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(54) **WIRELESS SYSTEM CONTROL AND INVENTORY MONITORING FOR WELDING-TYPE DEVICES**

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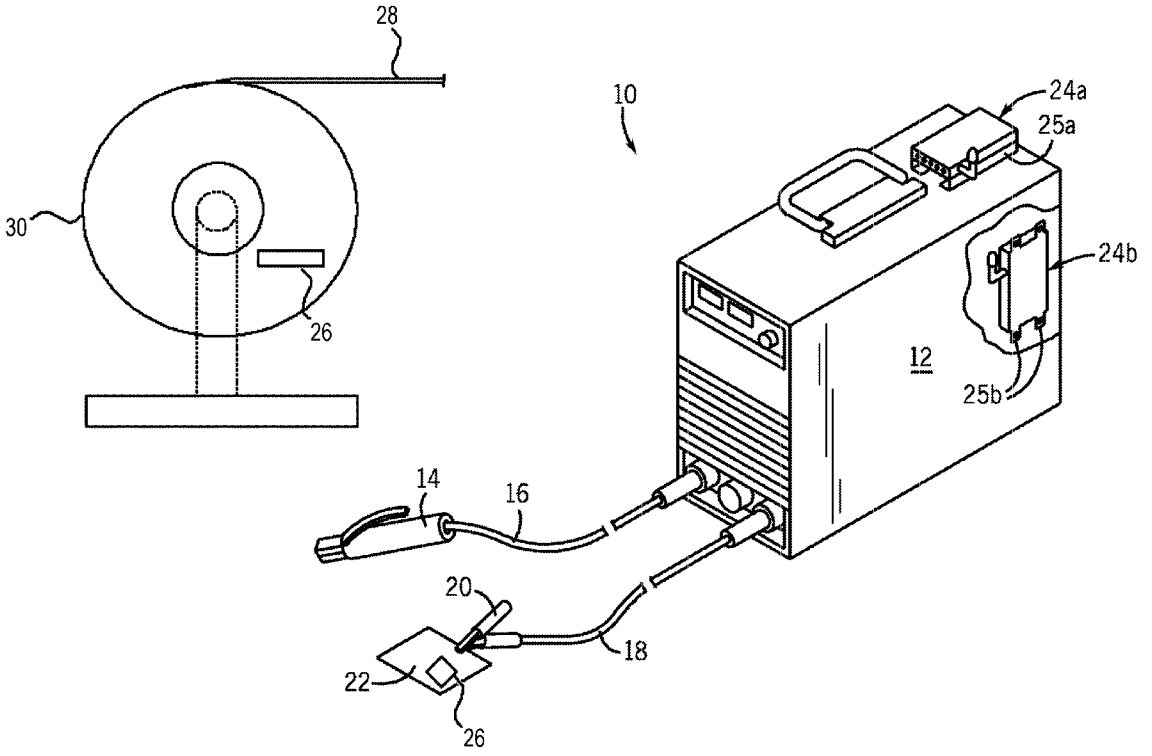
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(57) **ABSTRACT**

A welding-type system is designed for wireless control and for inventory monitoring of welding consumables. The welding-type system includes a power source to produce a welding-type power, wherein the power source is operable in a plurality of operating modes. The welding-type system also includes a controller configured to set a plurality of operating parameters within the power source, at least one wireless monitoring device coupled to the controller, and at least one welding-type consumable associated with a wireless transmitter. The wireless transmitter is configured to emit low frequency magnetic signals having consumable data encoded therein that is indicative of the at least one welding-type consumable. The wireless monitoring device is arranged to communicate with the wireless transmitter by receiving and transmitting the low frequency magnetic signals, with the low frequency magnetic signals being transmitted at a frequency of approximately 131 kHz.



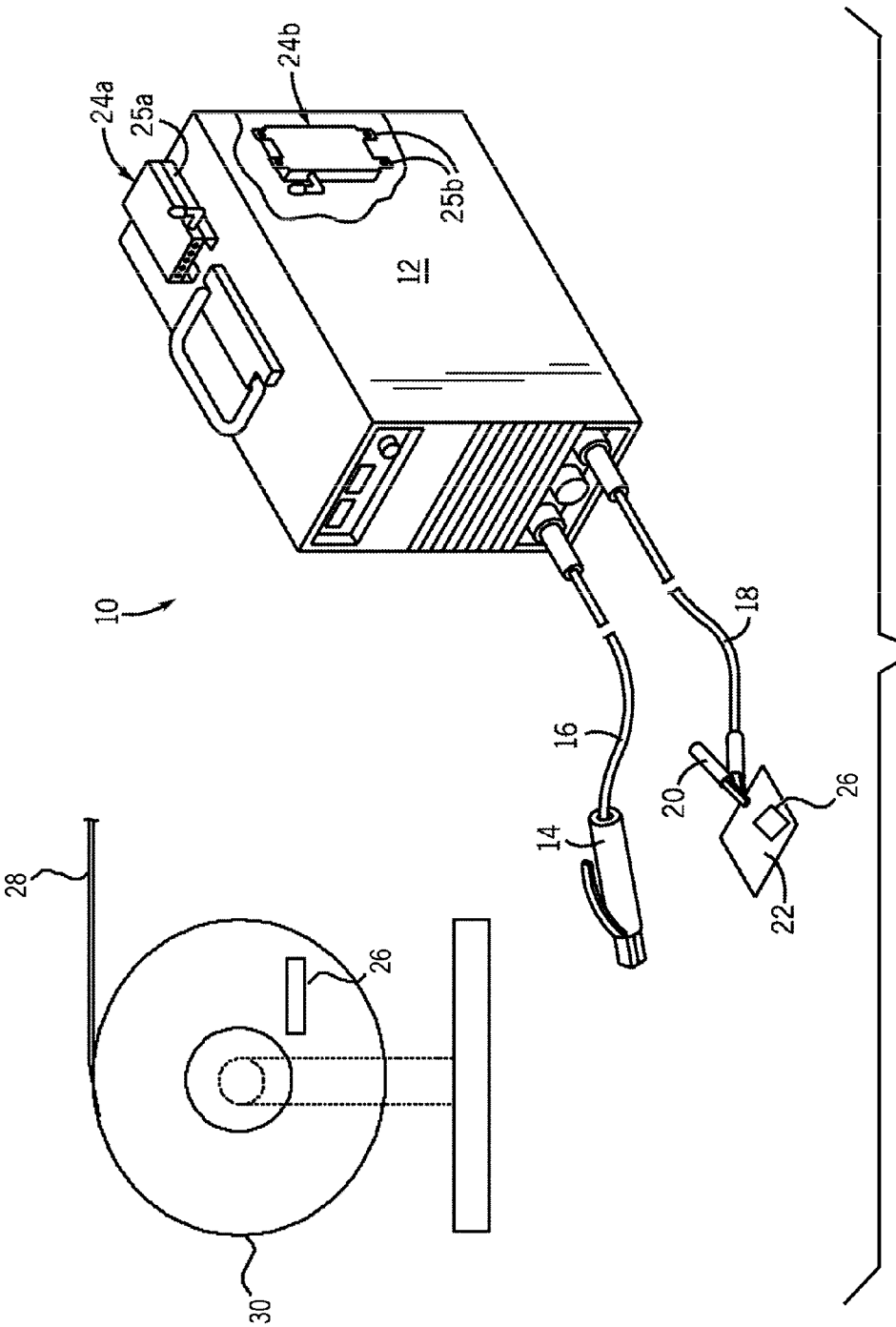


FIG. 1

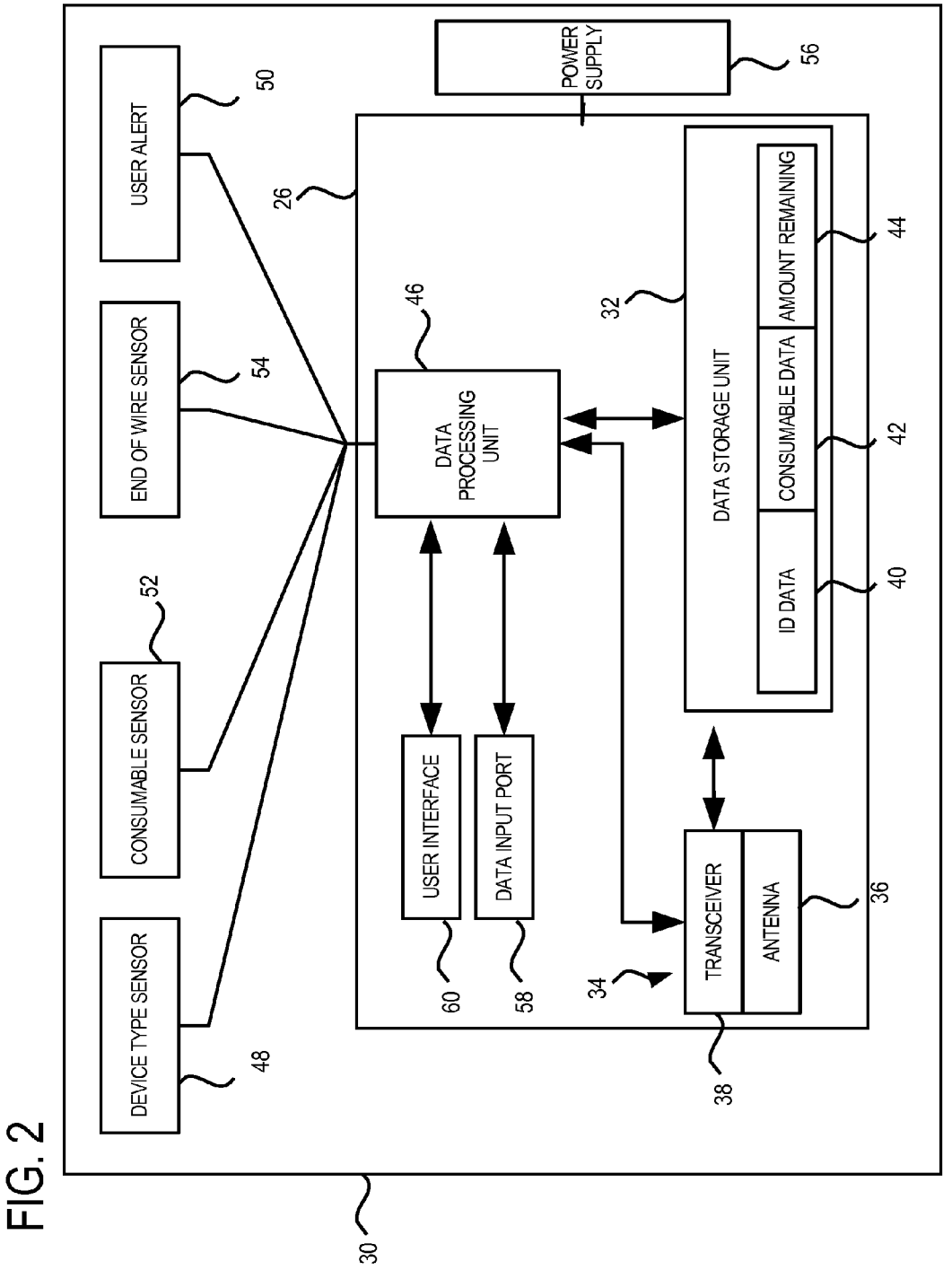

USER ALERT
50
END OF WIRE SENSOR
54
CONSUMABLE SENSOR
52
DEVICE TYPE SENSOR
48
30
26
POWER SUPPLY
56
DATA PROCESSING UNIT
46
USER INTERFACE
60
DATA INPUT PORT
58
34
32
DATA STORAGE UNIT
AMOUNT REMAINING
44
CONSUMABLE DATA
42
ID DATA
40
TRANSCEIVER
ANTENNA
36
38

FIG. 2

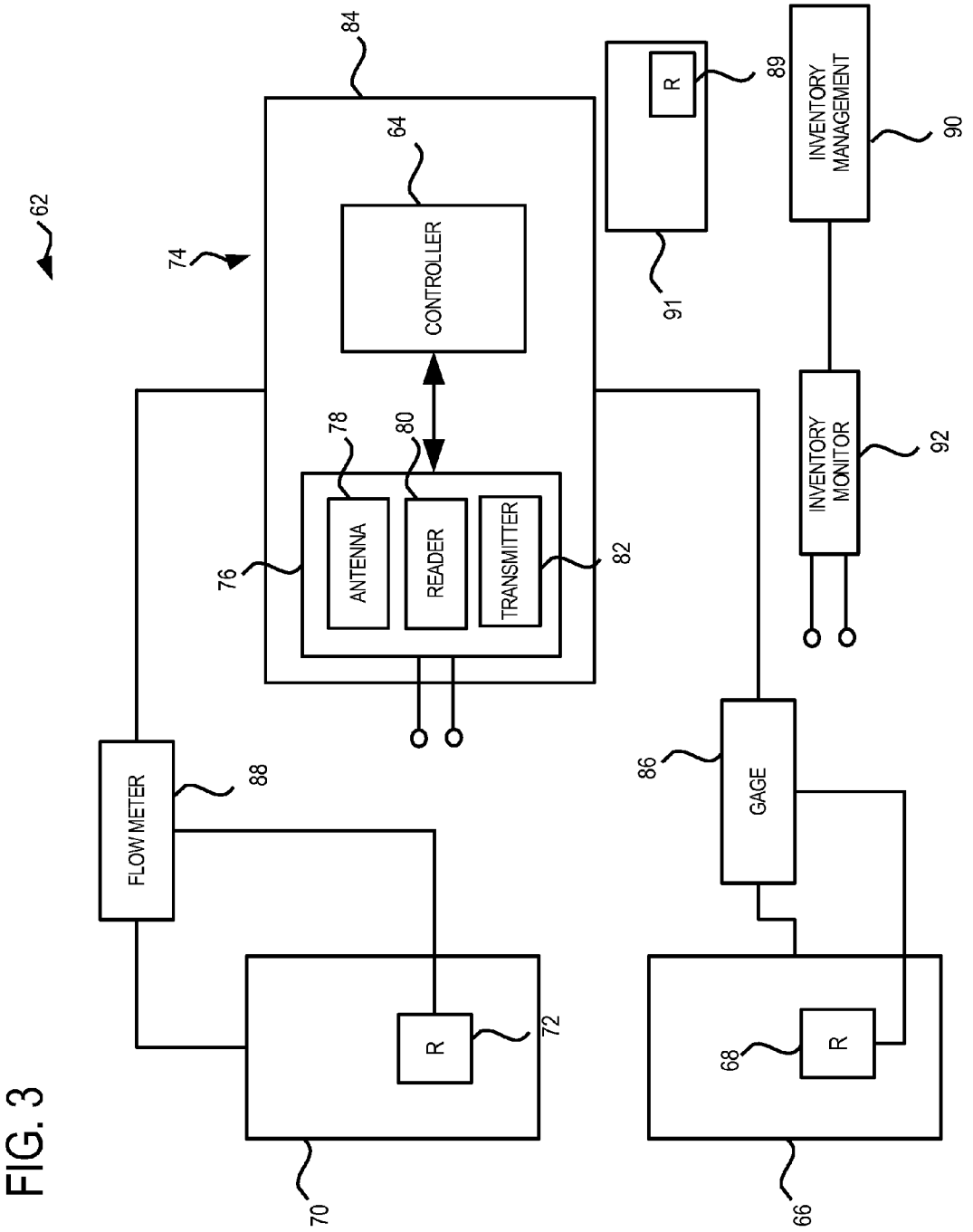

62
74
84
64
CONTROLLER
78
80
76
ANTENNA
READER
TRANSMITTER
82
R
89
91
INVENTORY MANAGEMENT
90
INVENTORY MONITOR
92
FLOW METER
88
GAGE
86
R
72
70
R
68
66

FIG. 3

WIRELESS SYSTEM CONTROL AND INVENTORY MONITORING FOR WELDING-TYPE DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a non-provisional of, and claims priority to, provisional U.S. Patent Application No. 60/842,932, filed on Sep. 7, 2006.

BACKGROUND OF THE INVENTION

[0002] The present invention relates generally to the art of welding and, more particularly, to the monitoring and/or controlling of welding apparatuses and processes based on information gathered and extracted from electronically readable information storage devices encoded with information pertaining to a given welding consumable.

[0003] Welding-type systems generally include a power source constructed to generate a welding-type power. The welding-type power is communicated to a torch assembly or a welding gun via a weld cable that extends between the torch and the power source. Numerous interrelated and non-interrelated parameters that affect the welding-type process are controlled by the power source. These parameters, in turn, are at least in part determined by a plurality of consumables that are used during the welding-type process, such as weld wire, shielding gas, and various other consumables. A specific type of consumable can determine an operating mode, as well as numerous parameters within that operating mode, to which the specific consumable is best suited. For example, before carrying out a welding-type process, a user should ensure that a proper welding wire type has been selected as well as ensure that the selected wire has an amperage rating appropriate for the particulars of the welding-type process to be carried out. If the welding-type process particulars and the consumable are not properly matched, damage to the welding-type system and/or a poor-cut quality may result.

[0004] In some prior art welding systems, data on consumables to be used in a welding process are transferred wirelessly from the consumable to the welding system. That is, an electronic storage device containing data on the particulars of the consumable (production date, wire diameter, shielding gas type, etc.) is positioned on or in proximity to the consumable or a consumable container, and wirelessly transmits the data to a monitoring device coupled to a controller of the power source. One such device for storing consumable specific knowledge in a welding environment is a radio frequency identification (RFID) tag. The RFID tag is able to store data specific to the consumable and wirelessly transmit that data to a monitoring device to allow for selection of operating modes and welding parameters based on the particulars of the consumable.

[0005] While the use of RFID tags in a welding environment allows for wireless communication of consumable information to a welding system, there are several drawbacks and limitations to using RFID tags in a harsh welding environment. That is, the performance of RFID tags is adversely affected in environments where interference is typically encountered. The presence of steel and other metals, which is typical in a welding environment, interferes with the ability of high-frequency, electronic signals to be efficiently transmitted and received by the RFID tags. Because conventional high frequency (13.56 MHz) and ultra-high frequency (916 MHz) RFID tags primarily use the radio portion of electromagnetic induction to transmit a signal, the wireless electronic signals used for communication by RFID tags is particularly susceptible to this interference. Additionally, because of the high frequencies associated with RFID communication, active RFID tags consume a great deal of energy. When used in conjunction with welding consumables that may be stored for extensive periods of time before use, an RFID tag with a short active life span would be highly undesirable.

[0006] As such, a need exists for an electronically readable information storage devices from which information can be gathered and extracted, and for a medium by which data signals can be dependably transferred in a harsh, welding environment, such that the monitoring and controlling of welding apparatuses and processes can be efficiently performed. Additionally, a need exists for an electronically readable information storage device that remains in a powered state for a long period of time.

BRIEF DESCRIPTION OF THE INVENTION

[0007] The present invention provides a system and method for wireless monitoring and/or controlling of welding apparatuses and processes that overcomes the aforementioned drawbacks. Consumable data is gathered and extracted from electronically readable information storage devices encoded with information pertaining to the consumable and wirelessly transmits that data via a dependable and efficient medium. The electronically readable information storage devices are durable and are able to remain in an operable condition for an extended period of time.

[0008] In accordance with one aspect of the present invention, a welding-type system includes a power source to produce a welding-type power, the power source being operable in a plurality of operating modes. The welding-type system also includes a controller configured to set a plurality of operating parameters within the power source, at least one wireless monitoring device coupled to the controller, and at least one welding-type consumable associated with a wireless transmitter, the wireless transmitter configured to emit low frequency magnetic signals having consumable data encoded therein indicative of the at least one welding-type consumable. The at least one wireless monitoring device is arranged to communicate with the wireless transmitter by receiving and transmitting the low frequency magnetic signals, with the low frequency magnetic signals being transmitted at a frequency of approximately 131 kHz.

[0009] In accordance with another aspect of the present invention, a wireless communication welding-type system includes a power source to produce a welding-type power, a controller configured to set a plurality of operating parameters within the power source, and at least one wireless monitoring device coupled to the controller. The wireless communication welding-type system also includes a wireless transceiver tag in communication with the at least one wireless monitoring device, the wireless transceiver tag associated with a welding-type consumable and configured to communicate with the at least one wireless monitoring device by way of a bidirectional, on-demand, peer-to-peer protocol transmitted via substantially magnetic waves emitted at a frequency of approximately 131 kHz. The protocol includes consumable data encoded therein indicative of the welding-type consumable.

[0010] In accordance with yet another aspect of the present invention, a method for controlling a welding-type process having a plurality of operating conditions includes the steps of providing a consumable to be used in a welding-type process and positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store consumable data regarding parameters of the consumable. The method also includes the steps of reading the consumable data from the wireless tag from a wireless monitoring device, transmitting the consumable data from the wireless tag to the wireless monitoring device by way of a low frequency magnetic signal transmitted at a frequency of approximately 131 kHz, and controlling a welding-type device by setting the plurality of operating parameters, the setting of the plurality of operating parameters being determined by the transmitted consumable data.

[0011] In accordance with a further aspect of the present invention, a method for monitoring an inventory of consumables in conjunction with performing a welding-type process includes the steps of providing a consumable to be used in a welding-type process and positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store data on an available quantity of the consumable. The method also includes the steps of measuring the quantity of consumable consumption during performance of the welding-type process, electronically modifying the memory of the wireless tag to reflect an updated available quantity of the consumable, and transmitting a data signal to a wireless monitoring device on an on-demand basis. The data signal includes data therein on the updated available quantity of the consumable and substantially comprises magnetic waves being transmitted at a frequency of approximately 131 kHz.

[0012] Various other features and advantages of the present invention will be made apparent from the following detailed description and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The drawings illustrate one preferred embodiment presently contemplated for carrying out the invention.

[0014] In the drawings:

[0015] FIG. **1** is a perspective view of a welding-type apparatus in accordance with the present invention.

[0016] FIG. **2** is a schematic view of one embodiment of a wireless transmitter in accordance with the present invention.

[0017] FIG. **3** is a schematic of a Rubee protocol based welding system in connection with controlling a welding process and monitoring consumption of welding consumables.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] As one skilled in the art will fully appreciate, the hereinafter description of welders, welding accessories, welding devices, and welding systems also applies to the constituents of any system that requires high power outputs, such as heating and cutting systems. That is, the present invention is equivalently applicable with any device requiring high power output, including welders, plasma cutters, induction heaters, aircraft ground power units, and the like, as well as accessories and components thereof. Reference to welding power, welding-type power, welding-type processes, or welders generally, includes welding, cutting, heating power, or ground power for aircraft. Description of a welding apparatus illustrates just one embodiment in which the present invention may be implemented.

[0019] In addition, it will be understood that the present invention is applicable to a multitude of welding-type devices, accessories, consumables, and the various containers thereof. Not only is the present invention particularly useful in providing for wireless communication with a welding-type power source, the present invention also finds utility when extended to include other components of a welding-type apparatus. Wire feeders, generators, weld guns and torches, advanced and user-adapted systems, and other accessories are all capable of being incorporated with the present invention. The phrase "welding-type device" shall include all devices useable in a welding system, including but not limited to welders, power sources, wire feeders, generators, weld guns and torches, advanced and user adapted systems, other device accessories, and the like.

[0020] Referring to FIG. **1**, a welding apparatus **10**, in accordance with the present invention, is shown. As depicted, welding apparatus **10** includes a welding-type device such as a power source **12**, although the present invention is not limited to welding-type power sources. Power source **12** is preferably constructed to receive an input power and generate an output suitable for welding. A torch **14** is operably connected to power source **12** via weld cable **16**. Ground cable **18** attaches clamping member **20** to power source **12**. Clamping member **20** is constructed to removably secure cable **18** to workpiece **22** so that a desired welding application may be performed. Wireless monitoring device **24** can be seen in break away view, **24***b*, attached inside power source **12** or optionally attached atop, **24***a*, an outer surface of power source **12**. The desired position of wireless monitoring device **24** will depend upon the type of welding-type apparatus **10**, the desired mode of wireless communication, and other design considerations. In the present invention, wireless monitoring device **24** operates as a low frequency, magnetic signal-based communication device. Wireless monitoring device **24***a* may be positioned outside power source **12** for increased range and better reception, or alternatively, in a preferred embodiment, wireless monitoring device **24***b* is disposed inside the housing of power source **12** for increased durability.

[0021] Wireless monitoring device **24** is arranged to be in communication with a wireless transmitter **26** positioned in proximity to power source **12** so as to be within a communication range with wireless monitoring device **24**. Wireless transmitter **26** is positioned adjacent to or on a welding consumable **28** that is to be used by welding apparatus **10** and is associated with that welding consumable **28**. As shown in FIG. **1**, welding consumable is in the form of a weld wire **28**, but it is also envisioned that wireless transmitter could also be associated with other consumables typically used in a welding-type process (e.g., shielding gas). In one embodiment, wireless transmitter **26** is positioned on a reel or spool **30** (i.e., a consumable container) that holds the welding wire **28**. An additional wireless transmitter **26** can also be positioned on, and associated with, workpiece **22**. Wireless monitoring device **24** and wireless transmitters **26** communicate with each other by

way of low frequency magnetic signals, thus conveying information back and forth regarding the welding consumable **28**.

[0022] As defined with respect to the present invention, the low frequency magnetic signals transmitted between wireless monitoring device **24** and wireless transmitter **26** are emitted at between approximately 131-134 kHZ, and preferably at 131 kHz. The 131-134 kHz frequency is understood to be a signal that is in conformance with IEEE standard 1902.1, which is commonly referred to as RuBee™. (RuBee technology is available from Visible Assets, Inc., One, Datran Center, 9100 South Dadeland Blvd., Suite 106, Miami, Fla. 33156-7189.) The Rubee low frequency magnetic signal is predominantly comprised of magnetic waves (i.e., 99.9% magnetic waves) that are transmitted at a frequency of 131 kHZ, thus operating in the low-frequency band of the radio frequency (RF) spectrum. Accordingly, the present invention includes ranges of at least 90-100% magnetic signal to electrical signal with a preferred range of 98% to 99.9%. RuBee is a bidirectional, on-demand, peer-to-peer, radiating transceiver tag protocol that uses Long Wave (LW) magnetic signals to send and receive data packets in a local regional network. RuBee tags offer a real-time, tag-searchable protocol using IPv4 addresses and subnet addresses linked to asset taxonomies that run at speeds of 300 to 9,600 Baud.

[0023] The RuBee low frequency magnetic signal is differentiated from Radio-frequency identification (RFID) in that RFID works in a backscatter transponder mode and simply reflects the radio signal, whereas Rubee tags transmit their own signal predominantly by way of a magnetic field, H. RFID tags do not transmit an H signal or an E (electric field) signal, but rather, reflect a base-station carrier signal. As will be described in detail below, the RuBee protocol is implemented for wireless communication between wireless monitoring device **24** and wireless transmitter **26** to transfer data relevant to welding consumable **28** that can be implemented to assist in welding apparatus **10** setup and inventory monitoring of consumable **28**.

[0024] Referring now to FIG. **2**, a schematic view of wireless transmitter **26** is shown. Wireless transmitter is configured as a wireless tag **26** operable with a RuBee protocol and is affixed to a consumable container **30**. For purposes of illustration, consumable container **30** will be described as a weld wire reel; however, it is understood that the features of the embodiment of FIG. **2** are not only equally applicable for use with wire drums, bulk packs, spools and the like, but also for use with other welding-type devices and accessories, such as shielding gas tanks and storage containers for other consumables. Wireless tag **26** is preferably attached directly to wire reel **30**, though it is appreciated that proper placement of wireless tag **26** in, on, or near a consumable container will vary depending upon the type of container.

[0025] Wireless tag **26** includes a data storage unit **32** and a transmitter or wireless communication unit **34**. Wireless communication unit **34**, in turn, includes a tag antenna **36** and a transceiver **38** operatively connected to the tag antenna **36**. Transceiver **38** is configured to emit and receive low frequency magnetic signals at a frequency of approximately 131 kHz. The transceiver **38** and data storage unit **32** are connected for bidirectional data transfer, as shown.

[0026] In a preferred embodiment, data storage unit **32** is a digital storage device capable of having several types of information stored thereon related to a consumable. In the embodiment shown, data storage unit **32** includes an identification number or code **40** unique to wireless tag **26**. This ID number **40** is encoded in transmissions of wireless communication unit **34** to identify the source of the transmissions and, at minimum, includes an internet protocol (IP) address that identifies wireless tag **26**. Data storage unit **32** also includes data **42** indicating the type of consumable material on the reel or other container **30** to which wireless tag **26** is connected. It is appreciated that consumable type data **42** may be as simple as a code indicating the general type of consumable of a container **30**, such as a code indicating that the consumable is weld wire. Consumable type data **42** may also indicate such characteristic information as wire length, diameter, gauge, alloy type, or core type, flux characteristics, shielding gas type and pressure, various temperatures of interest, safety or MSDS information, particular welding instructions or ideal welding processes, and other similar characteristic information of welding-type consumables. This information may be used to match consumable containers with appropriate power sources or welding processes and to warn users or disable power sources when non-compatible consumables, equipment, or other welding-type devices are combined. In addition to consumable type data **42**, data storage unit **32** also contains consumable amount data **44**. That is, as will be explained in detail below, an amount of a consumable used in a welding-type process can be measured and compared with the original consumable data **42** to determine an amount of remaining consumable present in container **30**. This remaining amount data **44** can then be stored in data storage unit **32**.

[0027] In addition to the actual data **40**, **42**, **44** stored in data storage unit **32**, data storage unit **32** may also be configured for rapid memory access, as when supplying a "real-time" data transfer. Regardless of real-time capability, data storage unit **32** should, at a minimum, be capable of providing identification information to wireless communication unit **34** for transmittal, such as a consumable type or consumable characteristics.

[0028] Wireless tag **26** also includes a micro-controller, or processing unit **46**. Processing unit **46** is configured to decode and identify received messages transmitted via the RuBee protocol. If an appropriate response message is to be sent to wireless monitoring device **24** (shown in FIG. **1**), based on some inquiry therefrom, processing unit **46** may request appropriate data from data storage unit **32**, generate a data packet, and relay the message to wireless communication unit **34** for transmission. Alternatively, processing unit **46** may generate data packets for response messages containing information received directly from a plurality of sensors described here below, such information including, for example, an amount of remaining consumable. Therefore, processing unit **46** is bi-directionally connected to both wireless communication unit **34** and data storage unit **32**.

[0029] Operably connected to data processing unit **46** are a number of sensors configured to acquire information related to a welding process. One such sensor is a device-type sensor **48** that can be used to detect what type of equipment the consumable container **30** is connected to, and can be used to inform attached equipment of the type of consumable contained therein. Thus, device-type sensor **48** may provide information for use in active monitoring of the compatibility of welding-type devices. For example, when wire reel **30** is attached to a welding system (not shown),

device type sensor **48** detects which type of system the reel **30** is connected to via the low frequency magnetic signals of the RuBee protocol. The device type information may be encoded in a transmission of wireless communication unit **34** and sent to wireless monitoring device **24** (shown in FIG. **1**). If the consumable type of the wire reel **30** and the particular welding system type are incompatible or at least not intended to be connected for the production process of that location, the wireless monitoring device and/or a welding apparatus controller, may issue a warning signal in response, causing activation of user alert **50** or disabling of the welding system.

[0030] Consumable sensor **52** and end of wire sensor **54** are used to provide more accurate and precise inventory monitoring. That is, a consumable container can detect via sensor **52** how much consumable is remaining therein, then continuously, periodically, or responsively update a monitoring device of such information. Sensor **52** will vary in construction in accordance with the type of consumable it is configured to detect. For example, sensor **52** could comprise a pressure gauge to measure shielding gas, a counter to measure linear feet of weld wire leaving a reel, a level sensor to monitor the drop in the level of wire on a reel or in a drum, or the like. The end of wire sensor **54** is adapted to automatically signal that the consumable wire in a container is gone or nearly gone. Preferably, sensor **54** is attached to the terminal end of a length of wire on a reel such that when the end of the wire is pulled from the reel, the sensor **54** is automatically disconnected from wireless tag **26** or broken, signaling to the data storage unit **32** and/or the processing unit **46** that no consumable remains. Alternatively, a sensor having a similar function may be integrated with a pressure gauge on a shielding gas tank, to signal when pressure is low.

[0031] Wireless tag **26** also includes a battery or other power source **56**, and optionally a data input port **58**, and/or a user interface **60**. Battery **56** enables wireless tag **26** to operate in a powered transmission state, consistent with RuBee based communication. While the low frequency magnetic signals of the RuBee protocol transmitted by wireless tag **26** serve to extend life of battery **56** (as opposed to high frequency RFID transmissions), various battery management techniques may be employed to conserve power. For example, wireless tag **26** could operate in a low-power or "sleep" mode until receipt of a request signal, relay signal, or other signal which would necessitate a response or action of wireless tag **26**. Alternatively, wireless tag **26** could be configured to only transmit or receive signals on an intermittent period, as opposed to receiving or transmitting signals at any time which could drain power.

[0032] FIG. **3** schematically illustrates the use of RuBee tags in connection with controlling a welding process and maintaining an inventory of consumable usage in connection therewith. More particularly in this respect, FIG. **3** schematically illustrates a welding system **62** including a controller **64**, a welding wire supply barrel **66** having a RuBee tag **68** thereon, a shielding gas tank **70** having a RuBee tag **72** mounted thereon, and a welding apparatus **74** to which the welding wire and gas are delivered in connection with performing the welding process. As set forth above, each of RuBee tags **68**, **72** contains consumable specific information thereon, which as pertains to welding wire supply barrel **66** and shielding gas tank **70**, can include such characteristic information as wire length, diameter, gauge, alloy type, or core type, flux characteristics, shielding gas type and pressure, various temperatures of interest, and other similar characteristic information of welding-type consumables.

[0033] Each of the Rubee tags **68**, **72** communicates with a wireless monitoring device **76** via a 131 kHz signal to convey information regarding the welding wire and shielding gas, respectfully. The wireless monitoring device **76** includes a field antenna **78** configured to receive the low frequency magnetic signals emitted by RuBee tags **68**, **72** and a reader **80** in operative communication with the field antenna **78** to receive the consumable specific data encoded in the low frequency magnetic signals. Wireless monitoring device **76** also includes a transmitter **82** in operative communication with the field antenna **78** that is configured to send data signals to the RuBee tags **68**, **72**.

[0034] In addition to being in wireless communication with RuBee tags **68**, **72**, wireless monitoring device **76** is also coupled to controller **64**, which is positioned on or within a power source **84**. Controller **64** is configured to set a plurality of operating parameters within power source **84** and select a desired operating mode for welding apparatus **74** based, at least in part, on detection of consumables and the specific characteristics thereof. Wireless monitoring device **76** receives data on the consumables contained in wire supply barrel **66** and gas tank **70** via wireless communication with RuBee tags **68**, **72** and conveys the consumable data to controller **64**. Based on the consumable data received, controller **64** sets and/or adjusts the operating parameters of power source **84**. The appropriate operating parameters, such as current wave shape, welding wire feed speed, welding angle, arc current, arc voltage, current polarity, power, arc length, and shielding gas flow rate (among others), are preferably stored in a look-up table in volatile memory of controller **64**. As such, a real-time determination of the appropriate operating parameters of the welding apparatus **84**, specific to a particular consumable, may be determined and implemented.

[0035] The consumable specific data stored on RuBee tags **68**, **72** can be extracted prior to use and/or in connection with use of the wire and/or shielding gas consumable in a given welding apparatus. When extracted prior to use, the information enables an operator to manually make the necessary preliminary adjustments to power source **84** (and other welding system components) by way of controller **64** for obtaining optimum performance from welding apparatus **74** and/or to select between two or more operating modes. With respect to consumable specific information pertaining to the wire diameter, for example, the diameter data can be extracted from RuBee tag **68** prior to initiating operation of the welding apparatus **74**, thus enabling the operator to adjust parameters of the process so as to obtain a desired deposition rate in response to the wire diameter. With respect to the consumable specific information pertaining to the shielding gas, for example, the type of shielding gas and the pressure of the shielding gas can be encoded on RuBee tag **72**, and the extracting of such information prior to initiating operation of the welding apparatus **74** enables the operator to adjust parameters of the process or to anticipate times in the process where a parameter such gas flow rate needs to be adjusted, so as to maintain a desired weld bead quality.

[0036] When the consumable specific information is transmitted from RuBee tags **68**, **72** to wireless monitoring device **76** in connection with the operation of the welding apparatus **74** (i.e., during the welding process), the consumable infor-

mation can be used to automatically configure welding apparatus **74**. That is, consumable data received by controller **64** is used to automatically adjust an appropriate parameter or parameters for optimizing the apparatus performance, or to automatically switch between different operating modes of the apparatus, such as, for example, a spray arc mode or a pulsed arc welding mode. Such operating modes are given by way of example only, and many other modes of operation can be selected between depending on the particular welding apparatus and/or process with which the principals of the present invention are used. Likewise, the parameter of wire feed speed and shielding gas pressure are given by way of example only, and it will be appreciated that many other parameters can be controlled and/or adjusted using the principals of the present invention such as, arc voltage, arc current, power, arc length, wave shape, arc length or gap, to name but a few.

[0037] Referring still to FIG. **3**, in one embodiment, a RuBee tag **89** is also positioned on, and associated with, a workpiece **91**. RuBee tag **89** attached to workpiece **91** includes data stored thereon regarding a preferred welding process to be performed in relation to the workpiece. That is, RuBee tag **89** includes data thereon that specifies at least one of a desired welding wire feed speed, welding angle, arc current, arc voltage, current polarity, power, arc length, and a shielding gas flow rate to be used in the welding process. This workpiece data from Rubee tag **89** is transmitted to wireless monitoring device **76** and passed on to controller **64**.

[0038] Upon receiving both consumable data from RuBee tags **68**, **72** and workpiece data from RuBee tag **89**, controller **64** is configured to compare the data and determine whether proper consumables are on hand for performing the welding process specified by data contained on RuBee tag **89**, and corresponding to workpiece **91** or job packet. If the consumable on hand matches the requirements specified in the workpiece data stored on RuBee tag **89**, then controller **64** allows welding apparatus **74** to perform the desired welding process. If, however, the available consumable on hand does not match the requirements specified in the workpiece data stored on RuBee tag **89**, controller **64** does not allow welding apparatus **74** to perform the desired welding process (i.e., disables welding apparatus **74**) and may set an alarm to alert a user of such a condition. Thus, efficient matching of a workpiece **91** to be welded and a proper consumable can be easily achieved by inclusion of RuBee tag **89** in conjunction with RuBee tags **68**, **72**.

[0039] As part of the consumable specific information stored thereon, RuBee tags **68**, **72** include data thereon regarding the amount of weld wire on the spool **66** and the amount of gas initially in gas tank **70**. Consumable amount sensors or devices **86**, **88** are in electrical communication with RuBee tags **68**, **72** to communicate thereto a rate of consumable consumption, thus allowing RuBee tags **68**, **72** to process the consumption data and update for electronic storage therein, the amount of available consumable remaining. For example, a flow meter **88** is connected to tank **70** and is operable during the welding process to output a signal to RuBee tag **72** indicative of a gas flow rate and thus the quantity of gas used. Additionally, a counter gauge **86** configured to measure linear feet of weld wire leaving a container is connected to spool **66** and is operable during the welding process to output a signal to RuBee tag **68** indicative of a wire feed rate and thus the length of welding wire used.

[0040] RuBee tags **68**, **72** process the consumption data provided by flow meter **88** and counter gauge **86** and update the consumable data stored on a memory device in the tag to reflect the amount of available shielding gas and weld wire remaining in/on the gas tank **70** and the spool **66** respectively. It is envisioned that this updated consumable data can then be transmitted by RuBee tags **68**, **72** to wireless monitoring device **76** and controller **84**, signaling that a consumable level is getting low. Thus, if appropriate, controller **84** may signal welding apparatus **74** to shut down if a consumable is about to run out.

[0041] It is also envisioned that the updated consumable data can be wirelessly transmitted by RuBee tags **68**, **72** to an inventory control system **90**. Inventory control system would include a wireless monitoring device **92** in communication with RuBee tags **68**, **72**. This wireless monitoring device **92** would receive data from the RuBee tags **68**, **72** reflecting current quantities of gas and wire in the respective receptacles. This information would be transmitted to the inventory control system **90**, with the information available therefrom visually such as on a television screen (not shown) and/or by a printout. Thus, facility operators could be alerted of an impending shortage of a welding consumable at a particular location and act to provide additional consumable at the location before a welding process is forced to be interrupted due to a lack of that consumable. Additionally, by monitoring the amount of consumable within multiple containers within a facility, inventory control system **90** can determine exactly how much consumable material is on hand. Thus, appropriate re-supply requests can be generated for a particular consumable and active on-site inventory management can be achieved.

[0042] In addition to providing consumable data and workpiece data, RuBee tags **68**, **72**, **89** can be used to track the shipment of the consumables (and consumable containers) and workpieces from a manufacturer or storage facility to a welder. This type of tracking provides information to the user concerning available inventory that can be used for a welding operation and/or the location or date of arrival of new inventory for a welding operation. Such inventory tracking can be used to ensure that needed consumables are readily available for used for a particular welding operation in a particular location.

[0043] Therefore, according to one embodiment of the present invention, a welding-type system includes a power source to produce a welding-type power, the power source being operable in a plurality of operating modes. The welding-type system also includes a controller configured to set a plurality of operating parameters within the power source, at least one wireless monitoring device coupled to the controller, and at least one welding-type consumable associated with a wireless transmitter, the wireless transmitter configured to emit low frequency magnetic signals having consumable data encoded therein indicative of the at least one welding-type consumable. The at least one wireless monitoring device is arranged to communicate with the wireless transmitter by receiving and transmitting the low frequency magnetic signals, with the low frequency magnetic signals being transmitted at a frequency of approximately 131 kHz.

[0044] According to another embodiment of the present invention, a wireless communication welding-type system includes a power source to produce a welding-type power, a controller configured to set a plurality of operating parameters within the power source, and at least one wireless monitoring device coupled to the controller. The wireless communication welding-type system also includes a wireless transceiver tag in communication with the at least one wireless monitoring device, the wireless transceiver tag associated with a welding-type consumable and configured to communicate with the at least one wireless monitoring device by way of a bidirectional, on-demand, peer-to-peer protocol transmitted via substantially magnetic waves emitted at a frequency of approximately 131 kHz. The protocol includes consumable data encoded therein indicative of the welding-type consumable.

[0045] According to yet another embodiment of the present invention, a method for controlling a welding-type process having a plurality of operating conditions includes the steps of providing a consumable to be used in a welding-type process and positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store consumable data regarding parameters of the consumable. The method also includes the steps of reading the consumable data from the wireless tag from a wireless monitoring device, transmitting the consumable data from the wireless tag to the wireless monitoring device by way of a low frequency magnetic signal transmitted at a frequency of approximately 131 kHz, and controlling a welding-type device by setting the plurality of operating parameters, the setting of the plurality of operating parameters being determined by the transmitted consumable data.

[0046] According to still a further embodiment of the present invention, a method for monitoring an inventory of consumables in conjunction with performing a welding-type process includes the steps of providing a consumable to be used in a welding-type process and positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store data on an available quantity of the consumable. The method also includes the steps of measuring the quantity of consumable consumption during performance of the welding-type process, electronically modifying the memory of the wireless tag to reflect an updated available quantity of the consumable, and transmitting a data signal to a wireless monitoring device on an on-demand basis. The data signal includes data therein on the updated available quantity of the consumable and substantially comprises magnetic waves being transmitted at a frequency of approximately 131 kHz.

[0047] The present invention has been described in terms of the preferred embodiment, and it is recognized that equivalents, alternatives, and modifications, aside from those expressly stated, are possible and within the scope of the appending claims.

What is claimed is:

1. A welding-type system comprising:

a power source to produce a welding-type power, the power source being operable in a plurality of operating modes;

a controller configured to set a plurality of operating parameters within the power source;

at least one wireless monitoring device coupled to the controller;

at least one welding-type consumable associated with a wireless transmitter, the wireless transmitter configured to emit low frequency magnetic signals having consumable data encoded therein indicative of the at least one welding-type consumable; and

wherein the at least one wireless monitoring device is arranged to communicate with the wireless transmitter by receiving and transmitting the low frequency magnetic signals, the low frequency magnetic signals being transmitted at a frequency of approximately 131 kHz.

2. The welding-type system of claim **1** wherein the at least one wireless monitoring device is configured to communicate with the controller and transmit the consumable data in the received low frequency magnetic signals thereto.

3. The welding-type system of claim **1** wherein the controller is configured to set one or more of the plurality of operating parameters within the power source based on the consumable data transmitted thereto by the wireless monitoring device.

4. The welding-type system of claim **1** wherein controller is configured to select one of the plurality of operating modes for operating the power source based on the consumable data transmitted thereto by the wireless monitoring device.

5. The welding-type system of claim **1** wherein the plurality of operating parameters comprises at least one of a current wave shape, a welding wire feed speed, a welding angle, an arc current, an arc voltage, a current polarity, power, arc length, and a shielding gas flow rate.

6. The welding-type system of claim **1** wherein the wireless transmitter further comprises a wireless tag including:

a tag antenna;

a transceiver operatively connected to the tag antenna and configured to emit and receive low frequency magnetic signals;

a data storage device operable to store the consumable data thereon and identification data to identify the wireless transmitter;

a programmed data processor configured to process data received from the transceiver and the data storage device, and to send data to cause the transceiver to emit at least one of an identification signal based upon the identification data stored and a consumable signal based upon the consumable data stored; and

an energy source for activating the transceiver and the data processor.

7. The welding-type system of claim **6** wherein the consumable data comprises a type and an amount of the at least one welding-type consumable.

8. The welding-type system of claim **7** further comprising a consumable amount sensor configured to measure a quantity of consumption of the at least one welding-type consumable during performance of a welding operation and relay a signal to the wireless tag to modify the consumable data on the data storage device to reflect a remaining quantity of the at least one welding-type consumable.

9. The welding-type system of claim **1** wherein the at least one wireless monitoring device further comprises:

a field antenna configured to receive the low frequency magnetic signals emitted by the wireless transmitter;

a reader in operative communication with the field antenna to receive the data encoded in the low frequency magnetic signals; and

a transmitter in operative communication with the field antenna, the transmitter configured to send data signals to the wireless transmitter.

10. The welding-type system of claim **1** wherein the low frequency magnetic signals comprise a bidirectional, on-demand, peer-to-peer, radiating transceiver tag protocol.

11. The welding-type system of claim **1** further comprising a wireless workpiece transmitter associated with a workpiece to be welded, the wireless workpiece transmitter configured to store data thereon related to a desired plurality of operating parameters for welding the workpiece.

12. A wireless communication welding-type system comprising:

a power source to produce a welding-type power;

a controller configured to set a plurality of operating parameters within the power source;

at least one wireless monitoring device coupled to the controller;

a wireless transceiver tag in communication with the at least one wireless monitoring device, the wireless transceiver tag associated with a welding-type consumable and configured to communicate with the at least one wireless monitoring device by way of a bidirectional, on-demand, peer-to-peer protocol transmitted via substantially magnetic waves emitted at a frequency of approximately 131 kHz; and

wherein the protocol includes consumable data encoded therein indicative of the welding-type consumable.

13. The wireless communication welding-type system of claim **12** wherein the controller is configured to set one or more of the plurality of operating parameters within the power source based on the consumable data that is transmitted thereto by the wireless monitoring device.

14. The wireless communication welding-type system of claim **12** wherein the wireless transceiver tag further comprises a data storage device configured to store the consumable data thereon, the consumable data comprising at least an amount of the consumable.

15. The wireless communication welding-type system of claim **14** wherein the data storage device comprises a writeable memory, and wherein an updated amount of the consumable is written thereto based on a measured consumption of the consumable.

16. A method for controlling a welding-type process having a plurality of operating conditions comprising the steps of:

providing a consumable to be used in a welding-type process;

positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store consumable data regarding parameters of the consumable;

reading the consumable data from the wireless tag from a wireless monitoring device;

transmitting the consumable data from the wireless tag to the wireless monitoring device by way of a low frequency magnetic signal transmitted at a frequency of approximately 131 kHz; and

controlling a welding-type device by setting the plurality of operating parameters, the setting of the plurality of operating parameters being determined by the transmitted consumable data.

17. The method of claim **16** wherein the step of controlling the welding-type device further comprises selecting one of a plurality of operating modes for operating the welding-type device based on the transmitted consumable data.

18. The method of claim **16** wherein the low frequency magnetic signal is a bidirectional, on-demand, peer-to-peer, radiating transceiver tag protocol.

19. A method for monitoring an inventory of consumables in conjunction with performing a welding-type process including the steps of:

providing a consumable to be used in a welding-type process;

positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store data on an available quantity of the consumable;

measuring the quantity of consumable consumption during performance of the welding-type process;

electronically modifying the memory of the wireless tag to reflect an updated available quantity of the consumable;

transmitting a data signal to a wireless monitoring device on an on-demand basis, the data signal including data therein on the updated available quantity of the consumable; and

wherein the data signal substantially comprises magnetic waves being transmitted at a frequency of approximately 131 kHz.

20. The method of claim **19** wherein the step of positioning further comprises positioning the wireless electronic control on a consumables container housing the consumable.

21. The method of claim **19** further comprising the step of generating a re-supply order for the consumable when the available quantity of the consumable reaches a designated level determined by at least one of user setting, past re-supply levels, rate of usage, and estimated requirements.

22. The method of claim **19** wherein the data signal is a bidirectional, on-demand, peer-to-peer, radiating transceiver tag protocol.

23. A method for monitoring an inventory of consumables in conjunction with performing a welding-type process including the steps of:

providing a consumable to be used in a welding-type process;

positioning a wireless tag in proximity to the consumable and associating the wireless tag with the consumable, the wireless tag having a memory to store data on an available quantity of the consumable;

determining a location of the consumable; and

wherein the data signal substantially comprises magnetic waves being transmitted at a frequency of approximately 131 kHz.

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