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Reconfigurable welding-type power sockets and power plugs

Abstract

In some examples, apparatuses, systems, and/or methods for configuring and/or reconfiguring welding-type power sockets and/or welding-type plugs may include welding-type power sockets and/or welding-type plugs that may be configurable (and/or reconfigurable) through custom socket inserts, socket connectors, plug adapters, and plug receptacles.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of, and claims priority to, co-pending U.S. patent application Ser. No. 16/033,922, filed Jul. 12, 2018,

entitled “Reconfigurable Welding-Type Power Sockets and Power Plugs,” the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

(1) The present disclosure generally relates to welding-type systems, and more particularly to welding-type power sockets and power plugs that are configurable (and/or reconfigurable).

BACKGROUND

(2) Some welding systems include welding components (e.g., torch, clamp, wire feeder, etc.) that are powered by a welding power supply. Power is transferred from a welding power supply to a welding component via a cable connection with a power socket of the power supply, such as through a plug end of the cable. However, some power supplies have power sockets that are configured to connect only with one particular type of plug and/or cable. This may make it difficult to connect one type of plug to a power socket designed for a different type of plug.

(3) Limitations and disadvantages of conventional and traditional approaches will become apparent to one of skill in the art, through comparison of such systems with the present disclosure as set forth in the remainder of the present application with reference to the drawings.

SUMMARY

(4) The present disclosure is directed to welding-type power sockets and plugs that are configurable (and/or reconfigurable), for example, substantially as illustrated by and/or described in connection with at least one of the figures, and as set forth more completely in the claims.

(5) These and other advantages, aspects and novel features of the present disclosure, as well as details of an illustrated example thereof, will be more fully understood from the following description and drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** illustrates an example of a welding-type system, in accordance with aspects of this disclosure.

(2) FIG. **2** is a block diagram of the example welding-type system of FIG. **1**, in accordance with aspects of this disclosure.

(3) FIG. **3***a* is a perspective exploded view of an example welding-type power socket, in accordance with aspects of this disclosure.

(4) FIG. **3***b* is a front view of the example welding-type power socket of FIG. **3***a* with one of the socket inserts of FIG. **3***a*, in accordance with aspects of this disclosure.

(5) FIG. **3***c* is a cross-section of the example welding type power socket of FIG. **3***b*, along the line **3***c*-**3***c* in FIG. **3***b*, in accordance with aspects of this disclosure

(6) FIG. **4***a* is a front view of an example bulkhead, in accordance with aspects of this disclosure.

(7) FIG. **4***b* is a cross-section of the example bulkhead of FIG. **4***a*, along the line **4***b*-**4***b* of FIG. **4***a*, in accordance with aspects of this disclosure.

(8) FIG. **5***a* is a front view of an example socket connector, in accordance with aspects of this disclosure.

(9) FIG. **5***b* is a cross-section of the example socket connector of FIG. **5***a*, along the line **5***b*-**5***b* of FIG. **5***b*, in accordance with aspects of this disclosure.

(10) FIG. **5***c* is a front view of another example socket connector, in accordance with aspects of this disclosure.

(11) FIG. **5***d* is a cross-section of the example socket connector of FIG. **5***d*, along the line **5***d*-**5***d* in FIG. **5***c*, in accordance with aspects of this disclosure.

(12) FIG. **6***a* is a front view of an example insert, in accordance with aspects of this disclosure.

(13) FIG. **6***b* is a cross-section of the example insert of FIG. **6***a*, along the line **6***b*-**6***b* of FIG. **6***a*, in

accordance with aspects of this disclosure.
(14) FIG. **6***c* is a front view of another example insert, in accordance with aspects of this disclosure.
(15) FIG. **6***d* is a cross-section of the example insert of FIG. **6***c*, along the line **6***d*-**6***d* of FIG. **6***c*, in accordance with aspects of this disclosure.
(16) FIG. **6***e* is a front view of another example insert, in accordance with aspects of this disclosure.
(17) FIG. **6***f* is a cross-section of the example insert of FIG. **6***e*, along the line **6***f*-**6***f* of FIG. **6***e*, in accordance with aspects of this disclosure.
(18) FIG. **7***a* is a perspective exploded view of an example plug assembly, in accordance with aspects of this disclosure.
(19) FIG. **7***b* is a perspective exploded view of another example plug assembly, in accordance with aspects of this disclosure.
(20) FIG. **8***a* is a perspective view of an example plug adapter, in accordance with aspects of this disclosure.
(21) FIG. **8***b* is a front view of the example plug adapter of FIG. **8***a*, in accordance with aspects of this disclosure.
(22) FIG. **8***c* is a cross-section of the example plug adapter of FIG. **8***b*, along the line **8***c*-**8***c* of FIG. **8***b*, in accordance with aspects of this disclosure.
(23) FIG. **8***d* is a perspective view of another example plug adapter, in accordance with aspects of this disclosure.
(24) FIG. **8***e* is a front view of the example plug adapter of FIG. **8***d*, in accordance with aspects of this disclosure.
(25) FIG. **8***f* is a cross-section of the example plug adapter of FIG. **8***e*, along the line **8***f*-**8***f* of FIG. **8***e*, in accordance with aspects of this disclosure.
(26) FIG. **8***g* is a perspective view of another example plug adapter, in accordance with aspects of this disclosure.
(27) FIG. **8***h* is a front view of the example plug adapter of FIG. **8***g*, in accordance with aspects of this disclosure.
(28) FIG. **8***i* is a cross-section of the example plug adapter of FIG. **8***b*, along the line **8***c*-**8***c* of FIG. **8***b*, in accordance with aspects of this disclosure.
(29) FIG. **8***j* is a perspective view of another example plug adapter, in accordance with aspects of this disclosure.
(30) FIG. **8***k* is a front view of the example plug adapter of FIG. **8***j*, in accordance with aspects of this disclosure.
(31) FIG. **8***l* is a cross-section of the example plug adapter of FIG. **8***k*, along the line **8***l*-**8***l* of FIG. **8***k*, in accordance with aspects of this disclosure.
(32) FIG. **8***m* is a perspective view of another example plug adapter, in accordance with aspects of this disclosure.
(33) FIG. **8***n* is a front view of the example plug adapter of FIG. **8***m*, in accordance with aspects of this disclosure.
(34) FIG. **8***o* is a cross-section of the example plug adapter of FIG. **8***n*, along the line **8***o*-**8***o* of FIG. **8***n*, in accordance with aspects of this disclosure.
(35) FIG. **8***p* is a perspective view of another example plug adapter, in accordance with aspects of this disclosure.
(36) FIG. **8***q* is a front view of the example plug adapter of FIG. **8***p*, in accordance with aspects of this disclosure.
(37) FIG. **8***r* is a cross-section of the example plug adapter of FIG. **8***q*, along the line **8***r*-**8***r* of FIG. **8***q*, in accordance with aspects of this disclosure.
(38) FIG. **9***a* is a front view of an example plug receptacle, in accordance with aspects of this disclosure.
(39) FIG. **9***b* is a cross-section of the example plug receptacle of FIG. **9***a*, along the line **9***b*-**9***b* of

FIG. **9***a*, in accordance with aspects of this disclosure.
(40) FIG. **10***a* is a front view of the plug assembly of FIG. **7***a*, with one of the plug adapters of FIG. **7***a*, in accordance with aspects of this disclosure.
(41) FIG. **10***b* is a cross-section of the plug assembly of FIG. **10***a*, along the line **10***b*-**10***b* in FIG. **10***a*, in accordance with aspects of this disclosure.
(42) FIG. **10***c* is a cross section of the plug assembly of FIG. **7***b*, with one of the plug adapters of FIG. **7***b*, in accordance with aspects of this disclosure.
(43) FIG. **11** is a flow diagram illustrating an example method of operation, in accordance with aspects of this disclosure.
(44) The figures are not necessarily to scale. Where appropriate, similar or identical reference numerals are used to refer to similar or identical components. For example, reference numerals utilizing lettering (e.g., socket connector **500***a*, socket connector **500***b*) refer to instances of the same reference numeral that does not have the lettering (e.g., socket connectors **500**).
DETAILED DESCRIPTION
(45) Preferred examples of the present disclosure may be described hereinbelow with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail because they may obscure the disclosure in unnecessary detail. For this disclosure, the following terms and definitions shall apply.
(46) As used herein, the terms "about" and/or "approximately," when used to modify or describe a value (or range of values), position, orientation, and/or action, mean reasonably close to that value, range of values, position, orientation, and/or action. Thus, the examples described herein are not limited to only the recited values, ranges of values, positions, orientations, and/or actions but rather should include reasonably workable deviations.
(47) As utilized herein, the terms "e.g.," and "for example" set off lists of one or more non-limiting examples, instances, or illustrations.
(48) As used herein, "and/or" means any one or more of the items in the list joined by "and/or". As an example, "x and/or y" means any element of the three-element set {(x), (y), (x, y)}. In other words, "x and/or y" means "one or both of x and y". As another example, "x, y, and/or z" means any element of the seven-element set {(x), (y), (z), (x, y), (x, z), (y, z), (x, y, z)}. In other words, "x, y and/or z" means "one or more of x, y and z".
(49) As used herein, the terms "coupled," "coupled to," and "coupled with," each mean a structural and/or electrical connection, whether attached, affixed, connected, joined, fastened, linked, and/or otherwise secured. As used herein, the term "attach" means to affix, couple, connect, join, fasten, link, and/or otherwise secure. As used herein, the term "connect" means to attach, affix, couple, join, fasten, link, and/or otherwise secure.
(50) As used herein the terms "circuits" and "circuitry" refer to physical electronic components (i.e., hardware) and any software and/or firmware ("code") which may configure the hardware, be executed by the hardware, and or otherwise be associated with the hardware. As used herein, for example, a particular processor and memory may comprise a first "circuit" when executing a first one or more lines of code and may comprise a second "circuit" when executing a second one or more lines of code. As utilized herein, circuitry is "operable" and/or "configured" to perform a function whenever the circuitry comprises the necessary hardware and/or code (if any is necessary) to perform the function, regardless of whether performance of the function is disabled or enabled (e.g., by a user-configurable setting, factory trim, etc.).
(51) As used herein, a control circuit may include digital and/or analog circuitry, discrete and/or integrated circuitry, microprocessors, DSPs, etc., software, hardware and/or firmware, located on one or more boards, that form part or all of a controller, and/or are used to control a welding process, and/or a device such as a power source or wire feeder.
(52) As used, herein, the term "memory" and/or "memory device" means computer hardware or circuitry to store information for use by a processor and/or other digital device. The memory and/or

memory device can be any suitable type of computer memory or any other type of electronic storage medium, such as, for example, read-only memory (ROM), random access memory (RAM), cache memory, compact disc read-only memory (CDROM), electro-optical memory, magneto-optical memory, programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), electrically-erasable programmable read-only memory (EEPROM), a computer-readable medium, or the like.

(53) As used herein, the term "processor" means processing devices, apparatuses, programs, circuits, components, systems, and subsystems, whether implemented in hardware, tangibly embodied software, or both, and whether or not it is programmable. The term "processor" as used herein includes, but is not limited to, one or more computing devices, hardwired circuits, signal-modifying devices and systems, devices and machines for controlling systems, central processing units, programmable devices and systems, field-programmable gate arrays, application-specific integrated circuits, systems on a chip, systems comprising discrete elements and/or circuits, state machines, virtual machines, data processors, processing facilities, and combinations of any of the foregoing. The processor may be, for example, any type of general purpose microprocessor or microcontroller, a digital signal processing (DSP) processor, an application-specific integrated circuit (ASIC). The processor may be coupled to, or integrated with a memory device.

(54) The term "power" is used throughout this specification for convenience, but also includes related measures such as energy, current, voltage, and enthalpy. For example, controlling "power" may involve controlling voltage, current, energy, and/or enthalpy, and/or controlling based on "power" may involve controlling based on voltage, current, energy, and/or enthalpy.

(55) As used herein, welding-type power refers to power suitable for welding, cladding, brazing, plasma cutting, induction heating, CAC-A and/or hot wire welding/preheating (including laser welding and laser cladding), carbon arc cutting or gouging, and/or resistive preheating.

(56) As used herein, a welding-type power supply and/or power source refers to any device capable of, when power is applied thereto, supplying welding, cladding, brazing, plasma cutting, induction heating, laser (including laser welding, laser hybrid, and laser cladding), carbon arc cutting or gouging and/or resistive preheating, including but not limited to transformer-rectifiers, inverters, converters, resonant power supplies, quasi-resonant power supplies, switch-mode power supplies, etc., as well as control circuitry and other ancillary circuitry associated therewith.

(57) Some examples of the present disclosure relate to a removable insert for a socket of a welding power supply, comprising a base having a keyed entryway configured to connect with a key interface of a plug, a nose comprising a contact surface configured to make electrical contact with a complementary contact surface of a socket connector, and a coupler configured to couple the removable insert to the socket connector.

(58) In some examples, the keyed entryway comprises a bore encircled by an inner surface of the base, the inner surface having a keyed surface. In some examples, the keyed surface comprises a latch that protrudes into the bore or an axial groove that expands the bore. In some examples, the contact surface comprises a frustoconical surface. In some examples, the coupler comprises a shoulder screw having a head, a screw thread, and a shank connecting the head to the screw thread, the screw thread configured to engage complementary threaded grooves of the socket connector. In some examples, the head of the shoulder screw is positioned within the nose, the head having a tool interface configured for coupling to a tool. In some examples, the coupler further comprises a nut engaged to the screw thread.

(59) Some examples of the present disclosure relate to a welding power supply, comprising a housing having an electrical panel with an insulating bulkhead, and a socket connector within the insulating bulkhead, the socket connector comprising a bore encircled by an inner surface, the inner surface comprising a contact surface configured to make electrical contact with a complementary contact surface of a removable insert, and a coupling surface configured to engage a complementary coupling surface of the removable insert.

(60) In some examples, the contact surface comprises a conical surface. In some examples, the coupling surface comprises threaded grooves. In some examples, the inner surface further comprises a central surface between the contact surface and the coupling surface. In some examples, the bore has a first diameter at the coupling surface, and a second diameter that is larger than the first diameter at the contact surface. In some examples, the bore has a third diameter at the central surface, the third diameter being larger than the first diameter and smaller than the second diameter. In some examples, the welding power supply further comprises power conversion circuitry positioned within the housing, the power conversion circuitry configured to generate welding-type output power and being in electrical communication with the socket connector.
(61) Some examples of the present disclosure relate to a removable insert for a socket of a welding power supply, comprising a mechanical connector configured to mechanically connect the removable insert to a socket connector of the welding power supply, a first electrical connector configured to electrically connect the removable insert to the socket connector, and a second electrical connector configured to electrically connect the removable insert to a plug.
(62) In some examples, the mechanical connector comprises a shoulder screw having a head, a screw thread, and a shank connecting the head to the screw thread, the screw thread configured to engage complementary threaded grooves of the socket connector. In some examples, the first electrical connector comprises an electrically conductive frustoconical surface. In some examples, the second electrical connector comprises a base having a keyed entryway configured to connect with a key interface of the plug. In some examples, the keyed entryway comprises a bore encircled by an inner surface of the base, the inner surface having a keyed surface. In some examples, the keyed surface comprises a latch that protrudes into the bore or an axial groove that expands the bore.
(63) Some examples of the present disclosure relate to welding-type power sockets and/or welding-type plugs that are configurable (and/or reconfigurable) through custom socket inserts, socket connectors, plug adapters, and plug receptacles. Currently, conventional welding-type power supplies have power sockets that are configured to connect with only one particular type of plug. Likewise, conventional welding components have plugs configured to connect with only one particular type of power socket. Welding components having singular connection types make it difficult to connect a plug of one type to a power socket of a different type, and vice versa.
(64) While it is possible to take apart a welding-type power supply and reconfigure the power sockets internally to work with a different type and/or style of plug, such an internal reconfiguration can be difficult, and/or time consuming. Devices do exist for external reconfiguration of welding-type power sockets. However, these devices often only loosely connect to the power sockets. Thus, when a plug is connected to a power socket through the device, the plug may be more securely coupled to the device than the device is coupled to the power socket, resulting in unintentional removal of the device from the power socket when the plug is removed from the power sockets. This risk of unintentional removal may be increased where the device and plug are attached and/or removed using the same or similar motion. Further, the devices tend to use the same structures and/or surfaces to establish both a mechanical and electrical connection with the power sockets. Therefore, a loose mechanical connection may also result in a loose and/or unreliable electrical connection.
(65) Some examples of the present disclosure, therefore, relate to inserts that may be more securely coupled to welding-type power sockets, so as to configure (and/or reconfigure) the power sockets for connection to different plug types (and/or shapes, styles, designs, etc.) with less risk of unintentional removal. The adapters further include different surfaces and/or structures to establish mechanical, versus electrical, connections with the power sockets. Additionally, the methods, modes, motions, and/or mediums of connection between adapter and power socket are different than that of the connection between plug and adapter. Thus, the adapters may be more securely, effectively, and/or reliably used to configure (and/or reconfigure) the plugs and/or sockets.

(66) FIGS. **1** and **2** show a perspective view and block diagram view, respectively, of an example of a welding-type system **10**. It should be appreciated that, while the example welding-type system **10** shown in FIGS. **1** and **2** may be described as a gas metal arc welding (GMAW) system, the presently disclosed system may also be used with other arc welding processes (e.g., flux-cored arc welding (FCAW), gas shielded flux-cored arc welding (FCAW-G), gas tungsten arc welding (GTAW), submerged arc welding (SAW), shielded metal arc welding (SMAW), or similar arc welding processes) or other metal fabrication systems, such as plasma cutting systems, induction heating systems, and so forth.

(67) In the example of FIGS. **1** and **2**, the welding-type system **10** includes a welding-type power supply **12** (i.e., a welding-type power source), a welding wire feeder **14**, a gas supply **20**, and a welding torch **16**. The welding-type power supply **12** generally supplies welding-type power for the various welding-type components and/or accessories of the welding-type system **10** (e.g., the welding wire feeder **14** and/or welding torch **16**) through an electrical panel **102** of a housing **104** of the welding-type power supply. In the example of FIG. **1**, the electrical panel **102** is part of a front panel **106** on the housing **104** of the welding-type power supply **12**. In some examples, the electrical panel **102** may instead be part of a rear panel, a side panel, a top panel, and/or a bottom panel of the housing **104**.

(68) As shown in the examples of FIGS. **1** and **2**, the electrical panel **102** includes welding-type power sockets **300**. As shown, two of the power sockets **300** are connected to power plugs **700**. The sockets **300** may be configured for positive polarity and/or negative polarity. In the example of FIG. **1**, there is also a third (unlabeled) socket between the sockets **300**. In some examples, there may be more or less than two sockets **300**, such as a single socket and/or three or more sockets. In the example of FIG. **2**, the sockets **300** extend through the housing **104**, such that a portion of each socket **300** is both inside and outside the housing **104**.

(69) In the example of FIGS. **1** and **2**, the welding-type power supply **12** is coupled to the welding wire feeder **14** and work piece **26** through the power sockets **300**. More particularly, the wire feeder **14** and work piece **26** are connected to the power sockets **300** via plugs **700**. One plug **700** is connected to one or more weld cables **38** which lead to the wire feeder **14**, while another plug **700** is coupled to one or more lead cables **39** that lead to the work piece **26** through the work clamp **23**. While not specifically labeled, in some examples, the welding wire feeder **14** may include one or more sockets and/or plugs as well.

(70) In the illustrated examples, the welding wire feeder **14** is connected to the welding torch **16** in order to supply welding wire and/or welding-type power to the welding torch **16** during operation of the welding-type system **10**. In some examples, the welding-type power supply **12** may couple and/or directly supply welding-type power to the welding torch **16**. In the illustrated example, the power supply **12** is separate from the wire feeder **14**, such that the wire feeder **14** may be positioned at some distance from the power supply **12** near a welding location. However, it should be understood that the wire feeder **14**, in some examples, may be integral with the power supply **12**. In some examples, the wire feeder **14** may be omitted from the system **10** entirely.

(71) In the examples of FIGS. **1** and **2**, the welding-type system **10** includes a gas supply **20** that may supply a shielding gas and/or shielding gas mixtures to the welding torch **16**. A shielding gas, as used herein, may refer to any gas or mixture of gases that may be provided to the arc and/or weld pool in order to provide a particular local atmosphere (e.g., shield the arc, improve arc stability, limit the formation of metal oxides, improve wetting of the metal surfaces, alter the chemistry of the weld deposit, and so forth). In the example of FIG. **1**, the gas supply **20** is coupled to the welding torch **16** through the wire feeder **14** via a gas conduit **42**. In such an example, the welding wire feeder **14** may regulate the flow of gas from the gas supply **20** to the welding torch **16**. In the example of FIG. **2**, the gas supply **20** is depicted as coupled directly to the welding torch **16** rather than being coupled to the welding torch **16** through the wire feeder **14**. The gas supply **20** may be integral with or separate from the power supply **12**. In some examples, no gas supply **20**

may be used.
(72) In the example of FIG. **2**, the welding-type power supply **12** includes an operator interface **28**, control circuitry **30**, and power conversion circuitry **32**. The power conversion circuitry **32** is configured to receive input power from a power source **34** (e.g., the AC power grid, an engine/generator set, or a combination thereof), and adjust the input power as appropriate for a desired welding-type application. Though the power source **34** is shown in FIG. **2** as being outside the housing **104**, in some examples the power source **34** may be internal to the housing **104**. The power conversion circuitry **32** is configured to output welding-type power to the wire feeder **14** and/or work piece **26** through the power sockets **300**. The control circuitry **30** may control the power conversion circuitry **32** to produce the appropriate and/or desired welding-type power. An operator may provide weld input and/or weld settings (e.g., regarding the appropriate and/or desired welding-type power) through the operator interface **28**.
(73) The power conversion circuitry **32** may include circuit elements (e.g., transformers, rectifiers, capacitors, inductors, diodes, transistors, switches, and so forth) capable of converting input power to welding-type output power. In some examples, the welding-type output power of the power conversion circuitry **32** may comprise one or more of a direct current electrode positive (DCEP) output, direct current electrode negative (DCEN) output, DC variable polarity, and/or a variable balance (e.g., balanced or unbalanced) AC output, as dictated by the demands of the welding-type system **10** (e.g., based on the type of welding process performed by the welding-type system **10**, and so forth).
(74) The control circuitry **30** is configured to control the power conversion circuitry **32** using one or more control algorithms. In the example of FIG. **2**, the control circuitry **30** comprises one or more processors **35** and/or memory **37**. The one or more processors **35** may use data stored in the memory **37** to execute the control algorithms to control the power conversion circuitry **32**. In some examples, the control circuitry **30** may use input from feedback sensors and/or an operator to control the power conversion circuitry **32**.
(75) In some examples, the welding-type system **10** may receive weld settings from the operator via the operator interface **28**. In the example of FIG. **1**, control elements **29** of the operator interface **28** are provided on the front panel **106** of the housing **104**, proximate the electrical panel **102**. As shown, the control elements **29** may include switches, knobs, gauges, etc. In the example of FIG. **2**, the operator interface **28** is coupled to the control circuitry **30**, and may communicate the weld settings to the control circuitry **30** via this coupling.
(76) In the example of FIGS. **1** and **2**, the welding-type system **10** includes one or more sensors **36**. The control circuitry **30** may monitor the current and/or voltage of the arc **24** using the sensors **36**. In the examples of FIGS. **1** and **2**, a first sensor **36***a* is clamped to the work piece **26**, and a second sensor **36***b* is positioned on and/or proximate to the welding torch **16**. In some examples, additional sensors **36** may positioned on and/or proximate the wire feeder **14** and/or weld cable **38**. The one or more sensors **36** may comprise, for example, current sensors, voltage sensors, impedance sensors, and/or other appropriate sensors. In some examples, the control circuitry **30** may determine and/or control the power conversion circuitry **32** to produce an appropriate power output, arc length, and/or electrode extension based at least in part on feedback from the sensors **36**.
(77) The power conversion circuitry **32** may provide DC and/or AC welding-type output power via the power sockets **300**. As such, the welding-type power supply **12** may power the welding wire feeder **14** that, in turn, powers the welding torch **16**, in accordance with demands of the welding-type system **10**. The lead cable **39** terminating in the clamp **23** couples the welding-type power supply **12** to the work piece **26** to close the circuit between the welding-type power supply **12**, the work piece **26**, and the welding torch **16**. An operator may engage a trigger **22** of the torch **16** to initiate an arc **24** between a wire electrode **18** fed through the torch **16** and the work piece **26**. In some examples, engaging the trigger **22** of the torch **16** may initiate a different welding-type function, instead of an arc **24**.

(78) FIG. **3***a* shows an exploded view of an example power socket assembly **300**. FIG. **3***c* shows an assembled cross-sectional view of the power socket assembly **300**. While the example power socket assembly **300** shown in FIGS. **3***a* and **3***c* shows only the socket connector **500***a*, it should be understood that socket connector **500***b* could also have been used. Likewise, while the cross-section of FIG. **3***c* shows only the socket insert **600***a* and socket connector **500***a*, any combination of socket inserts **600** and socket connectors **500** shown in FIGS. **3***a* and **5***a*-**6***f* may be used to form the power sockets **300** in FIGS. **1** and **2**. It should be understood that the disclosed example power sockets **300** may be used to provide multiple power outputs in the electrical panel **102**. When fully assembled, the components of the power socket assembly **300** are approximately centered about a common axis **101**, as shown, for example in FIG. **3***c*.

(79) In the examples of FIGS. **3***a*-**3***c*, each power socket **300** includes an insulating bulkhead **400**, an insulating cap **302**, a socket connector **500**, and a socket insert **600**. The insulating bulkhead **400** formed on the electrical panel **102** extends from an exterior of the housing **104**, through the electrical panel **102**, and into an interior of the housing **104**. The insulating cap **302** encircles the bulkhead **400** within the housing **104** (see also FIGS. **4***a* and **4***b*). The insulating bulkhead **400** and/or insulating cap **302** may be formed of an electrically insulating material. In some examples, the bulkhead **400** and/or cap **302** may additionally, or alternatively, be formed of a thermally insulating material.

(80) In the examples of FIGS. **3***a*-**4***b*, the insulating bulkhead **400** includes a generally cylindrical exterior surface **402** extending from the electrical panel **102** on the exterior of the housing **104**. An interior surface **404** of the bulkhead **400** surrounds a slot **406** that extends through the electrical panel **102** and bulkhead **400** into the housing **104**. The interior surface **404** of the bulkhead **400** is approximately circular and/or cylindrical, with two parallel straight edge portions **408** truncating the circular/cylindrical shape. The resulting shape of the slot **406** is similar to the shape of a collar **502** of the socket connector **500**, so that the socket connector **500** may snugly fit within the slot **406**, as further explained below.

(81) As may be seen, for example, in FIG. **4***b*, the slot **406** has a diameter that decreases as the slot **406** extends inward toward the cap **302**. More particularly, the inner surface **404** of the bulkhead **400** includes a shoulder **410** and taper **412** that narrows the diameter of the slot **406**. The shoulder **410** and/or taper **412** are configured to abut the collar **502** of a socket connector **500** when a socket connector **500** is inserted into the slot **406**, so as to help retain the socket connector **500** within the slot **406** and prevent the socket connector **500** from moving farther into the interior of the housing **104**.

(82) FIGS. **5***a*-**5***d* show two different example socket connectors **500**. The socket connectors **500** may comprise electrically conductive material, such as brass and/or copper, for example. In some examples, the different socket connectors **500** may be used to output different power polarities, such that one socket connector **500** is used in the electrical panel **102** to output positive polarity welding-type power while the other socket connector **500** is used in the electrical panel **102** to output negative polarity welding-type power. In some examples, two of the same socket connectors **500** may be used to output both positive and negative polarity welding-type power. In some examples, one of the socket connector **500** may be used in the electrical panel **102** and configured to output positive or negative polarity welding-type power, while a different socket connector (not shown) may be used in the electrical panel **102** and configured to output the other polarity of welding-type power. In some examples, the operator interface **28** may include a control element that allows for selection of power socket polarity.

(83) In the examples of FIGS. **5***a*-**5***d*, each socket connector **500** comprises an inner surface and an outer surface. The outer surface includes a collar **502**, a body **504** that extends from the collar **502**, and a nose **506** that extends from the body **504**. In the examples of FIGS. **3***a*-**5***d*, the collar **502** is generally circular, with two opposing and/or parallel wrench flats **508**. The collar **502** has a shape similar to that of the slot **406**, so as to provide a snug fit within the slot **406**. The collar **502** may be

configured to abut the shoulder **410** and/or taper **412** of the bulkhead **400** when assembled within the slot **406**.

(84) In the examples of FIGS. **5***a*-**5***d*, the body **504** of each socket connector **500** is generally cylindrical, and includes a groove **510** in an approximate middle of the body **504** configured to fit an O-ring. In the example of FIGS. **5***b* and **5***d*, the collar **502** has the largest outer diameter, followed by the body **504**, then the nose **506**, and then the groove **510**. When the power socket **300** is fully assembled, the body **504** may be substantially and/or entirely covered by bulkhead **400** and/or cap **302**. However, the nose **506** extends forward from the body **504**, such that the nose **506** extends further into the housing **104**, beyond the cap **302**, therefore remaining uncovered within the housing **104**.

(85) In the examples of FIGS. **5***a*-**5***d*, the nose **506** includes engagement features, such as screw threads, for example. The engagement features of the nose **506** may be configured to engage with complementary engagement features (e.g., threaded grooves) of a nut **306**. As may be seen in FIGS. **3***a* and **3***c*, for example, the nut **306** may be combined with a washer **308** to retain the socket connector **500** within the slot **406** (in conjunction with the shoulder **410** and/or taper **412**) and to retain the cap **302** over the bulkhead **400** and/or body **504** of the socket connector **500**.

(86) In the examples of FIGS. **5***a*-**5***d*, the inner surface of each socket connector **500** surrounds a bore **512** that extends through the socket connector **500**. The inner surface of the socket connector includes a contact surface **514**, a coupling surface **518**, and a central surface **516**. In the examples of FIGS. **5***b* and **5***d*, the contact surface **514** extends from the collar **502** into the body **504**, and terminates short of the groove **510**. The central surface **516** extends from the contact surface **514** towards the nose **506**. The coupling surface **518** extends from the central surface **516** towards a receiving surface **520**, further explained below. As shown, the diameter of the bore **512** is largest at the contact surface and smallest at the coupling surface **518**, with the bore **512** having a diameter at the central surface **516** that is larger than the diameter of the bore **512** at the coupling surface **518**, but smaller than the diameter of the bore **512** at the contact surface **514**.

(87) The contact surface **514** is configured to make electrical contact with a nose **614** of an insert **600**. In the examples of FIGS. **5***b* and **5***d*, the contact surface **514** is approximately conical (and/or frustoconical), such that the bore **512** decreases in diameter traveling from the collar **502** in towards the central surface **516**. The conical (and/or frustoconical) shape of the contact surface **514** provides a substantial surface area for electrical contact, and increases the likelihood of good electrical contact when an insert **600** is firmly secured to the socket connector **500**.

(88) In the examples of FIGS. **5***b* and **5***d*, the central surface **516** lies between the contact surface **514** and the coupling surface **518**. The central surface **516** encircles a portion of the bore **512** that is configured to fit a nut **616** of the insert **600**. The coupling surface **518** is configured to engage a complementary coupler **618** of the insert **600**. The coupling surface **518** may include engagement features, such as, for example, threaded grooves, to connect with (and/or attach to) complementary engagement features of a coupler **618** of the insert **600**.

(89) In the example of FIG. **5***b*, the inner surface of the socket connector **500***a* further includes a receiving surface **520***a* that is configured to receive and make contact with one or more electrical conductors (and/or wires, wiring, cables, leads, clips etc.) coming from the power conversion circuitry **32**. In some examples, the electrical conductors may extend into the bore **512** encircled by the receiving surface **520***a* so as to connect the socket connector **500** to the power conversion circuitry **32**. In some examples, the socket connector **500** may additionally, or alternatively, be connected to the power conversion circuitry **32** via the nose **506**, which may make electrical contact with one or more electrical conductors. In the example of FIG. **5***d*, the socket connector **500***b* has a different receiving surface **520***b* that is part of the outer surface of the socket connector **500***b*. The receiving surface **520***b* extends from the nose **506**, and has a hole **522** that may receive a bolt or other fastener so as to couple the one or more electrical conductors to the socket connector **500***b*.

(90) Each socket connector **500** is configured for coupling to a plurality of inserts **600**. In the example of FIG. **3***a*, three inserts **600** are shown. Any of the inserts **600** may be coupled to either socket connector **500**. In some examples, other inserts (not shown) may be coupled to the socket connectors **500**. Each insert **600** may be comprised of an electrically conductive material, such as brass, copper, and/or any other appropriately conductive material. As shown, each insert **600** has a "male" end with a coupler **618** for connecting to the socket connector **500**, and a "female" end with a keyed entryway **602** for connecting to a key interface **802** of a plug **700**, as discussed further below. In some examples, an insert **600** may instead include two "male" ends. However, having one end be a "male" end and the other end be a "female" end configured for connecting to the plug **700** advantageously avoids additional and/or unnecessary outcroppings on the welding-type power supply **12** and/or power supply housing **104**.
(91) Each "female" end keyed entryway **602** is configured to accept (and/or receive, connect with, attach to, engage with, etc.) a particular type of plug **700** that has a particular complementary (and/or matching) key interface **802**. The coupler **618** of each insert **600** has engagement features configured for secure external connection to the complementary engagement features of the coupling surface **518** of the socket connector **500**. Thus, an operator may securely and externally reconfigure a power socket **300** of a welding-type power supply **12** for a different type of plug **700**, without having to access the internals of the housing **104**, and without worrying that the insert **600** will become mechanically and/or electrically removed from the power socket **300** if/when the operator removes the plug **700** from the power socket **300**.
(92) In the examples of FIGS. **3***a* and **6***a*-**6***f*, each insert **600** includes body **604** and a coupler **618**. The body includes a base **606** and a nose **614**. As shown, the base **606** has an outer surface that is approximately cylindrical, with parallel and opposing flats **608** that truncate the cylinder. The shape of the base **606** approximates that of the slot **406** of the bulkhead **400**, so that the insert **600** may fit within the bulkhead **400** to connect with the socket connector **500**. As shown, the nose **614** extends from the base **606**. In the examples of FIGS. **3***a* and **6***a*-**6***f*, the nose **614** is approximately conical (and/or frustoconical), being shaped (and/or configured) to electrically contact (and/or connect) with the contact surface **514** of the socket connector **500**.
(93) In the examples of FIGS. **3***a* and **6***a*-**6***f*, each insert **600** includes a coupler **618** comprising a shoulder screw **610** and a nut **616** engaged to the shoulder screw **610**. As shown, the shoulder screw **610** includes a head **620** attached to a shank **622**. The shank **622** extends between the head **620** and a screw thread **624**. The head **620** is positioned within a recess **626** of the nose **614**, and includes a tool interface **628** configured to receive a work end of a tool, such as a screwdriver and/or Allen wrench, for example. When assembling and/or disassembling the insert **600** into and/or out of the power socket **300**, an operator may insert a tool end of a tool into the tool interface **628** and turn the shoulder screw **610** via the tool and tool interface **628** connection, so as to couple and/or uncouple the screw threads **624** from the coupling surface **518** of the socket connector **500**.
(94) In the examples of FIGS. **3***a* and **6***a*-**6***f*, the screw threads **624** extend out of the nose **614** of the insert **600**, along with a small sliver of the shank **622**. As shown, the nut **616** is engaged to the screw threads **624** adjacent to the nose **614**. As the shoulder screw **610** is not integrally connected to the rest of the insert **600** in the examples of FIGS. **3***a* and **6***a*-**6***f*, the nut **616** ensures that body **604** is removed along with the shoulder screw **610** when removing the insert **600** from the socket connector **500**. For instance, during operation, the power socket **300** may undergo heating due to thermal effects of the electrical power conducted through the power socket **300**. The power socket **300** may eventually cool down when the welding-type system **10** and/or welding-type power supply **12** is no longer in use. The repeated heating and cooling may cause the nose **614** of the insert **600** to partly fuse with the contact surface **514** of the socket connector **500**. Thus, without the nut **616**, an operator may attempt to remove the insert **600** via the tool interface **628** of the shoulder screw **610**, and only succeed in removing the shoulder screw **610** from the body **604** of the insert

600, while the nose **614** (and/or body **604**) of the insert **600** remains fused to the contact surface **514**. However, with the nut **616** in place, the shoulder screw **610** is prohibited from being removed from the body **604** of the insert **600**. Instead, the mechanical force that would have removed the shoulder screw **610** from the body **604** of the insert **600** is instead applied to the nut **616**, and in turn applied by the nut **616** to the nose **614**. This mechanical force may help to dislodge a fused nose **614** and contact surface **514**, and allow the insert **600** to be successfully removed from the socket connector **500**.

(95) As shown in the examples of FIGS. **3***a* and **6***a*-**6***f*, the base **606** of each insert **600** includes a keyed entryway **602**. Each keyed entryway **602** is configured to receive a particular key interface **802** of a plug **700**, as further discussed below. The keyed entryway **602***a* of the insert **600***a* is different from the keyed entryway **602***b* of the insert **600***b*, such that a plug **700** intended for insert **600***b* will not work with insert **600***a*, and vice versa. In particular, the insert **600***a* is configured to work with DINSE-type plugs **700**, while the insert **600***b* is configured to work with TWECO-type plugs **700**. More particularly, each keyed entryway **602** comprises a hollow opening within the interior of the base **606**, with a keyed surface that uniquely configures the opening for a particular type of plug **700**.

(96) As may be seen, for example, in FIGS. **3***a*, **6***a*, and **6***b*, the insert **600***a* includes a keyed entryway **602***a*. As shown, the keyed entryway **602***a* is shorter and less wide (with a smaller diameter) than the keyed entryway **602***b* in FIG. **6***d*. As shown, the keyed entryway **602***a* includes a groove **629** in the inner surface of the base **606**. The groove **629** comprises the keyed surface of the keyed entryway **602***a*. The groove **629** expands the keyed entryway **602***a* within the base **606** along the axial length of the keyed entryway **602***a*. The groove **629** expands the keyed entryway **602***a*, so as to increase the diameter of the keyed entryway **602***a* along its axial length. As shown in FIGS. **6***a* and **6***b*, the groove **629** becomes slightly shallower at an inflection point **632**. The keyed entryway **602** also includes a second groove **634** that expands the diameter of the keyed entryway in an arc around the keyed entryway at the inflection point **632**. The second groove **634** provides space for a ridge **822** of a corresponding plug **700** to rotate within the keyed entryway **602***a* at the inflection point **632**. Thus, the width of the second groove **634** may be approximately equal to (or slightly larger than) a width (and/or thickness) of the ridge **822**. The configuration of the keyed entryway **602***a* comprises a DINSE-type (and/or style) configuration.

(97) In operation, a DINSE-type plug **700** would have a key interface **802***a* comprising a cylindrical stem **820** with the ridge **822**, such that the stem **820** could be inserted into the keyed entryway **602***a* when the ridge **822** is in alignment with the groove **629**. Thereafter, the plug **700** (and/or stem **820**) could be turned and/or twisted within the keyed entryway **602***a* to move the ridge **822** out of alignment with the groove **629**, thereby securing the plug **700** within the keyed entryway **602***a*. When thus secured, the interior surface of the base **606** provides an electrical connection with the key interface **802***a* of the plug **700**. The groove **629** prevents any non-DINSE plug **700** from connecting with the insert **600***a*.

(98) As may be seen, for example, in FIGS. **6***c* and **6***d*, the insert **600***b* includes a keyed entryway **602***b* with a keyed surface comprising a latch **630** that protrudes into the keyed entryway **602***b*. As shown, the latch **630** is a protuberance that extends from an inner surface of the base **606** of the insert **600***b* into the opening of the keyed entryway **602***b*. In the examples of FIGS. **6***c* and **6***d*, the latch **630** lessens the diameter of the keyed entryway **602***b* within the base **606**. Notably, the keyed entryway **602** has an approximately consistent diameter most everywhere else within the body **604** of the insert **600***b*. The latch **630** is positioned closer to the nose **614** of the insert **600***b* than the beginning of the keyed entryway **602***b*. The configuration of the keyed entryway **602***b* comprises a TWECO-type (and/or style) configuration.

(99) In operation, a TWECO-type plug **700** would have a key interface **802***b* comprising a cylindrical stem **820** with a cutout **823** that matched the latch **630**, such that the stem **820** could be inserted into the keyed entryway **602***b* at an orientation where the cutout **823** aligned with the latch

630, so that the stem **820** could pass by the latch **630**. Thereafter, the plug **700** (and/or stem **820**) could be turned and/or twisted within the keyed entryway **602***b* to move the cutout **823** out of alignment with the latch **630**, thereby securing the plug **700** within the keyed entryway **602***b*. When thus secured, the interior surface of the base **606** provides an electrical connection with the key interface **802***b* of the plug **700**. The latch **630** prevents any non-TWECO-plug **700** from connecting with the insert **600***b*.

(100) As may be seen, for example, in FIGS. **6***e* and **6***f*, the insert **600***c* includes a keyed entryway **602***c* with a keyed surface comprising a pair of opposing grooves. Each of the grooves **652** has an inflection point **654**, similar to the groove **629** and inflection point **632** of the insert **600***a*. The keyed entryway **602***c* (and/or keyed surface) further includes threaded grooves **650** to assist with turning of a complementary plug adapter **800***c*. In operation, shoulders **827** of a complementary plug adapter **800***c* may move within the grooves **652**, until encountering the inflection points **654**, at which point the plug adapter **800***c* may be turned to take the shoulders **827** out of alignment with the grooves **652**. In some examples, one or more of the inflection points **654** may be omitted from the insert **600***c*.

(101) In some examples, the plug adapter **800***c* may have a key interface **802** similar to the stem portion described in U.S. Pat. No. 7,377,825, which is owned by the assignee of the present application, and hereby incorporated by reference. In some examples, the insert **600***c* may have a base **606** similar to portions of the receptacle U.S. Pat. No. 7,377,825.

(102) FIGS. **7***a* and **7***b* show examples of welding-type power plug assemblies **700**, **701**. The plug assembly **700** in FIG. **7***a* may be considered a “male” plug assembly **700**, while the plug assembly **701** in FIG. **7***b* may be considered a “female” plug assembly **701**. As shown, the plug assembly **700** includes a plug adapter **800**, a plug receptacle **900**, and a plug cover **702**. The plug assembly **701** includes a plug adapter **801**, a plug receptacle **900**, and a plug cover **702**. The plug adapters **800**, **801** and plug receptacle **900** may be comprised of electrically conductive material, such as brass and/or copper, for example. The plug cover **702** may be comprised of an electrically and/or thermally insulating material (e.g., rubber), so as to allow an operator to grasp the plug assembly **700** during operation. In the examples of FIGS. **10***b* and **10***c*, the plug cover **702** encloses the plug receptacle **900** and much of the plug adapter **800**, **801** when the plug assembly **700** is assembled together. In some examples (e.g., FIG. **10***b*), portions of the plug adapter **800**, **801** may extend beyond the plug cover **702** when the plug assembly **700**, **701** is assembled. In some examples (e.g., FIG. **10***c*), the plug cover **702** may encircle the entirety of the plug adapter **800**, **801** when the plug assembly **700**, **701** is assembled.

(103) FIGS. **7***a*, **7***b*, **9***a*, and **9***b* show an example receptacle **900**. As shown, the receptacle **900** includes an outer surface and an inner surface. The outer surface includes a base **902** and a tube **904**. In the examples of FIGS. **7**, **9***a*, and **9***b*, both the base **902** and tube **904** are approximately cylindrical. As shown, the base **902** has opposing wrench flats **908** that truncate the cylindrical shape of the base. The base **902** includes cap screw holes **910** on opposing sides of the base **902**. The tube **904** includes axially aligned set screw holes **912**. The surfaces encircling the set screw holes **912** and/or cap screw holes **910** may be formed with threaded grooves to engage the screws.

(104) The inner surface of the receptacle **900** encircles a conduit **914** that extends through the receptacle **900**. The inner surface includes an adapter interface **916**, a tail interface **918** and a cable interface **920**. As shown, the diameter of the conduit **914** is largest at the beginning of the adapter interface **916**, then narrows to a smaller diameter within the tail interface **918**, before expanding again within the cable interface **920**. The adapter interface **916** is shaped approximately conically (and/or frustoconically) and is configured to contact, connect, and/or interface with the receptacle interface **806** of the plug adapter **800**, so as to establish an electrical connection between the plug adapter **800** and the receptacle **900**. The diameter of the conduit **914** at the widest point within the adapter interface **916** is smaller than the diameter of a central disc **804** of the plug adapter **800** (and/or body **604** of the plug adapter **801**), such that the central disc **804** will not fit within the

conduit **914**.
(105) In the example of FIGS. **7***a*, **7***b*, and **9***b*, the plug receptacle **900** includes opposing cap screw holes **910** in the outer surface that lead to the tail interface **918**. As shown, the tail interface **918** is approximately cylindrical. In some examples, the tail interface **918** may be formed with engagement features, such as threaded grooves, for example, to engage complementary engagement features on the tail **818**. When the plug assembly **700**, **701** is assembled together, the cap screw holes **910** may align with complementarily shaped and/or sized cap screw holes **704** in the plug cover **702** to receive cap screws **710**, such as nylon cap screws, for example. In some examples, the cap screws **710** may be formed of some other electrically and/or thermally insulating material. The surface of the receptacle **900** surrounding the cap screw holes **910** may include threaded grooves to receive the cap screws **710**. In operation, the cap screws **710** may assist in frictionally retaining the tail **818** within the conduit **914** encircled by the tail interface **918**.
(106) In the examples of FIGS. **7***a*, **7***b*, and **9***b*, the plug receptacle **900** further includes set screw holes **912** that lead to the cable interface **920**. As shown, the cable interface **920** is approximately cylindrical. The set screw holes **912** may be encircled by threaded grooves, to receive set screws **712**. The set screws **712** may be formed of electrically conductive material, such as a metallic material, for example. When the plug assembly **700** is assembled together with a welding cable **1000**, exposed wiring **1002** of the welding cable **1000** (that has been stripped of insulation **1004**) may be held against the cable interface **920** by set screws **712** within the set screw holes **912** to provide an electrical connection between the welding cable **1000** and the plug receptacle **900**.
(107) In the examples of FIGS. **7***a* and **7***b*, several different plug adapters **800**, **801** are shown. In FIG. **7***a*, plug adapters **800***a*-**800***c* include “male” style key interfaces **802**. In FIG. **7***b*, the plug adapters **801***a*-**801***c* include “female” style key entryways **602**, similar to the key entryways **602** of the socket inserts **600**. FIG. **10***b* shows an example assembled plug assembly **700** with the plug adapter **800***a*. FIG. **10***c* shows an example assembled plug assembly **701** with the plug adapter **801***a*. It should be understood that any of the plug adapters **800**, **801** could be interchanged with the plug adapters **800***a*, **801***a* in FIGS. **10***b* and **10***c*, and/or otherwise used with the socket assembly **700**.
(108) In the examples of FIGS. **7***a* and **8***a*-**8***i*, the plug adapters **800** include a central disc **804** having wrench flats **808** that may be used by a wrench (and/or other appropriate tool) to connect and/or disconnect the plug adapter **800** to/from the plug receptacle **900**. The plug adapter **800** further includes a key interface **802**, a receptacle interface **806**, and a tail **818**. The key interface **802** and receptacle interface **806** extend from opposite faces of the central disc **804**. In the examples of FIG. **7**, the receptacle interface **806** is a conical (and/or frustoconical) surface. The receptacle interface **806** is configured to electrically contact, connect to, and/or interface with a complementary surface in the plug receptacle **900**, so as to establish an electrical connection with the plug receptacle **900**, through which electrical power may flow.
(109) In the examples of FIGS. **7***a* and **8***a*-**8***i*, the receptacle interface **806** and the tail **818** connect at an end opposite of the key interface **802**. As shown, the tail **818** is approximately cylindrical, with an outer diameter slightly less than the stem **820** of the key interface **802**. The tail **818** may be formed with engagement features, such as screw threads, for example. The tail **818** may be configured to engage with the tail interface **918** of the receptacle **900**, such as through complementary engagement features (e.g., threaded grooves) of the tail interface **918**. Thus, the tail **818** and tail interface **918** (with or without with cap screws **710**) may allow an operator to securely connect the plug adapter **800** to, and disconnect the plug adapter from, the receptacle **900**, as desired.
(110) In the example of FIGS. **8***a*-**8***c*, the key interface **802***a* of the plug adapter **802***a* comprises a cylindrical stem **820** with a key interface feature. As shown, the key interface feature comprises a ridge **822** that protrudes radially away from the body. As shown, the ridge **822** is sized, shaped, and/or otherwise configured to fit through the groove **629** of the keyed entryway **602***a*. Thus, the

plug assembly **700** may be connected with the socket **300** by inserting the key interface **802** into the keyed entryway **602***a* of the insert **600**, whereby the ridge **822** will move through the groove **629** until the ridge **822** hits the inflection point **632**. Thereafter, the plug assembly **700** may be turned and/or twisted to move the ridge **822** through the second groove **634**, to a point where the ridge **822** is out of alignment with the groove **632***a*. Once the ridge **822** is out of alignment with the groove **632***a*, the plug assembly **700** may not be removed from the socket **300** without moving the ridge **822** back into alignment.

(111) FIGS. **8***d*-**8***i* show example plug adapters **800***b* and **800***c* with different key interface features. In the example of FIGS. **8***d*-**8***f*, the plug adapter **800***b* includes a key interface **802***b* with a key interface feature comprising a cutout **823** in the stem **820** of the key interface **802**. The cutout **823** results in a flat surface **824** that extends from an end **826** of the key interface **802***b* to a semicircular wall **829**. The cutout **823** further forms an annular channel **830** that circles part of the flat surface **826**, forming a hook **832**. In operation, the cutout **823** is configured to allow the key interface **802** to proceed past the latch **630** in the keyed entryway **602***b*. The annular channel **830** provides a path for the latch **630** when the key interface **802** rotates within the keyed entryway **602**. After rotation, the cutout **823** will be out of alignment with the latch **630**, and the hook **832** will grasp the latch **630**, so that the key interface **802** may not be withdrawn from the keyed entryway **602**.

(112) In the example of FIGS. **8***g*-**8***i*, the plug adapter **800***c* includes a key interface **802***c* with a stem **820** that is not completely cylindrical. Rather, the stem **820** includes flat sides **828** that truncate the otherwise cylindrical stem **820**. The cylindrical portions of the stem **820** are formed with screw threads **834**. Extending from the stem **820** is a key interface feature comprising a pair of opposing shoulders **827** formed on opposite sides of the cylindrical portions of the stem **820**. The shoulders **827** are configured to pass through a pair of opposing grooves **652** in a keyed entryway **602***c* of the insert **600***c* (and/or plug adapter **801***c*). In some examples, the plug adapter **800** may have a key interface **802** similar to the stem portion described in U.S. Pat. No. 7,377,825, which is owned by the assignee of the present application, and hereby incorporated by reference.

(113) FIGS. **7***b* and **8***j*-**8***r* show plug adapters **801** that have a “female” keyed entryway **602**, similar to the keyed entryways **602** of the socket inserts **600**. The plug adapters **801** share features with both the socket inserts **600** and the plug adapters **800**. In the examples of FIGS. **7***b*, **8***j*-**8***r*, and **10***c*, the plug adapters **801** still have the tail **818** and receptacle interface **806** (and/or nose **614**), but no central disc **804** or key interface **802**. Instead, the plug adapter **800** has a body **604** comprising of a base **606** with a keyed entryway **602**, similar to that of the inserts **600**. As all of these features were previously described, they will not be enumerated again here.

(114) FIG. **11** shows an example method **1100** for configuring and/or reconfiguring a welding-type power socket **300** and/or plug assembly **700** for welding-type operation. While the disclosure refers to an operator, it should be understood that, in some examples, an automated machine, such as a robot for example, may take the role of an operator. The method **1100** begins at block **1102**, assuming that the plug assembly **700** is disconnected from the power socket **300**, and the one or more socket connectors **500** are firmly attached within the bulkheads **400** of the electrical panel **102** of the welding-type power supply **12**. At block **1104**, the operator may attach one of the inserts **600** to the socket connector **500**, if desired, such as by securely coupling the coupler **618** of the insert **600** to the coupling surface **518** of the socket connector **500**. At block **1106**, the operator may attach one of the plug adapters **800**, **801** to the plug receptacle **900**, such as by connecting the tail **818** of the plug adapter **800** to the tail interface **918** of the plug receptacle **900**, and further tightening the cap screws **710**. Presumably the operator will attach an insert **600** with a keyed entryway **602** that corresponds to the key interface **802** of the plug adapter **800** being attached to the plug receptacle **900**. In some examples, blocks **1104** and/or **1106** may be skipped if the correct and/or desired socket insert(s) **600** and/or plug adapter(s) **800** are already attached. At block **1108**, the plug assembly **700** is connected to the power socket **300** by inserting the key interface **802** into the keyed entryway **602** and twisting and/or turning the plug assembly, so as to move the key

interface **802** into a locking arrangement with the keyed entryway **602**, with the key interface feature out of alignment with the keyed surface.
(115) At block **1110** the operator may determine whether a good connection has been made. If not, the method **1100** proceeds to block **1112**, discussed further below. If so, the method proceeds to block **1114**, where a welding operation may take place, using the welding-type power flowing from the welding-type power supply **12**, through the connection between the welding-type power socket **300** and the plug assembly **700** and to the appropriate welding component. In some examples, the welding cable **1000** may lead to another plug assembly **700** having a “female” plug adapter **800**, which may in turn be attached to another plug assembly **700** having a “male” plug adapter **800**, and so on in a daisy chain and/or extension fashion until the welding cable **1000** terminates in a welding component.
(116) At block **1116**, the operator may determine whether the welding type operation is finished. If not, block **1114** continues and/or repeats. If so, the method **1100** proceeds to block **1112**, where the operator may disconnect the plug assembly **700** from the power socket **300**. In some examples, this block may be skipped if further welding-type operations are planned for the near future. The method **1100** then proceeds to block **1118**, where the operator may remove the insert **600** and/or plug adapter **800** from the power socket **300** and/or plug assembly **700**, if so desired. In some examples, this block **1118** may be skipped if, for example, further welding-type operations are planned in the near future using the currently attached insert **600** and/or plug adapter **800**. The method once again ends/begins at block **1102**.
(117) While the present apparatuses, systems, and/or methods have been described with reference to certain implementations, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the present apparatuses, systems, and/or methods. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from its scope. Therefore, it is intended that the present apparatuses, systems, and/or methods not be limited to the particular implementations disclosed, but that the present apparatuses, systems, and/or methods will include all implementations falling within the scope of the appended claims.

Claims

1. A removable insert for a socket of a welding power supply, comprising: a base having a keyed entryway configured to connect with a key interface of a plug, the keyed entryway comprising a bore encircled by an inner surface of the base, the inner surface having a fixed keyed surface comprising a TWECO style latch that protrudes into the bore or a DINSE style axial groove that expands the bore; a nose comprising a contact surface configured to make electrical contact with a complementary contact surface of a socket connector of the welding power supply, thereby enabling conduction of electricity from the welding power supply to the plug, the contact surface comprising a frustoconical surface having a first frustoconical end with a first outer diameter and a second frustoconical end with a second outer diameter, the first outer diameter being larger than the second outer diameter, and the first frustoconical end abutting the base; and a coupler configured to couple the removable insert to the socket connector, thereby ensuring good electrical contact and connection with the socket connector of the welding power supply.
2. The removable insert of claim 1, wherein the bore of the keyed entryway leads to the coupler, the coupler comprising a shoulder screw.
3. The removable insert of claim 2, wherein the bore of the keyed entryway leads to a recess in the nose, at least a portion of the coupler being retained in the recess.
4. The removable insert of claim 1, wherein the coupler comprises a shoulder screw, the shoulder screw having a head at a first end of the shoulder screw, a screw thread at a second end that is opposite the first end, and a shank connecting the head to the screw thread.

5. The removable insert of claim 4, wherein the screw thread of the coupler is configured to engage complementary threaded grooves of the socket connector.
6. The removable insert of claim 5, wherein the head of the shoulder screw is entirely positioned within a recess of the nose, the head having a tool interface configured for coupling to a tool.
7. The removable insert of claim 5, wherein the coupler further comprises a nut screwed to the screw thread, the nut having an outer diameter no greater than a smallest outer diameter of the nose.
8. A removable insert for a socket of a welding power supply, comprising: a base having a keyed entryway configured to connect with a key interface of a plug, the keyed entryway comprising a bore encircled by an inner surface of the base, the inner surface having a fixed keyed surface comprising a TWECO style latch that protrudes into the bore; a nose comprising a contact surface configured to make electrical contact with a complementary contact surface of a socket connector of the welding power supply, thereby enabling conduction of electricity from the welding power supply to the plug, the contact surface comprising a frustoconical surface having a first frustoconical end with a first outer diameter and a second frustoconical end with a second outer diameter, the first outer diameter being larger than the second outer diameter, and the first frustoconical end abutting the base; and a coupler configured to couple the removable insert to the socket connector, thereby ensuring good electrical contact and connection with the socket connector of the welding power supply.
9. The removable insert of claim 8, wherein the bore of the keyed entryway leads to the coupler, the coupler comprising a shoulder screw.
10. The removable insert of claim 9, wherein the bore of the keyed entryway leads to a recess in the nose, at least a portion of the coupler being retained in the recess.
11. The removable insert of claim 8, wherein the coupler comprises a shoulder screw, the shoulder screw having a head at a first end of the shoulder screw, a screw thread at a second end that is opposite the first end, and a shank connecting the head to the screw thread.
12. The removable insert of claim 11, wherein the screw thread of the coupler is configured to engage complementary threaded grooves of the socket connector.
13. The removable insert of claim 12, wherein the head of the shoulder screw is entirely positioned within a recess of the nose, the head having a tool interface configured for coupling to a tool.
14. The removable insert of claim 12, wherein the coupler further comprises a nut screwed to the screw thread, the nut having an outer diameter no greater than a smallest outer diameter of the nose.
15. A removable insert for a socket of a welding power supply, comprising: a base having a keyed entryway configured to connect with a key interface of a plug, the keyed entryway comprising a bore encircled by an inner surface of the base, the inner surface having a fixed keyed surface comprising a DINSE style axial groove that expands the bore; a nose comprising a contact surface configured to make electrical contact with a complementary contact surface of a socket connector of the welding power supply, thereby enabling conduction of electricity from the welding power supply to the plug, the contact surface comprising a frustoconical surface having a first frustoconical end with a first outer diameter and a second frustoconical end with a second outer diameter, the first outer diameter being larger than the second outer diameter, and the first frustoconical end abutting the base; and a coupler configured to couple the removable insert to the socket connector, thereby ensuring good electrical contact and connection with the socket connector of the welding power supply.
16. The removable insert of claim 15, wherein the bore of the keyed entryway leads to the coupler, the coupler comprising a shoulder screw.
17. The removable insert of claim 16, wherein the bore of the keyed entryway leads to a recess in the nose, at least a portion of the coupler being retained in the recess.
18. The removable insert of claim 15, wherein the coupler comprises a shoulder screw, the shoulder

screw having a head at a first end of the shoulder screw, a screw thread at a second end that is opposite the first end, and a shank connecting the head to the screw thread.

19. The removable insert of claim 18, wherein the screw thread of the coupler is configured to engage complementary threaded grooves of the socket connector, and the coupler further comprising a nut screwed to the screw thread, the nut having an outer diameter no greater than a smallest outer diameter of the nose.

20. The removable insert of claim 19, wherein the head of the shoulder screw is entirely positioned within a recess of the nose, the head having a tool interface configured for coupling to a tool.