particularly to socket wrenches and rotary tools. Rotary tools (e.g., a powered drill driver or hand wrench) are typically utilized to provide a rotational force to a tool adapter or workpiece (e.g., a fastener) to either tighten or loosen the fastener. Various tool attachments or onboard strain gauges can be used to limit the amount of torque delivered from the wrench to the workpiece.

SUMMARY OF THE INVENTION

In one embodiment, the invention provides, among other things, a socket adapter for limiting torque delivered from a tool to a socket piece. The socket adapter includes a female receiver that is coupleable to and driven by the tool, and a male drive that is coupled to and driven by the female receiver for transferring torque to the socket piece. The socket adapter further includes a clutch mechanism having a first clutch surface, a second clutch surface that engages the first clutch surface, and an adjustment mechanism for adjusting a clamping force between the first clutch surface and the second clutch surface. The second clutch surface slides relative to the first clutch surface when a reaction torque exerted on the clutch mechanism exceeds a predetermined torque limit.

In another embodiment, the invention provides, among other things, a socket adapter for limiting torque delivered from a tool to a socket piece including a clutch mechanism that is removably coupled to the tool and disposed between an output member of the tool and an output member of the socket adapter. The clutch mechanism includes a first clutch surface, a second clutch surface that engages the first clutch surface, and an adjustment mechanism for adjusting a clamping force between the first clutch surface and the second clutch surface. The second clutch surface slides relative to the first clutch surface when a reaction torque exerted on the clutch mechanism exceeds a predetermined torque limit. The adjustment mechanism is only accessible for adjustment by removing the clutch mechanism from the tool.

In another embodiment, the invention provides, among other things, a method of limiting torque delivered from a tool to a socket piece including driving a female receiver and a male drive with an output member of the tool by rotating the tool around a longitudinal axis, slipping a clutch mechanism between the female receiver and the male drive when a reaction torque from the socket piece is greater than a predetermined torque limit, such that the female receiver rotates relative to the male drive, and adjusting the predetermined torque limit of the clutch mechanism by inserting an adjustment tool through the female receiver and rotating an adjustment mechanism along the longitudinal axis, resulting in increased or decreased frictional forces of the clutch mechanism that resist relative rotation between the female receiver and the male drive.

Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a clutch socket adapter according to an embodiment of the invention, illustrating the clutch socket adapter receivable by a socket wrench.

FIG. **2** is an exploded view of the clutch socket adapter of FIG. **1**.

FIG. **3** is an exploded cross-sectional view of the clutch socket adapter of FIG. **2**, taken along line **3-3**.

FIG. **4** is a cross-sectional view of the clutch socket adapter of FIG. **1**, taken along line **4-4**.

Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

DETAILED DESCRIPTION

FIG. **1** illustrates a tool, such as ratchet wrench **10**, for delivering torque to a workpiece (e.g., a nut, a screw, a socket adapter, etc.). In the illustrated embodiment, the tool is a hand tool. In other embodiments, the tool may be a power tool, such as a driver drill. The illustrated ratchet wrench **10** includes an elongated handle **14**, a grip **18** disposed at a distal end **22** of the elongated handle **14**, and a working end **26** coupled to the elongated handle **14** opposite the grip **18**. The working end **26** includes a male drive **30** for engaging and driving a workpiece. The male drive **30** may be ¼ inch square drive, ⅜ inch square drive, ½ inch square drive, or some other size drive. In the illustrated embodiment, the working end **26** also includes a ratchet mechanism **34** for selectively transmitting rotational force from the elongated handle **14** to the male drive **30**.

FIG. **1** further illustrates a clutch socket adapter **50** that is coupleable to the ratchet wrench **10** for limiting the amount of torque delivered from the ratchet wrench **10** to a workpiece. The clutch socket adapter **50** includes a socket member **54** with a female receiver **58** (FIG. **2**) for receiving the male drive **30** of the wrench **10**. The clutch socket adapter **50** further includes a drive member **62** with a male drive **66** for receiving a socket that engages and drives a workpiece (e.g., a nut, a bolt head, etc.). The socket member **54** and the drive member **62** are coaxial along a longitudinal axis **64** of the clutch socket adapter **50**. As shown in FIG. **2**, the male drive **66** of the clutch socket adapter **50** includes an annular groove **70** that receives an O-ring **74** and a retaining ring **78**. The O-ring **74** and the retaining ring **78** extend beyond the outer periphery of the male drive **66** and are compressible to retain a socket on the male drive **66**.

With reference to FIGS. **1** and **2**, the clutch socket adapter **50** further includes an intermediate member **82** that is disposed between the socket member **54** and the drive member **62**. The intermediate member **82** includes an annular rim **86** that extends into an aperture **84** (FIG. **3**) of the socket member **54**. Specifically, the annular rim **86** includes a pair of flat regions **90** that mate with corresponding flat regions **94** (FIG. **3**) on the socket member **54** to form a keyed

relationship therebetween, inhibiting relative rotation between the socket member **54** and the intermediate member **82**. In other embodiments, the annular rim **86** and the aperture **84** may have other configurations to form the keyed relationship (e.g., square, hexagonal, D-shaped, oblong, etc.). Furthermore, one or more spring pins **96** are receivable within bore holes **98***a*, **98***b* of the annular rim **86** and the socket member **54**, inhibiting axial movement between the socket member **54** and the intermediate member **82**. That said, the socket member **54** and the intermediate member **82** are axially and rotationally constrained together when the socket member **54** and the intermediate member **82** are coupled together. However, the socket member **54** and the intermediate member **82** are capable of being decoupled in order to replace the socket member **54** with a separate socket member **54'** having a different sized female receiver **58'** (FIG. **3**).

With reference to FIGS. **2** and **3**, the clutch socket adapter **50** further includes a clutch mechanism **100** that is provided via a first clutch surface **104** of the drive member **62**, a second clutch surface **108** of the intermediate member **82**, and an adjustment mechanism **112**. The adjustment mechanism **112** couples the intermediate member **82** to the drive member **62**. Specifically, the adjustment mechanism **112** is a clamping screw that includes a head **116** and a threaded region **124**. The head **116** seats against a shoulder **120** of the intermediate member **82**. The threaded region **124** threadably engages a corresponding threaded region **128** of the drive member **62**. The threaded regions **124**, **128** may be provided with a thread locking compound to inhibit the adjustment mechanism **112** from inadvertently adjusting. The threaded region **124**, however, does not threadably engage the intermediate member **82**. The illustrated head **116** is a hex head, which can be driven by a hex tool upon inserting the hex tool through the female receiver **58** of the socket member **54**. In other embodiments, the head **116** may alternatively be a Phillips head, a slotted head, or other types of heads. In the illustrated embodiment, the first clutch surface **104** and the second clutch surface **108** are entirely flat, planar surfaces that extend along a direction perpendicular to the axis **64**. The first clutch surface **104** and the second clutch surface **108** rely on friction forces to resist relative rotation between the drive member **62** and the intermediate member **82**. Therefore, the friction force between the first clutch surface **104** and the second clutch surface **108** is increased when the adjustment mechanism **112** exerts an increased clamping force (i.e., is tightened) between the drive member **62** and the intermediate member **82**. Similarly, the friction force between the first clutch surface **104** and the second clutch surface **108** is decreased when the adjustment mechanism **112** exerts a decreased clamping force (i.e., is loosened) between the drive member **62** and the intermediate member **82**.

As explained in further detail below, the intermediate member **82** rotates (or slides) relative to the drive member **62** when a reaction torque exerted on the drive member **62** overcomes the friction force between the first clutch surface **104** and the second clutch surface **108**.

In operation, the clutch socket adapter **50** may be coupled to the ratchet wrench **10** once the desired socket member **54**, **54'** is coupled to the intermediate member **82**, where the female receiver **58** receives the male drive **30** of the ratchet wrench **10**. Subsequently, a hex tool may be inserted through the female receiver **58** to adjust a torque limit of the clutch mechanism **100**. Specifically, the hex tool engages and rotates the head **116** of the adjustment mechanism **112** to adjust the clamping force between the intermediate member **82** and the drive member **62**. By adjusting the clamping force, the torque limit of the clutch mechanism **100** is correspondingly adjusted. In some embodiments, the adjustment mechanism **112** is adjusted to a factory preset clamping force during a manufacturing process, where subsequent adjustment is inhibited.

For example, tightening (e.g., rotating in a first direction) the adjustment mechanism **112** increases the clamping force, thereby increasing the friction force between the first clutch surface **104** and the second clutch surface **108**. The torque limit at which the intermediate member **82** rotates relative to the drive member **62** increases as a result of increased friction force. Similarly, loosening (e.g., rotating in a second direction opposite the first direction) the adjustment mechanism **112** decreases the clamping force, thereby decreasing the friction force between the first clutch surface **104** and the second clutch surface **108**. The torque limit at which the intermediate member **82** rotates relative to the drive member **62** decreases as a result of decreased friction force. Although in some embodiments the first direction may be clockwise and the second direction may be counterclockwise, in other embodiments, the first direction may be counterclockwise and the second direction may be clockwise.

Once the clamping force—and therefore the torque limit—is set, the male drive **66** of the clutch socket adapter **50** may be coupled to a socket. At this point, a user may exert a torque on a workpiece via the socket to drive (e.g., rotate) the workpiece by applying a force F (FIG. **1**) on the elongated handle **14**. The workpiece is driven by the socket wrench **10** and the clutch socket adapter **50** until the reaction torque exerted on the clutch socket adapter **50** overcomes the torque limit. Specifically, the second clutch surface **108** rotates (or slides) in direction A (FIG. **4**) relative to the first clutch surface **104** when the reaction torque exerted on the drive member **62** overcomes the torque limit. Any additional force F applied to the elongated handle **14** of the socket wrench **10** will result in rotation of the elongated handle **14**, the socket member **54**, and the intermediate member **82** relative to the drive member **62** and the workpiece.

Various features of the invention are set forth in the following claims.

What is claimed is:

1. A socket adapter for limiting torque delivered from a tool to a socket piece, the socket adapter comprising:

a female receiver that is coupleable to and driven by the tool;

a male drive that is coupled to and driven by the female receiver for transferring torque to the socket piece; and

a clutch mechanism having

a first clutch surface,

a second clutch surface that engages the first clutch surface, and

an adjustment mechanism for adjusting a clamping force between the first clutch surface and the second clutch surface,

wherein the second clutch surface slides relative to the first clutch surface when a reaction torque exerted on the clutch mechanism exceeds a predetermined torque limit, and

wherein the male drive is rotatable relative to the female receiver about a longitudinal axis, and wherein the first clutch surface and the second clutch surface are flat, planar surfaces that extend along a direction perpendicular to the longitudinal axis.

2. The socket adapter of claim **1**, wherein the first clutch surface is coupled to the female receiver and the second clutch surface is disposed on the male drive.

3. The socket adapter of claim 1, wherein the adjustment mechanism is rotatable about the longitudinal axis to adjust the clamping force.

4. The socket adapter of claim 1, wherein the clamping force defines the predetermined torque limit, which corresponds to a friction coefficient between the first clutch surface and the second clutch surface.

5. The socket adapter of claim 1, wherein the adjustment mechanism is rotated in a first direction to increase the clamping force, resulting in increasing the predetermined torque limit, and is rotated in a second direction opposite the first direction to decrease the clamping force, resulting in decreasing the predetermine torque limit.

6. The socket adapter of claim 1, wherein the first clutch surface is disposed on an intermediate member that is disposed between the female receiver and the male drive, and wherein the second clutch surface is disposed on the male drive.

7. The socket adapter of claim 6, wherein the intermediate member includes an annular rim projecting away from the first clutch surface and extending into an aperture of the female receiver.

8. The socket adapter of claim 7, wherein the annular rim includes a flat region that mates with a corresponding flat region on the female receiver to form a keyed relationship therebetween, thereby inhibiting relative rotation between the female receiver and the intermediate member.

9. The socket adapter of claim 6, wherein the adjustment mechanism is a threaded fastener having a head and a threaded region, wherein the adjustment mechanism couples the intermediate member to the male drive.

10. The socket adapter of claim 9, wherein the head seats against a shoulder of the intermediate member and the threaded region threads into the male drive, thereby clamping the first clutch surface against the second clutch surface.

11. The socket adapter of claim 6, wherein the female receiver is removably coupled to the intermediate member via at least one pin.

12. The socket adapter of claim 11, wherein the female receiver is removable from the intermediate member to adapt to different sized tools without disassembling the clutch mechanism or changing the predetermined torque limit of the clutch mechanism.

13. The socket adapter of claim 1, wherein the predetermined torque limit of the clutch mechanism is the same regardless of whether the socket piece is being drive in a clockwise direction or a counterclockwise direction.

14. A socket adapter for limiting torque delivered from a tool to a socket piece, the socket adapter comprising:

a clutch mechanism that is removably coupled to the tool and disposed between an output member of the tool and an output member of the socket adapter, the clutch mechanism includes:

a first clutch surface,

a second clutch surface that engages the first clutch surface, and

an adjustment mechanism for adjusting a clamping force between the first clutch surface and the second clutch surface,

wherein the second clutch surface slides relative to the first clutch surface when a reaction torque exerted on the clutch mechanism exceeds a predetermined torque limit, and

wherein the adjustment mechanism is only accessible for adjustment by removing the clutch mechanism from the tool.

15. The socket adapter of claim 14, further comprising a female receiver that is coupleable to and driven by the tool, a male drive that is coupled to and driven by the female receiver for transferring torque to the socket piece, and an intermediate member that is disposed between the female receiver and the male drive, wherein the first clutch surface is disposed on the intermediate member and the second clutch surface is disposed on the male drive.

16. The socket adapter of claim 15, wherein the adjustment mechanism is a threaded fastener having a head and a threaded region, wherein the adjustment mechanism couples the intermediate member to the male drive.

17. The socket adapter of claim 16, wherein the head of the adjustment mechanism is accessible through an aperture in the female receiver that receives the output member of the tool.

18. The socket adapter of claim 17, wherein the male drive is rotatable relative to the female receiver about a longitudinal axis, and wherein the adjustment mechanism is rotatable about the longitudinal axis to adjust the clamping force via an adjustment tool that is inserted through the aperture of the female receiver and engages the head of the adjustment mechanism.

19. A method of limiting torque delivered from a tool to a socket piece, the method comprising:

driving a female receiver and a male drive with an output member of the tool by rotating the tool around a longitudinal axis;

slipping a clutch mechanism between the female receiver and the male drive when a reaction torque from the socket piece is greater than a predetermined torque limit, such that the female receiver rotates relative to the male drive; and

adjusting the predetermined torque limit of the clutch mechanism by inserting an adjustment tool through the female receiver and rotating an adjustment mechanism along the longitudinal axis, resulting in increased or decreased frictional forces of the clutch mechanism that resist relative rotation between the female receiver and the male drive.

* * * * *