SYSTEMS AND METHODS FOR UTILIZING WELDER POWER SOURCE DATA

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The invention described herein generally pertains to a system and method for aggregating welder parameters (e.g., power consumption parameter, welder process parameters, among others) from a first environment that includes one or more welder power sources and utilizing a portion of the aggregated welder parameters in at least one of a disparate welder power source or a second environment that includes one or more welder power sources. A parameter from a first welder power source in a first environment can be aggregated and collected in which a processing component evaluates such parameter to configure an additional welder power source in the first environment or one or more welder power sources in a second environment.
FIG. 2
FIG. 4
FIG. 6

1. Establish a welding output circuit path from a plurality of welding power sources.
2. Generate a welding output waveform for each welding power source.
3. Continuously sample output current and voltage levels for each welding power source.
4. Continuously generate a true energy or true power output in real time for each welding power source.
5. Transmit data for each welding power source to a cloud.
6. Process/aggregate data within the cloud to evaluate weld power source performance.
FIG. 7

1. PROCESSING COMPONENT

2. RECEIVE WELD DATA TO EVALUATE RESOURCES USED BY A POWER SOURCE PER WELD

3. RECEIVE SYSTEM DATA TO DETERMINE STATUS OF THE POWER SOURCE OVER A TIME PERIOD

4. EVALUATE WELD OUTPUT OF THE POWER SOURCE IN VIEW OF SYSTEM USAGE REQUIREMENTS

5. PREDICT FUTURE USAGE REQUIREMENTS OF THE POWER SOURCE BASED AT LEAST IN PART UPON WELD OUTPUT

6. DETERMINE ONE OR MORE FUTURE EVENTS BASED AT LEAST IN PART UPON FUTURE POWER SOURCE USAGE REQUIREMENTS
COMMUNICATE WITH A FIRST WELDER POWER SOURCE ON A FIRST NETWORK

COMMUNICATE WITH A SECOND WELDER POWER SOURCE ON A SECOND NETWORK

RECEIVE A PORTION OF DATA ASSOCIATED WITH THE FIRST WELDER POWER SOURCE

EVALUATE THE PORTION OF DATA TO IDENTIFY AT LEAST ONE WELDING PARAMETER FOR THE FIRST POWER SOURCE

COMPARE THE FIRST WELDER POWER SOURCE WITH THE SECOND POWER SOURCE TO IDENTIFY A RELATIONSHIP

UTILIZE THE AT LEAST ONE WELDING PARAMETER FOR THE SECOND POWER SOURCE BASED ON THE RELATIONSHIP

FIG. 8
SYSTEMS AND METHODS FOR UTILIZING WELDER POWER SOURCE DATA

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority to U.S. Provisional Application Ser. No. 61/558,717, filed Nov. 11, 2011, and entitled “SYSTEMS AND METHODS FOR IMPLEMENTING A WELDER POWER SOURCE WITH A LOCAL DATABASE OR CLOUD COMPUTING PLATFORM.” The entirety of the aforementioned application is incorporated herein by reference.

TECHNICAL FIELD

[0002] The invention described herein pertains generally to a system and method that utilizes weld data related to welder power source(s) to facilitate configuration of power consumption and/or welding processes.

BACKGROUND OF THE INVENTION

[0003] Welding systems reside at the core of the modern industrial age. From massive automobile assembly operations to automated manufacturing environments, these systems facilitate joining in ever more complicated manufacturing operations. One such example of a welding system includes an electric arc welding system. This may involve movement of a consumable electrode, for example, toward a work piece while current is passed through the electrode and across an arc developed between the electrode and the work piece. The electrode may be a non-consumable or consumable type, wherein portions of the electrode may be melted and deposited on the work piece. Often, hundreds or perhaps thousands of welders are employed to drive multiple aspects of an assembly process, wherein sophisticated controllers enable individual welders to operate within relevant portions of the process. For example, some of these aspects relate to control of power and waveforms supplied to the electrode, movements or travel of a welding tip during welding, electrode travel to other welding points, gas control to protect a molten weld pool from oxidation at elevated temperatures and provide ionized plasma for an arc, and other aspects such as arc stability to control the quality of the weld. These systems are often deployed over great distances in larger manufacturing environments and many times are spread across multiple manufacturing centers. Given the nature and requirements of modern and more complex manufacturing operations however, welding systems designers, architects and suppliers face increasing challenges in regard to upgrading, maintaining, controlling, servicing and supplying various welding locations. Unfortunately, many conventional welding systems operate in individually controlled and somewhat isolated manufacturing locations in regard to the overall assembly process. Thus, controlling, maintaining, servicing and supplying multiple and isolated locations in large centers, and/or across the globe, has become more challenging, time consuming and expensive.

[0004] As mentioned, welding environments are often isolated and geographically removed from one another and what is needed is an improved welding architecture to facilitate managing power supplies and/or configuration of welder power supplies.

SUMMARY OF THE INVENTION

[0005] In accordance with the present invention, there is provided a process for configuring a welder power source remotely based on a disparate welder power source comprising the steps of: communicating with a first welder power source on a first network; communicating with a second welder power source on a second network; receiving a portion of data associated with the first welder power source; evaluating the portion of data to identify at least one welding parameter for the first power source; comparing the first welder power source with the second power source to identify a relationship; and utilizing the at least one welding parameter for the second power source based on the relationship.

[0006] In accordance with the present invention, there is provided a welder system that comprises: a welder power source that collects a portion of data related to a weld process; a first component configured to create a modeled welding parameter for an additional welder power source based at least in part upon the collected portion of data; a second component configured to communicate the modeled welding parameter to the additional welder power source, wherein the additional welder power source uses a welding parameter based upon the modeled welding parameter.

[0007] In accordance with the present invention, there is provided welder system that comprises: means for communicating with a first welder power source on a first network; means for communicating with a second welder power source on a second network; means for receiving a portion of data associated with the first welder power source; means for evaluating the portion of data to identify at least one welding parameter for the first power source; means for comparing the first welder power source with the second power source to identify a relationship; and means for utilizing the at least one welding parameter for the second power source based on the relationship.

[0008] These and other objects of this invention will be evident when viewed in light of the drawings, detailed description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in the specification and illustrated in the accompanying drawings which form a part hereof, and wherein:

[0010] FIG. 1 is a block diagram illustrating a welder system that facilitates managing power consumption or welding process for one or more welder power sources;

[0011] FIG. 2 is a block diagram illustrating a graph that ascertains true energy and/or true power for a welding circuit path;

[0012] FIG. 3 is a block diagram illustrating a welder system that employs a power parameter or a welding parameter from a first welding environment to a second welding environment;

[0013] FIG. 4 is a block diagram illustrating a welding system that utilizes a weld parameter or a power parameter in a welding environment based on a relationship with a disparate welding environment;

[0014] FIG. 5 is a block diagram illustrating a welder system that generates a notification based on power consumption or a welding consumable for one or more welder power sources;
FIG. 6 is a flow diagram of ascertaining a true energy and/or a true power of a welding circuit path;

FIG. 7 is a flow diagram of adjusting a welder power source based on an environment-wide power consumption; and

FIG. 8 is a flow diagram of utilizing a power parameter or a welding parameter from a first welding environment to a second welding environment.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the invention relate to methods and systems that generally relate to aggregating welder parameters (e.g., power consumption parameter, welder process parameters, among others) from a first environment that includes one or more welder power sources and utilizing at least a portion of the aggregated welder parameters in at least one of a disparate welder power source (e.g., utilizing the aggregated parameter in a different welder power source than the welder power source the parameter was collected) or a second environment that includes one or more welder power sources. In an embodiment, a parameter from a first welder power source in a first environment can be aggregated and collected in which a processing component evaluates such parameter to configure an additional welder power source in the first environment or one or more welder power sources in a second environment. For instance, the processing component evaluates collected data from welding environments to adjust an activation time (e.g., powering on) of a welder power source or a deactivation time (e.g., powering down) of a welder power source in order to mitigate power consumption of an environment. In another instance, the processing component evaluates collected data from one or more welder power sources to employ in a disparate welder power source or a remote welding environment that includes one or more welder power sources, wherein the employment of the collected data is based on a relationship (e.g., percentage of commonality, substantially similar, size of environment, type of equipment, type of power source, type of welding process, an electrode type, a waveform, a welding signature, among others).

The best mode for carrying out the invention will now be described for the purposes of illustrating the best mode known to the applicant at the time of the filing of this patent application. The examples and figures are illustrative only and not meant to limit the invention, which is measured by the scope and spirit of the claims. Referring now to the drawings, wherein the showings are for the purpose of illustrating an exemplary embodiment of the invention only and not for the purpose of limiting same. FIG. 1 illustrates a schematic block diagram of an exemplary embodiment of welding system 100 including welding circuit path 105. Welding system 100 includes welder power source 110 and display 115 operationally connected to welder power source 110. Alternatively, display 115 may be an integral part of welder power source 110. For instance, display 115 can be incorporated into welder power source 110, a stand-alone component (as depicted), or a combination thereof. Welding system 100 further includes welding cable 120, welding tool 130, workpiece connector 150, spool of wire 160, wire feeder 170, wire 180, and workpiece 140. Wire 180 is fed into welding tool 130 from spool 160 via wire feeder 170, in accordance with an embodiment of the present invention. In accordance with another embodiment of the present invention, welding system 100 does not include spool of wire 160, wire feeder 170, or wire 180 but, instead, includes a welding tool comprising a consumable electrode such as used in, for example, stick welding. In accordance with various embodiments of the present invention, welding tool 130 may include at least one of a welding torch, a welding gun, and a welding consumable.

Welding circuit path 105 runs from welder power source 110 through welding cable 120 to welding tool 130, through workpiece 140 and/or to workpiece connector 150, and back through welding cable 120 to welder power source 110. During operation, electrical current runs through welding circuit path 105 as a voltage is applied to welding circuit path 105. In accordance with an exemplary embodiment, welding cable 120 comprises a coaxial cable assembly. In accordance with another embodiment, welding cable 120 comprises a first cable length running from welder power source 110 to welding tool 130, and a second cable length running from workpiece connector 150 to welder power source 110.

One or more welder power source(s) (e.g., welder power source 110) aggregates data respective to a respective welding process to which the welder power source is providing power to implement. Such collected data relates to each welder power source and is herein referred to as “weld data.” Weld data can include welding parameters and/or information specific to the particular welding process the welder power source is supplying power. For instance, weld data can be an output (e.g., a waveform, a signature, a voltage, a current, among others), a weld time, a power consumption, a welding parameter for a welding process, a welder power source output for the welding process, and the like.

Welder system 100 includes processing component 125 that evaluates a portion of data collected by at least welder power source 110. Processing component 125 ascertains a parameter related to the welder power source and in turn, a portion of a welding environment in which welder power source 110 is used) to employ in at least one of a disparate welder power source (not shown) that can be local or remote (in comparison to the welder power source 110) or an additional welding environment that can be local or remote (in comparison to the welder power source 110). Processing component 125 implements the at least one parameter with a disparate welder power source or disparate environment based upon a relationship therebetween.

Processing component 125 enables a parameter from one welder power source in an environment on a first network to be utilized with at least one of another welder power source in the environment on the first network, another welder power source in the environment on a second network, or another welder power source in another environment. Moreover, processing component 125 can implement a parameter collected with a suitable component or device utilized in a welding process (e.g., wire feeder, power source, among others).

For instance, processing component 125 identifies a relationship between a source of a parameter and a target, wherein the source is one of a welder power source or an environment that includes one or more welder power source and the target is where the parameter is to be implemented. The identified relationship can be based on factors such as, but not limited to, size of environment, type of equipment, type of power source, type of welding process, an electrode type, a waveform, a welding signature, an employee using the welder power source, a weld time, a portion of weld data, a
location of the welder power source, a location of the environment, a voltage, a current, a piece, a material of the workpiece, among others. In an embodiment, the relationship can be based on a percentage of commonality between one or more of the referenced factors. For instance, a list of five (5) factors can be used in which a eighty (80) percent of commonality exists before employing a collected parameter in a disparate welder power source or disparate environment.

[0025] Processing component 125 can be local or remote in comparison to welder power source 110. For instance, processing component 125 can be a stand-alone component (as depicted), incorporated into welder power source 110 in the first environment, incorporated into a computing platform (e.g., remote platform, local platform, cloud platform, software-as-a-service (SaaS) platform, among others), incorporated into a second environment, incorporated into a disparate welder power source in a second environment, or a combination thereof.

[0026] In one embodiment, processing component 125 is a computer operable to execute the disclosed methodologies and processes, including methods 600, 700, and 800 described herein. In order to provide additional context for various aspects of the present invention, the following discussion is intended to provide a brief, general description of a suitable computing environment in which the various aspects of the present invention may be implemented. While the invention has been described above in the general context of computer-executable instructions that may run on one or more computers, those skilled in the art will recognize that the invention also may be implemented in combination with other program modules and/or as a combination of hardware and/or software. Generally, program modules include routines, programs, components, data structures, etc., that perform particular tasks or implement particular abstract data types.

[0027] Moreover, those skilled in the art will appreciate that the inventive methods may be practiced with other computer system configurations, including single-processor or multi-processor computer systems, minicomputers, mainframe computers, as well as personal computers, hand-held computing devices, microprocessor-based or programmable consumer electronics, and the like, each of which may be operatively coupled to one or more associated devices. The illustrated aspects of the invention may also be practiced with distributed computing environments where certain tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices. For instance, a remote database, a local database, a cloud-computing platform, a cloud database, or a combination thereof can be utilized with processing component 125.

[0028] The processing component 125 can utilize an exemplary environment for implementing various aspects of the invention including a computer, wherein the computer includes a processing unit, a system memory and a system bus. The system bus couples system components including, but not limited to the system memory to the processing unit. The processing unit may be any of various commercially available processors. Dual microprocessors and other multi-processor architectures also can be employed as the processing unit.

[0029] The system bus can be any of several types of bus structure including a memory bus or memory controller, a peripheral bus and a local bus using any of a variety of commercially available bus architectures. The system memory can include read only memory (ROM) and random access memory (RAM). A basic input/output system (BIOS), containing the basic routines that help to transfer information between elements within processing component 125, such as during start-up, is stored in the ROM.

[0030] Processing component 125 can further include a hard disk drive, a magnetic disk drive, e.g., to read from or write to a removable disk, and an optical disk drive, e.g., for reading a CD-ROM disk or to read from or write to other optical media. Processing component 125 can include at least some form of computer readable media. Computer readable media can be any available media that can be accessed by the computer. By way of example, and not limitation, computer readable media may comprise computer storage media and communication media. Computer storage media includes volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by processing component 125.

[0031] Communication media typically embodies computer readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term “modulated data signal” means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, Radio Frequency (RF), Near Field Communications (NFC), Radio Frequency Identification (RFID), infrared, and/or other wireless media. Combinations of any of the above should also be included within the scope of computer readable media.

[0032] A number of program modules may be stored in the drives and RAM, including an operating system, one or more application programs, other program modules, and program data. The operating system in processing component 125 can be any of a number of commercially available operating systems.

[0033] In addition, a user may enter commands and information into the computer through a keyboard and a pointing device, such as a mouse. Other input devices may include a microphone, an IR remote control, a track ball, a pen input device, a joystick, a game pad, a digitizing tablet, a satellite dish, a scanner, or the like. These and other input devices are often connected to the processing unit through a serial port interface that is coupled to the system bus, but may be connected by other interfaces, such as a parallel port, a game port, a universal serial bus (“USB”), an IR interface, and/or various wireless technologies. A monitor (e.g., display 116), or other type of display device, may also be connected to the system bus via an interface, such as a video adapter. Visual output may also be accomplished through a remote display network protocol such as Remote Desktop Protocol, VNC, X-WINDOW
System, etc. In addition to visual output, a computer typically includes other peripheral output devices, such as speakers, printers, etc.

[0034] A display (in addition or in combination with display 115) can be employed with processing component 125 to present data that is electronically received from the processing unit. For example, the display can be an LCD, plasma, CRT, etc. monitor that presents data electronically. Alternatively or in addition, the display can present received data in a hard copy format such as a printer, facsimile, plotter etc. The display can present data in any color and can receive data from processing component 125 via any wireless or hard wire protocol and/or standard. In another example, processing component 125 and/or system 100 can be utilized with a mobile device such as a cellular phone, a smart phone, a tablet, a portable gaming device, a portable Internet browsing device, a Wi-Fi device, a Portable Digital Assistant (PDA), among others.

[0035] The computer can operate in a networked environment using logical and/or physical connections to one or more remote computers, such as a remote computer(s). The remote computer(s) can be a workstation, a server computer, a router, a personal computer, microprocessor based entertainment appliance, a peer device or other common network node, and typically includes many or all of the elements described relative to the computer. The logical connections depicted include a local area network (LAN) and a wide area network (WAN). Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

[0036] When used in a LAN networking environment, the computer is connected to the local network through a network interface or adapter. When used in a WAN networking environment, the computer typically includes a modem, or is connected to a communications server on the LAN, or has other means for establishing communications over the WAN, such as the Internet. In a networked environment, program modules depicted relative to the computer, or portions thereof, may be stored in the remote memory storage device. It will be appreciated that network connections described herein are exemplary and other means of establishing a communications link between the computers may be used.

[0037] Alternatively or in addition, a local or cloud (e.g., local, cloud, remote, among others) computing platform can be utilized for data aggregation, processing, and delivery. For this purpose, the cloud computing platform can include a plurality of processors, memory, and servers in a particular remote location. Under a software-as-a-service paradigm, a single application is employed by a plurality of users to access data resident in the cloud. In this manner, processing requirements at a local level are mitigated as data processing is generally done in the cloud, thereby relieving user network resources. The software-as-a-service application allows users to log into a web-based service (e.g., via a web browser) which hosts all the programs resident in the cloud.

[0038] In an example, a plurality of users can access a local or cloud database (e.g., local database, cloud database, remote database, among others) computing platform (e.g., processing component 125) via a web-based application on a computing device, such as a tablet, pad, laptop, cell phone, computer, or other component. The web-based application can allow a user to configure particular reports that quantify data in substantially any format and in comparison to any number of metrics, such as performance benchmarks and the like. Moreover, the software applications can be updated and distributed in a global fashion to ensure that each user is using the latest and greatest technology.

[0039] FIG. 2 graphically illustrates a process for determining true energy and/or true power to welding circuit path 105 of FIG. 1 using welding waveform 200. The true energy provided by a complex waveform is determined by integrating the product of voltage, current, and time using a sufficiently small sampling interval of time dt 210. The necessary sample interval 210 will depend on the frequency content of the voltage/current waveforms and the accuracy desired. This information can be processed, wherein the energy value is calculated, and presented to enable/enhance quality control procedures. Specialized circuitry can be included to overcome the problems associated with high speed sampling. Most commercial measurement devices made for 50/60 Hz sine waves have difficulty operating under these conditions. Alternatively, or in addition, a true power provided by the complex waveform is determined by averaging the product of voltage and current using a sufficiently small sampling interval of time dt 210.

[0040] Information can be delivered to a local or cloud (e.g., remote) database wherein an algorithm is applied to evaluate true power and/or true energy used by the welding system 100. Alternatively, data can be processed locally and subsequently delivered to a local or cloud database for global retrieval by any number of users. In yet another alternative, data can be delivered and processed locally, wherein one or more local components receive and process data. Weld data (residential in the local or cloud database, etc.) can be evaluated in view of particular benchmarks to evaluate performance of the welding system over time. In addition, this data can be employed to facilitate predictive analysis, which can identify particular welding system events.

[0041] Data can be used to determine expected energy usage over time to allow a user to perform data aggregation, wherein data from a plurality of weld systems (e.g., within a particular facility, location, or factory) is analyzed. Consolidation of data within a common location, such as a local or cloud database (e.g., local database, cloud database, remote database, among others) server farm, can facilitate such comparative data analysis and trending. Additionally, before or after this data has been processed, it can be accessed by users in substantially any location. For instance, users can use various portable devices including smart phones, tablets, laptop computers, etc. Data can also be served up using applications resident in the local or cloud database (e.g., local database, cloud database, remote database, among others) in a software-as-a-service (SaaS) model. In this manner, users can pay a subscription fee to access/employ the data sets and output related thereto. Data can be delivered to a user and/or used to trigger one or more other events. In one approach, data which is approaching a threshold can trigger an output to a purchasing system, whereby an order for a quantity of goods is automatically placed.

[0042] Power for each power source can be calculated by multiplying the true weld power by the efficiency of each power source. This information can be evaluated over a given time period (e.g., 24 hours) to determine when peak demand events occur. Peak demand events can be triggered by simple overlapping scheduling for machine startups, such as at the beginning of a shift. Once peak demand events are identified, they can be mitigated to provide a cost savings for energy...
usage. In one example, scheduling or other changes can be made to insure that peak demand does not exceed a predetermined threshold.

In one example, weld systems can be powered on or off relative to other systems at a location thereby minimizing peak performance to lower energy costs for a user. Alternatively or in addition, true energy/true power data is used in association to predict timing of one or more preventative maintenance events. Such predictive analysis can allow a user to order necessary components, materials, etc., in advance of need to allow favorable pricing conditions. In addition, such materials can be on-hand to insure that the welding system issues are preempted to minimize downtime and to maximize productivity. Thus, a user can monitor true energy/true power of a plurality of welding systems remotely to maximize output and minimize cost.

For a sufficiently small time interval, the welding power source will calculate Joule energy (sampled voltage x sampled current x time interval). The Joule energy will then be integrated over a suitable time period and presented to the operator of the equipment. For instance, the following can be employed:

\[ \text{true energy} = \int V \cdot I \cdot dt \]

and/or alternatively,

\[ \text{true power} = (\Sigma V \cdot I) / N. \]

where N is the number of voltage and current sample pairs over the suitable time period.

Fast sampling of the instantaneous voltage and instantaneous current is done with power source 110 of the welding system such that complex waveforms are sampled at a high enough rate to allow accurate calculation of Joule energy or true power. The samples of instantaneous voltage and current are multiplied together to generate multiple instantaneous power samples and are integrated over a predefined time interval to generate true energy, not just average energy. All of this processing is done in real time within power source 110 of the welding system. The result may be displayed to an operator of welding system 100 on display 115 of power source 110, for example. In this manner, sampled data can be processed at a high rate locally instead of delivery to a local or cloud database (e.g., local database, cloud database, remote database, among others). In accordance with an embodiment of the present invention, the control of power source 110, using the complex waveforms, provides the high speed sampling.

In accordance with an embodiment of the present invention, a running integrated value of true energy can be provided over a sliding time interval of, for example, one minute. Such a true energy value may be continuously updated and displayed to an operator on, for example, a display or meter 115 of the power source 110, thus giving the true energy (i.e., true heat) over the past one minute interval. Other time intervals may be used instead, in accordance with various other embodiments of the present invention.

The true energy level may be divided by a distance traveled by welding tool 130 to calculate a true energy per unit length. With welding travel speed information that can be measured by welding power source 110, communicated digitally, or manually entered by the operator, the Joule energy may be presented as Joules per unit length. A typical measurement unit is kJ/inch. The welding travel speed may be controlled by power source 110 which provides the welding speed to, for example, an automated robot welder or some other hard automatic or semi-automatic mechanism (not shown). Alternatively, the welding travel speed may be controlled by some other external device which provides the welding speed to power source 110. Similarly, a true power level may be divided by a distance traveled by welding tool 130 to calculate a true power per unit length.

Also, the true energy level may be divided by a deposited amount of wire to calculate a true energy per unit amount of deposited wire. With welding wire feed speed that can be measured by the welding power source 110, communicated digitally, or manually entered, the Joule energy per deposited amount of wire may be presented. A typical measurement unit is kJ/pound (of wire deposited). The welding wire feed speed may be measured by wire feeder 170 itself, in accordance with an embodiment of the subject invention. Similarly, the true power level may be divided by a deposited amount of wire to calculate a true power per unit amount of deposited wire.

In the case of having multiple power sources on a single workpiece, the combined Joule energy, kJ/inch, or kJ/pound may be compiled and presented to the operator. The information is presented per welding pass and as a total for the entire weld. The information, communicated between the power sources and a central collection point (a master power source or another device like a computer) may be further processed for quality control purposes.

In accordance with an embodiment of the present invention, the required true energy level for a particular welding process is entered or communicated to the welding power source. The true energy level may be displayed on a display 115 along with an indication of acceptability of the true energy level. If the actual energy, as determined by an embodiment of the present invention, falls outside the specified limits, welding power source 110 will alert the operator, log an event, or stop welding. As a result, a welder can know at all times whether or not he is being provided with the required energy for the present welding application. Similarly, the true power level may be displayed and processed.

Similarly, the true energy or true power per unit length and/or the true energy or true power per unit amount of deposited wire may be displayed along with an indication of acceptability. In accordance with an embodiment of the present invention, the Joule energy, kJ/inch, or kJ/pound is presented to the operator through a display or meter on the power source, on the wire feeder, or on a computer (through digital communications). Using the same measurement technique with a sufficiently small sampling interval, the true power, watts/inch or watts/pound may be presented and communicated in the same way as described above for Joule energy, in accordance with an embodiment of the subject invention.

For AC processes (e.g., processes using AC waveforms), the measurement techniques described above represent the total power. The AC components of this total are separately processed, communicated, and presented as a positive polarity portion, a negative polarity portion, and the total, in accordance with an embodiment of the present invention. The arc efficiency (heat transfer into the base material, i.e., workpiece) may be different for the two polarities. The resulting heat into the base material is determined with the known energy from the positive and negative polarities.

FIG. 3 illustrates welder system 300 that employs a power parameter or a welding parameter from welding environment to a second welding environment. Welder system
300 includes processing component 125 that aggregates and/or receives a welding parameter from at least one welding environment. It is to be appreciated that the welding environment can be a suitable welding environment networked with at least one welder power source. For instance, welder system 300 can include welding environment 310 that hosts welder power source 320 and welding environment 330 that hosts a number of welder power sources 340 such as welder power source, to welder power source, where N is a positive integer.

[0055] Processing component 125 aggregates and/or receives data from welding environment 310 and/or welding environment 330 and evaluates such data in order to implement such data or parameter to another welding environment or welder power source. In another embodiment, processing component 125 creates a parameter based on the evaluated data or parameters, wherein such created parameter is employed in another welding environment or another welder power source.

[0056] For instance, a welding environment can be located in Asia and a welding environment can be located in USA. Based on collected welding parameters from the welding environment in Asia, processing component 125 can identify a percentage of commonality between a number of welder power sources in the welding environment in USA. Based on such percentage of commonality, the welder parameters from Asia can be utilized in the welding environment in USA. In another example, the welding parameters from Asia can be used to create a new parameter(s) for employment in the welding environment in the USA.

[0057] By way of example and not limitation, processing component 125 can aggregate data in data store 350. In another embodiment, welding environments 320, 330 can communicate parameters or data to data store 350, wherein processing component 125 accesses such data or parameters. It is to be appreciated that data store 350 can be a local database, a cloud database, or a combination thereof. A “data store” or “memory” can be, for example, either volatile memory or nonvolatile memory, or can include both volatile and nonvolatile memory. The data store of the subject systems and methods is intended to comprise, without being limited to, these and other suitable types of memory. In addition, the data store can be a server, a database, a hard drive, a flash drive, an external hard drive, a portable hard drive, a cloud-based storage, and the like.

[0058] It is to be appreciated that data store 350 can be a stand-alone component (as depicted), incorporated into the processing component 125, incorporated into at least one welder power source (e.g., welder power source 320, welder power sources 340), or a combination thereof. A “data store” or “memory” can be, for example, either volatile memory or nonvolatile memory, or can include both volatile and nonvolatile memory. The data store of the subject systems and methods is intended to comprise, without being limited to, these and other suitable types of memory. In addition, the data store can be a server, a database, a hard drive, a flash drive, an external hard drive, a portable hard drive, a cloud-based storage, and the like.

[0059] FIG. 4 illustrates welder system 400 that utilizes a weld parameter or a power parameter in a welding environment based on a relationship with a disparate welding environment. Processing component 125 includes model component 410 that ascertains patterns or similarities in data received or collected via welder power source(s) and/or welding environment(s). Model component 410 identifies each factor for a source of the parameter or data. As discussed, the factor(s) can be related to size of environment, type of equipment, type of power source, type of welding process, an electrode type, a waveform, a welding signature, an employee using the welder power source, a weld time, a portion of weld data, a location of the welder power source, a location of the environment, a voltage, a current, a workpiece, a material of the workpiece, among others. Based upon identifying factors for each portion of data or parameters received, model component 410 can ascertain models of each welding environment and/or welder power sources. For instance, a model can be created for a welding environment for use of a type of a electrode. For instance, a model can be created for a type of material of a workpiece.

[0060] In an embodiment, processing component 125 collects information or a parameter related to a power consumption of at least one of a welder power source or a welding environment. For instance, as discussed above, a true power and/or a true energy can be identified. Moreover, processing component 125 identifies a cost related to such power or peak power times in order to adjust one or more welder power sources. In another example, an environment can be identified to include parameters for a low-cost or low consumption of power, wherein such parameters can be implemented in another environment or welder power source in order to replicate low consumption. In an embodiment, a power consumption model can be created for a number of welding environment(s) and/or welder power source(s) in order to reference or use in another environment or another welder power source.

[0061] In another embodiment, processing component 125 and/or model component 410 creates a welding consumable model that relates to a duration of time or a rate of consumption for a welding consumable. For instance, the rate of consumption or the duty time of time (e.g., for replacement or exhaustion) can be identified by evaluating data or parameters collected and/or received by processing component 125. Model component 410 ascertains an estimated rate of consumption or duty time for a consumable material used in a welding process based on replacement or lifespan of the consumable in welding environment(s) and/or a welding process for a welder power source.

[0062] In another embodiment, processing component 125 and/or model component 410 creates a welding parameter model based on evaluation of data collected from various welding processes from one or more welding environments. For example, a weld parameter (e.g., current, voltage, weld time, waveform, duration of waveform, signature, among others) for a first welding process can be evaluated and identified as part of a welding parameter model for another welding environment for a second welding process.

[0063] Weld system 400 includes match component 420 that identifies a welding environment from a plurality of welding environments 430 (e.g., a number of welding environments from welding environment, to welding environmentP, where P is a positive integer) in which to implement or model a parameter or portion of data collected via processing component 125. Match component 420 enables a user to manually identify factor(s) to consider and/or a percentage of commonality in order to identify usable data or parameter. For instance, a user can request a type of electrode for a type of power source and data or parameters meeting such criteria can be provided. Match component 420 further identifies welding environments 430 that include particular relationships to one another. For instance, rather than a query, match component 420 locates similar or substantially similar welder power sources and/or welding environments based on a select...
number of factor(s). In an example, all stick electrode welding environments and/or welder power sources that utilize composite electrodes can be listed in an order of most similar to least similar (for instance).

In an embodiment, a plurality of welding power sources can interface to a local database or cloud computing platform for data processing and/or distribution to one or more users. For this purpose, the local database or cloud computing platform can include processing component 125 and match component 420. As referenced above, processing component 125 includes memory and/or data store 350. Processing component 125 receives and/or collects data from welding power sources in which the data is organized into data sets for comparison to one or more disparate data sets, which can include predetermined benchmarks. Such benchmarks can relate to expected/desired performance of welding systems such as particular models and/or configurations with specific consumables or within specific environments. Processing component 125 can execute code to compare the aggregated data to these parameters, which are stored in memory and/or data store 350. Once processing is complete, the processed data can be formatted (e.g., within a web-based application, for instance) for delivery to one or more users and/or back to welding power sources and/or welding environments. This process can be initiated and repeated as necessary to configure welding power sources. In an aspect, system 400 can be implemented to provide performance data to a manufacturer to use for continuous improvement and/or quality programs.

In an embodiment, system 400 evaluates a condition of use to enable match component 420 to match a parameter from one source (e.g., welder power source, welding environment) to a target (e.g., another welder power source, another welding environment). By way of example and not limitation, the condition of use can be at least one of a type of welding process, a type of electrode, a type of welding signature, a waveform signature, a weld time, a material of a workpiece used in the welding process, a type of weld, among others.

FIG. 5 illustrates welder system 500 that generates a notification based on power consumption or a welding consumable for one or more welder power sources. Processing component 125 collects and/or receives data from welder power sources 510, wherein there can be a number of welder power sources from welder power source, to welder power sources, where M is a positive integer. Welder system 500 allows data and/or historic data from various welder power sources and/or various welding environments to be at least one of re-used in a welder power source, re-used in a welding environment, used as a basis for a parameter in a welder power source, used as a basis for a parameter in a welding environment, among others.

Power predict component 520 leverages data or a parameter from a first welder power source to implement in a second welder power source. In another embodiment, the data or parameter is used in a disparate welding environment. For instance, a powering up time and/or powering down time for a welder power source can be collected and/or utilized in another welder power source or another welding environment. Based on a true power or a true energy data collected, power predict component 520 adjusts energy consumption with controlling at least a welder power source within a welding environment. For instance, at least one of a power consumption of the first welder power source, an energy consumption for the first welder power source, a start time of activating the first welder power source, an end time of activating the first welder power source, and the like can be collected and employed in order to mimic or replicate the source of the data or parameter. In another embodiment, the true power and/or true energy for a first welder power source can be evaluated and power predict component 520 can adjust at least one of a start time of activating (e.g., powering up) the first welder power source or an end time of activating (e.g., powering down) the first welder power source. In another embodiment, the true power and/or true energy for a first welder power source can be evaluated and power predict component 520 can adjust at least one of a start time of activating (e.g., powering up) the second welder power source or an end time of activating (e.g., powering down) the second welder power source.

In one example, welder system 500 facilitates predictive data analysis. Welding power sources 510 can each include local data (not shown) and system data (not shown). In an example, local data can relate to the amount of resources used to execute a particular weld such as the amount of power or the weight of consumable. In contrast, system data can be directed to the status of the respective welding power source over a period of time, such as an on condition, an off condition, a fault condition, etc. The local data and system data can be accessed via a local database or cloud for processing via processing component 125. Processing component 125 can process data received and/or compare it to data, look up tables, etc. stored in data store (not shown) to evaluate resource usage over time to determine when resources are used and to what extent.

Power predict component 520 and/or weld process predict component 530, in turn, can use this data to provide a predictive analysis for a welding power source to evaluate/determine wire consumption rate, contact tip life, drive roll life, torch liner life, and other future events. For example, knowing the value of wire consumed at a particular speed at a given point in time does not allow determination of future events, without additional information. Thus, the compilation of time stamps and trending data over large periods of time can allow actionable predictions to be formulated. In one embodiment, a particular model of welder consumes a particular consumable at a rate, which is known from previous data sets. Knowing this information along with the amount of consumable loaded into a welding power source can trigger an alarm that notifies personnel to re-load consumable as the current amount is known to be inadequate based on the expected weld time and rate of consumption. Notification component 540 communicates a notification (e.g., an alarm, an audible signal, a visual signal, a vibration, a movement, a graphic, a text, an email, among others) that indicates an event based on prediction of system 500. The event, as discussed, can be a replenishment of a consumable, an operation on a welder power source, an inspection, among others.

In view of the exemplary devices and elements described supra, methodologies that may be implemented in accordance with the disclosed subject matter will be better appreciated with reference to the flow charts and/or method-
tologies of FIGS. 6-8. The methodologies and/or flow diagrams are shown and described as a series of blocks, the claimed subject matter is not limited by the order of the blocks, as some blocks may occur in different orders and/or concurrently with other blocks from what is depicted and described herein. Moreover, not all illustrated blocks may be required to implement the methods and/or flow diagrams described hereinafter.

[0072] Sequentially, the following occurs as illustrated in the decision tree flow diagram 600 of FIG. 6 which is a flow diagram 600 that ascertains a true energy and/or a true power of a welding circuit path. Methodology 600 determines the true energy and/or true power to, for instance, welding circuit path 105 of FIG. 1 according to the illustrated process of FIG. 2 in accordance with various aspects of the subject invention. A welding circuit path is established running from a welding power source through a welding cable to a welding tool, through a workpiece and/or to a workpiece connector, and back through the welding cable to the welding power source (reference block 610). A welding waveform is generated within the welding power source which is transmitted through the welding circuit path, and wherein the welding waveform comprises a welding current component and a welding voltage component (reference block 620). The instantaneous current levels and the instantaneous voltage levels of the welding waveform are continuously sampled within the welding power source at a predefined sample rate (reference block 630). A product of each of the sampled current levels and the corresponding sampled voltage levels are continuously generated (e.g., within the welder power source), as part of determining a true energy level and/or a true power level from the welding power source into the welding circuit path in real time (reference block 640).

[0073] Data for each welding power source is transmitted to a local database or cloud computing platform (reference block 650) and, the data is aggregated, processed, and compared to one or more benchmark values to evaluate welding power source performance (reference block 660). In an example, the value of true energy used by each welding power system is evaluated over a particular time period. This true energy value can be compared to one or more other welding power sources at a same/similar location and/or other of the same (e.g., substantially similar, a percentage of commonality, among others) models in use in other welding environments or locations across the world. This data can be collected for multiple uses including identifying various performance variables such as timing of expected maintenance events and/or component replacement. An event can be planned or initiated based on the results of the evaluation (reference block 670). In an embodiment, the event is an email, text, tweet, or other messaging that notifies one or more personnel of an impending need, such as ordering a new component or scheduling appropriate maintenance to attend to the welding power source in question.

[0074] FIG. 7 illustrates flow diagram 700 related to adjusting a welder power source based on an environment-wide power consumption. Flow diagram 700 can be employed to determine one or more future events related to welding power sources. Weld data is received to evaluate resources used by a power source per weld (reference block 710). Such resources can include power, consumables (e.g., wire, electrode), shielding gas, etc. System data is received to determine status of the power source over a time period (reference block 720). Such system data can include the state of a welding power source such as on, off, fault, etc. Weld output of the power source is evaluated in view of system usage requirements (reference block 730). For example, the amount of wire used over a period of time when the power source was in an on state. Future usage requirements of the power source is predicted based at least in part upon a weld output (reference block 740). One or more future events are determined based at least in part upon future power source usage requirements, such as weld tip life, wire consumption rate, among others (reference block 750).

[0075] FIG. 8 illustrates methodology 800 that utilizes a power parameter or a welding parameter from a first welding environment to a second welding environment. A communication is provided with a first welder power source on a first network (reference block 810). A communication is provided with a second welder power source on a second network (reference block 820). A portion of data associated with the first welder power source is received (reference block 830). The portion of data is evaluated to identify at least one welding parameter for the first power source (reference block 840). The first welder power source is compared with the second power source to identify a relationship (reference block 850). The at least one welding parameter is utilized for the second power source based on the relationship (reference block 860).

[0076] The method further includes receiving the portion of data from at least one of the first network or the second network. The method further includes receiving the portion of data from at least one of a cloud database, a local database, or a database remote to the first network and the second network. The method further includes the relationship is a percentage of commonality between a parameter of each the first welder power source and the second power source, wherein the parameter is at least one of a type of welding process, a weld, an electrode, an enterprise location, a type of a welder power source, a material of a workpiece used in a welding process, a size of an enterprise, a waveform used for a welder power source, a welding process signature, a weld time, a portion of weld data, or a portion of data related to a worker performing a welding process.

[0077] The method further includes creating a welding model based on one or more relationships for a plurality of welder power sources. The method further includes receiving the the at least one welding parameter at the second power source. The method further includes the at least one welding parameter is at least one of a welder power source signature, a weld time, or a type of an electrode. The method further includes the at least one welding parameter is at least one of a power consumption of the first welder power source, an energy consumption for the first welder power source, a start time of activating the first welder power source, or an end time of activating the first power source.

[0078] The method further includes evaluating the true energy consumption of the first welder power source and adjusting the start time of activating the first welder power source based on the evaluation of the true energy consumption of the first welder power source. The method further includes adjusting the end time of activating the first welder power source based on the evaluation of the true energy consumption of the first welder power source. The method further includes evaluating a true power consumption of the first welder power source and adjusting a start time of activating the second welder power source based on the evaluation of the true energy consumption of the first welder power source.
The method further includes adjusting an end time of activating the second welder power source based on the evaluation of the true energy consumption of the first welder power source. The method further includes identifying at least one of a consumption of material rate or a frequency to perform an operation on the first welder power source.

The above examples are merely illustrative of several possible embodiments of various aspects of the present invention, wherein equivalent alterations and/or modifications will occur to others skilled in the art upon reading and understanding this specification and the annexed drawings. In particular regard to the various functions performed by the above described components (assemblies, devices, systems, circuits, and the like), the terms (including a reference to a "means") used to describe such components are intended to correspond, unless otherwise indicated, to any component, such as hardware, software, or combinations thereof, which performs the specified function of the described component (e.g., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the illustrated implementations of the invention. In addition although a particular feature of the invention may have been disclosed with respect to only one of several implementations, such feature may be combined with one or more other features of the other implementations as may be desired and advantageous for any given or particular application. Also, to the extent that the terms "including", "includes", "having", "has", "with", or variants thereof are used in the detailed description and/or in the claims, such terms are intended to be inclusive in a manner similar to the term "comprising."

This written description uses examples to disclose the invention, including the best mode, and also to enable one of ordinary skill in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that are not different from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

The best mode for carrying out the invention has been described for purposes of illustrating the best mode known to the applicant at the time. The examples are illustrative only and not meant to limit the invention, as measured by the scope and merit of the claims. The invention has been described with reference to preferred and alternate embodiments. Obviously, modifications and alterations will occur to others upon the reading and understanding of the specification. It is intended to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. A method, comprising:
   - communicating with a first welder power source on a first network;
   - communicating with a second welder power source on a second network;
   - receiving a portion of data associated with the first welder power source;
   - evaluating the portion of data to identify at least one welding parameter for the first power source;
   - comparing the first welder power source with the second power source to identify a relationship; and
   - utilizing the at least one welding parameter for the second power source based on the relationship.

2. The method of claim 1, further comprising receiving the portion of data from at least one of the first network or the second network.

3. The method of claim 1, further comprising receiving the portion of data from at least one of a cloud database, a local database, or a database remote to the first network and the second network.

4. The method of claim 3, the relationship is a percentage of commonality between a parameter of each the first welder power source and the second power source, wherein the parameter is at least one of a type of welding process, a weld, an electrode, an enterprise location, a type of a welder power source, a material of a workpiece used in a welding process, a size of an enterprise, a waveform used for a welder power source, a welding process signature, a weld time, a portion of weld data, or a portion of data related to a worker performing a welding process.

5. A method, comprising creating a welding model based on one or more relationships for a plurality of welder power sources.

6. The method of claim 1, further comprising receiving the at least one welding parameter at the second power source.

7. The method of claim 1, the at least one welding parameter is at least one of a weld power source signature, a weld time, or a type of an electrode.

8. The method of claim 1, the at least one welding parameter is at least one of a power consumption of the first welder power source, an energy consumption for the first welder power source, a start time of activating the first welder power source, or an end time of activating the first power source.

9. The method of claim 8, further comprising:
   - evaluating the true energy consumption of the first welder power source;
   - adjusting the start time of activating the first welder power source based on the evaluation of the true energy consumption of the first welder power source.

10. The method of claim 9, further comprising:
    - adjusting the end time of activating the first welder power source based on the evaluation of the true energy consumption of the first welder power source.

11. The method of claim 8, further comprising:
    - evaluating a true power consumption of the first welder power source;
    - adjusting a start time of activating the second welder power source based on the evaluation of the true energy consumption of the first welder power source.

12. The method of claim 11, further comprising:
    - adjusting an end time of activating the second welder power source based on the evaluation of the true energy consumption of the first welder power source.

13. The method of claim 1, further comprising identifying at least one of a consumption of material rate or a frequency to perform an operation on the first welder power source.

14. A welder system, comprising:
   - a welder power source that collects a portion of data related to a weld process;
   - a first component configured to create a modeled welding parameter for an additional welder power source based at least in part upon the collected portion of data;
a second component configured to communicate the modeled welding parameter to the additional welder power source, wherein the additional welder power source uses a welding parameter based upon the modeled welding parameter.

15. The welder system of claim 14, the additional welder power source includes a substantially similar condition of use compared to the welder power source.

16. The welder system of claim 15, the condition of use is at least one of a type of welding process, a type of electrode, a type of welding signature, a waveform signature, a weld time, a material of a workpiece used in the welding process, or a type of weld.

17. The welder system of claim 14, further comprising a third component that is configured to identify a period of time to replace a consumable material related to the welder power source based upon evaluation of the collected portion of data.

18. The welder system of claim 14, further comprising a fourth component that is configured to identify a period of time to perform an operation on the welder power source based upon evaluation of the collected portion of data.

19. The welder system of claim 14, further comprising a fifth component that is configured to identify at least one of a start activation time for one or more welder power sources or an end activation time for one or more welder power sources based at least in part upon evaluation of the collected portion of data from the welder power source.

20. A welder system, comprising:
   means for communicating with a first welder power source on a first network;
   means for communicating with a second welder power source on a second network;
   means for receiving a portion of data associated with the first welder power source;
   means for evaluating the portion of data to identify at least one welding parameter for the first power source;
   means for comparing the first welder power source with the second power source to identify a relationship; and
   means for utilizing the at least one welding parameter for the second power source based on the relationship.

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