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(54) **METHOD AND APPARATUS FOR SETTING UP WELDING PARAMETERS**

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(57) **ABSTRACT**

Provided is a disclosure for a welding system with a display device configured to display an electronic parameter chart for use in setting up the welding system for use.

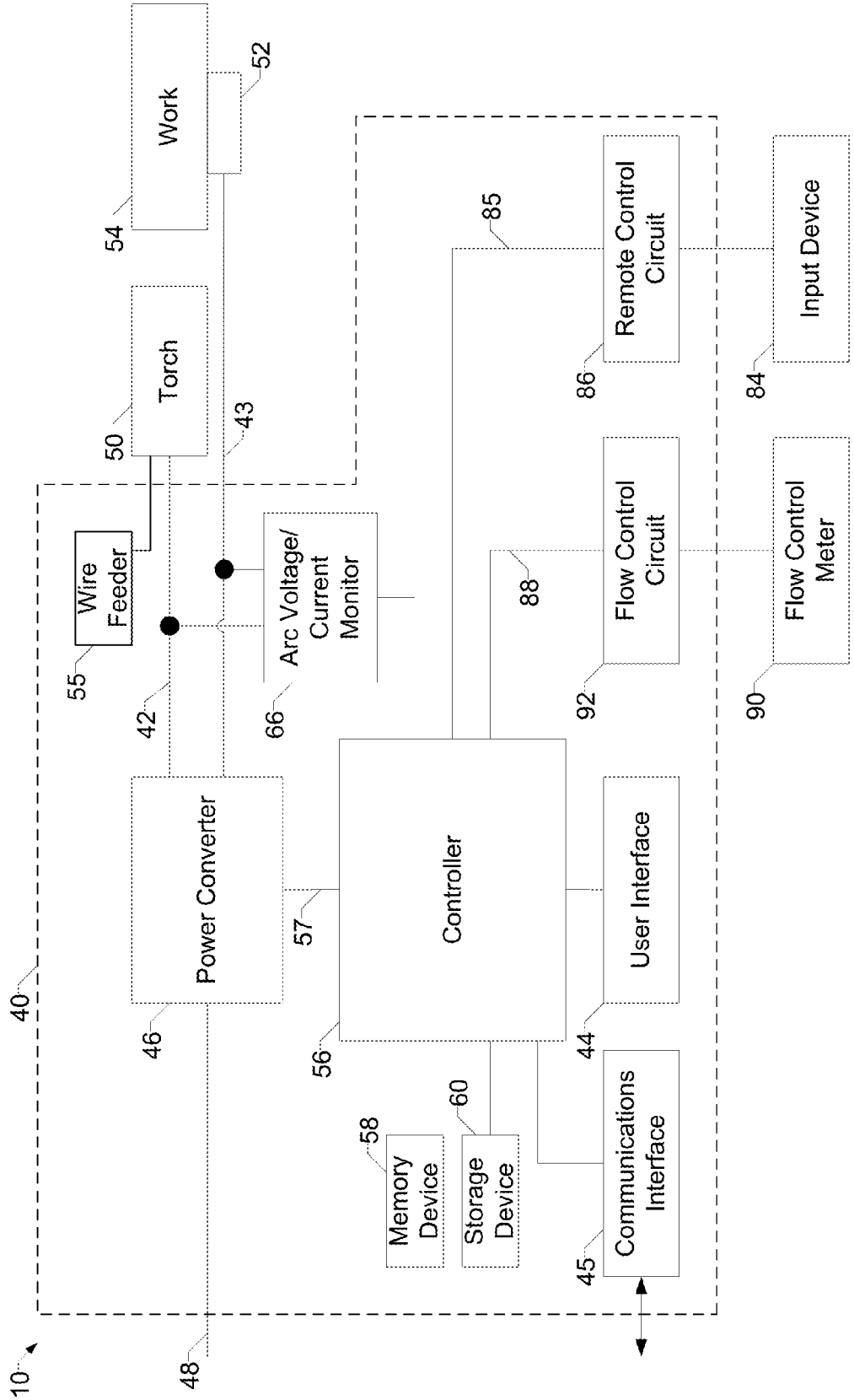
Work
52
54
Torch
50
43
Wire Feeder
55
42
Arc Voltage/ Current Monitor
66
Power Converter
46
57
Controller
56
User Interface
44
Remote Control Circuit
85
86
Input Device
84
Flow Control Circuit
88
92
Flow Control Meter
90
Memory Device
58
Storage Device
60
Communications Interface
45
40
10
48

FIG. 1

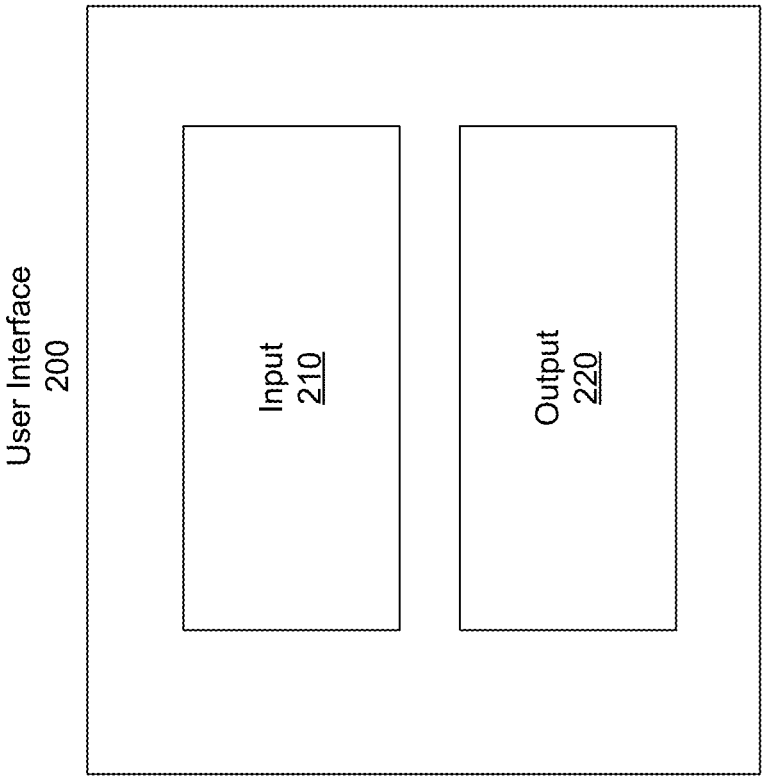

FIG. 2

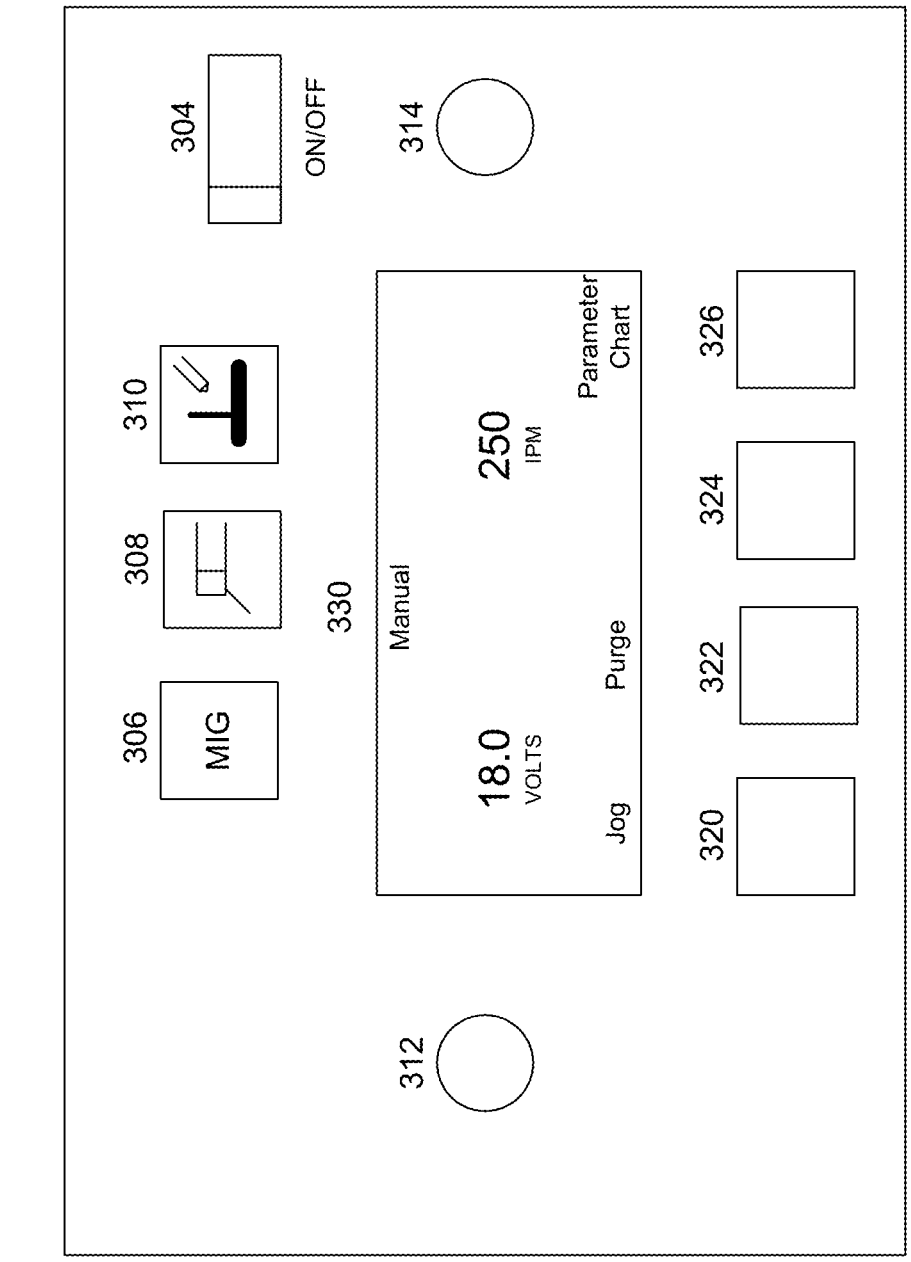
300
304
ON/OFF
314
310
308
306
MIG
330
Manual
250
IPM
Parameter
Chart
18.0
VOLTS
Purge
Jog
326
324
322
320
312

FIG. 3

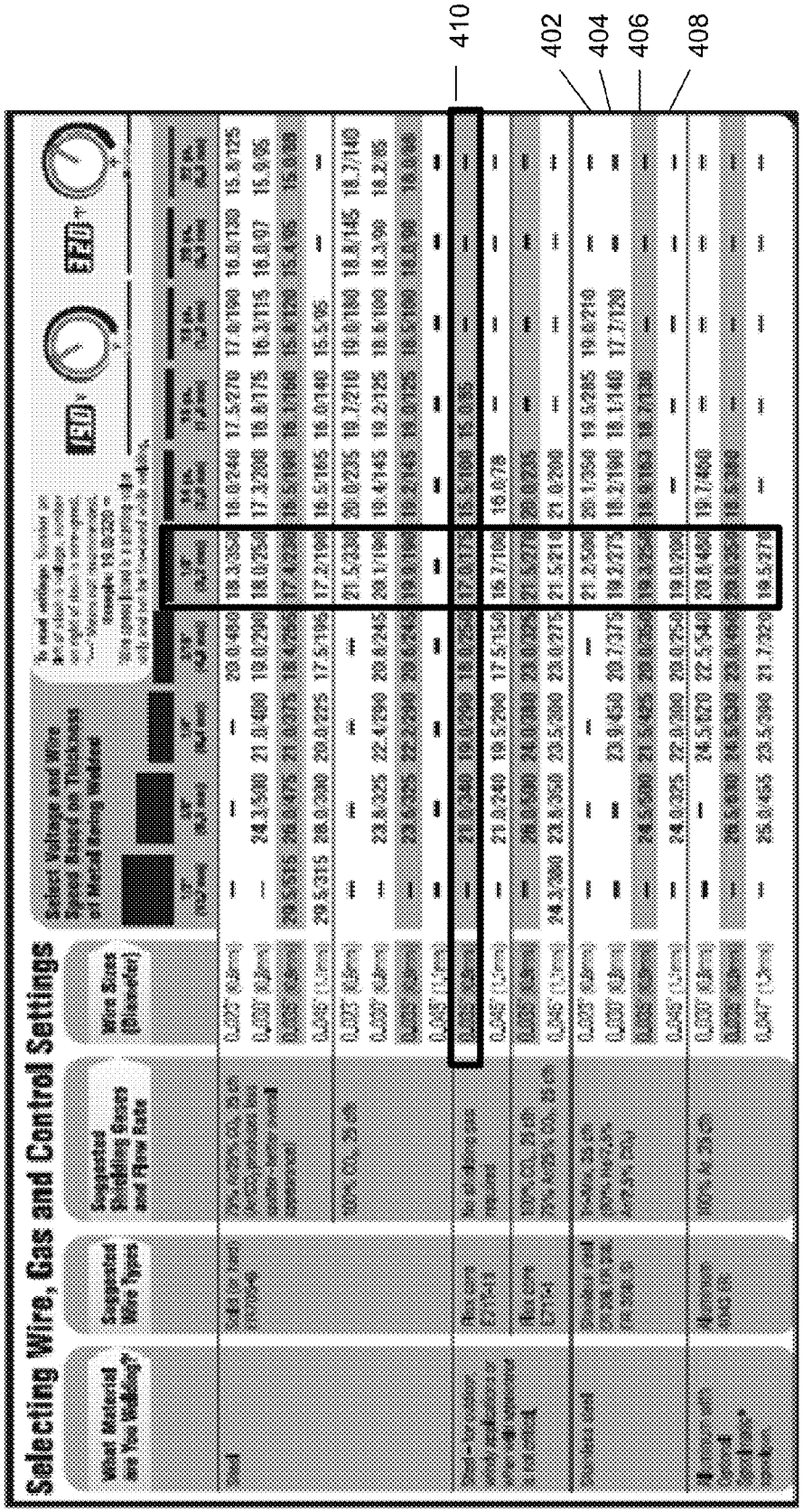
400
Selecting Wire, Gas and Control Settings
What Material are You Welding?
Suggested Wire Types
Suggested Shielding Gases and Flow Rate
Wire Size (Diameter)
410
402
404
406
408
420
422

FIG. 4A

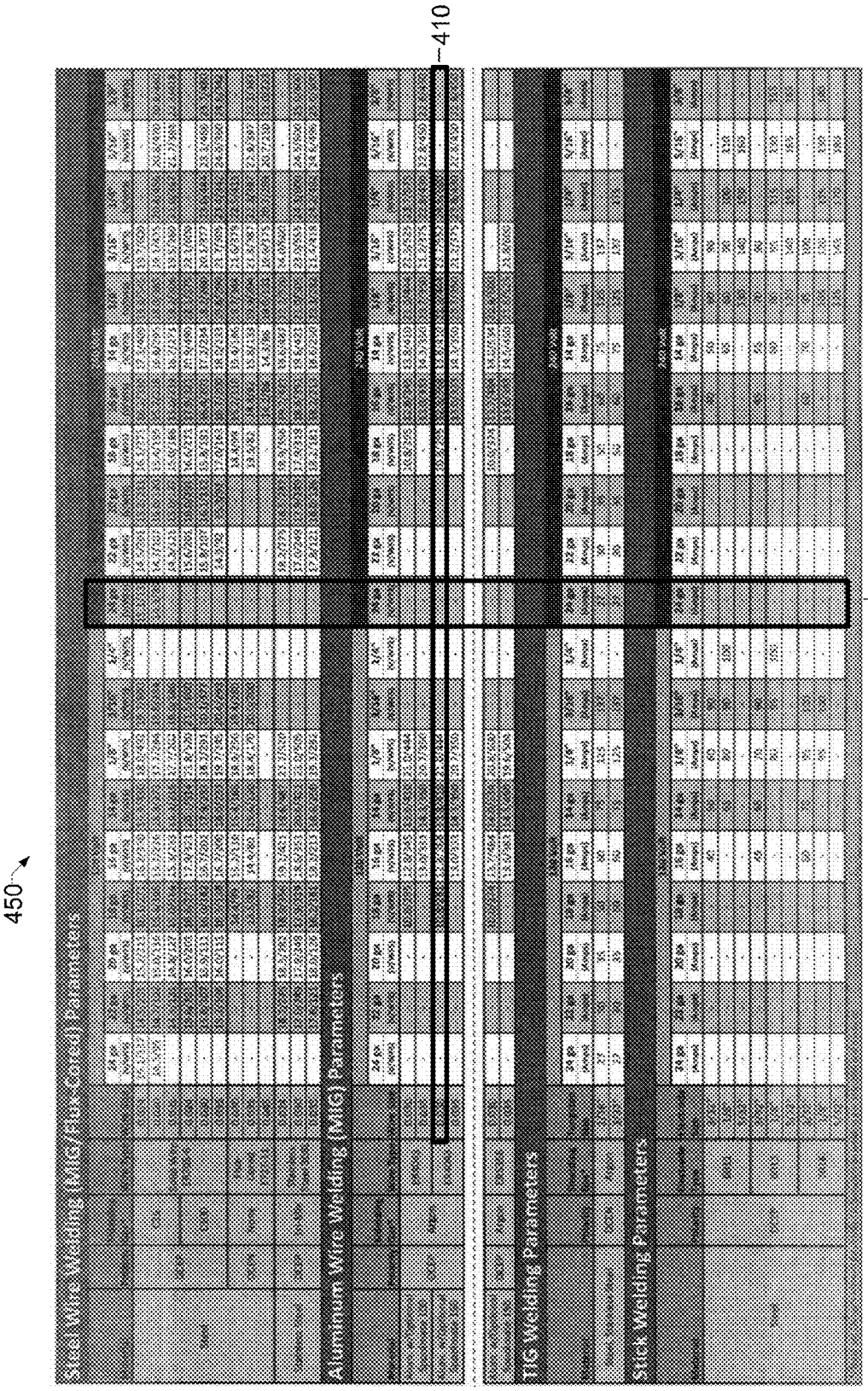
450
410
420
Steel Wire Welding (MIG/Flux-Cored) Parameters
Aluminum Wire Welding (MIG) Parameters
TIG Welding Parameters
Stick Welding Parameters

FIG. 4B

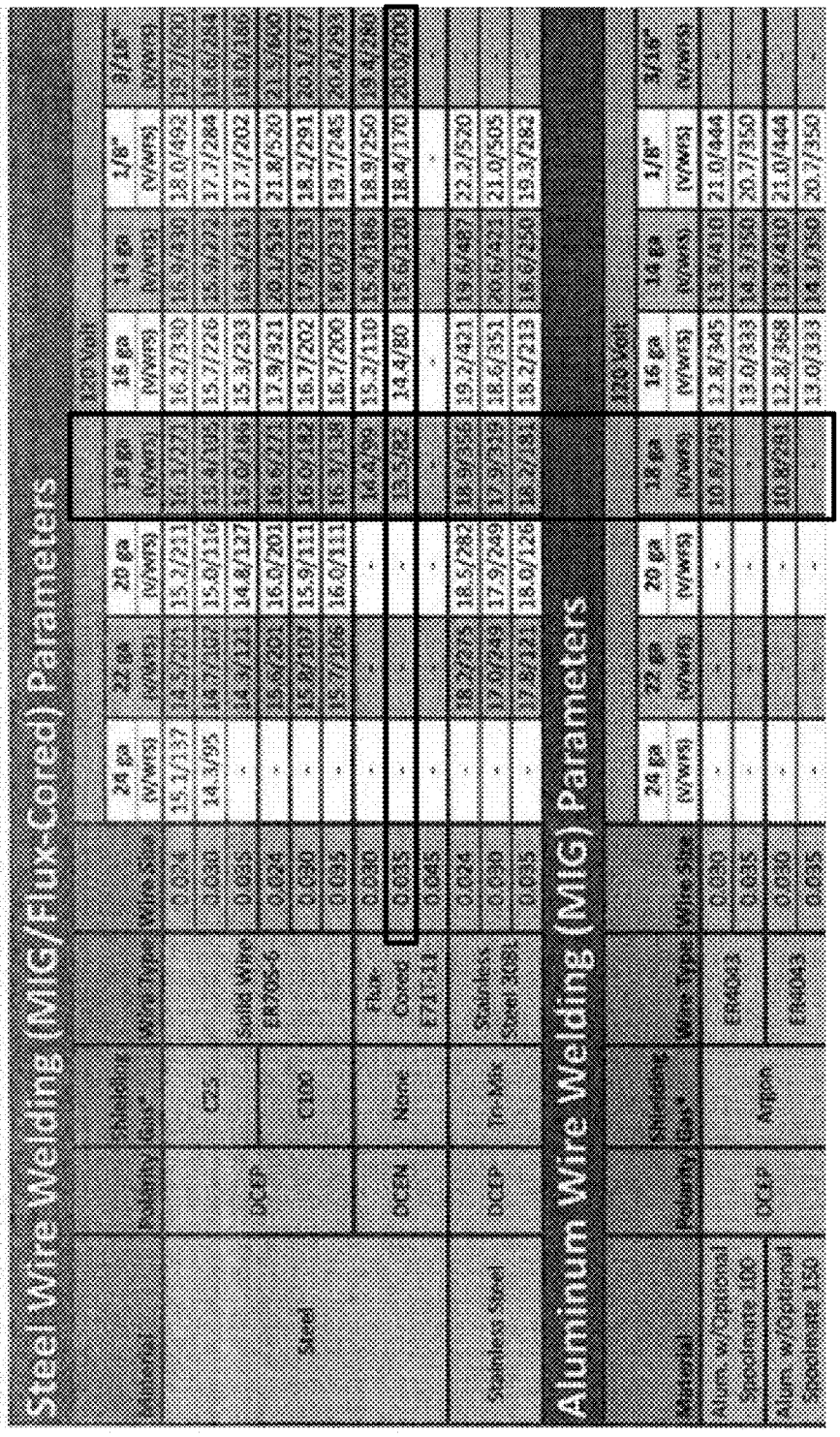
460
410
420
Steel Wire Welding (MIG/Flux-Cored) Parameters
Aluminum Wire Welding (MIG) Parameters

FIG. 4C

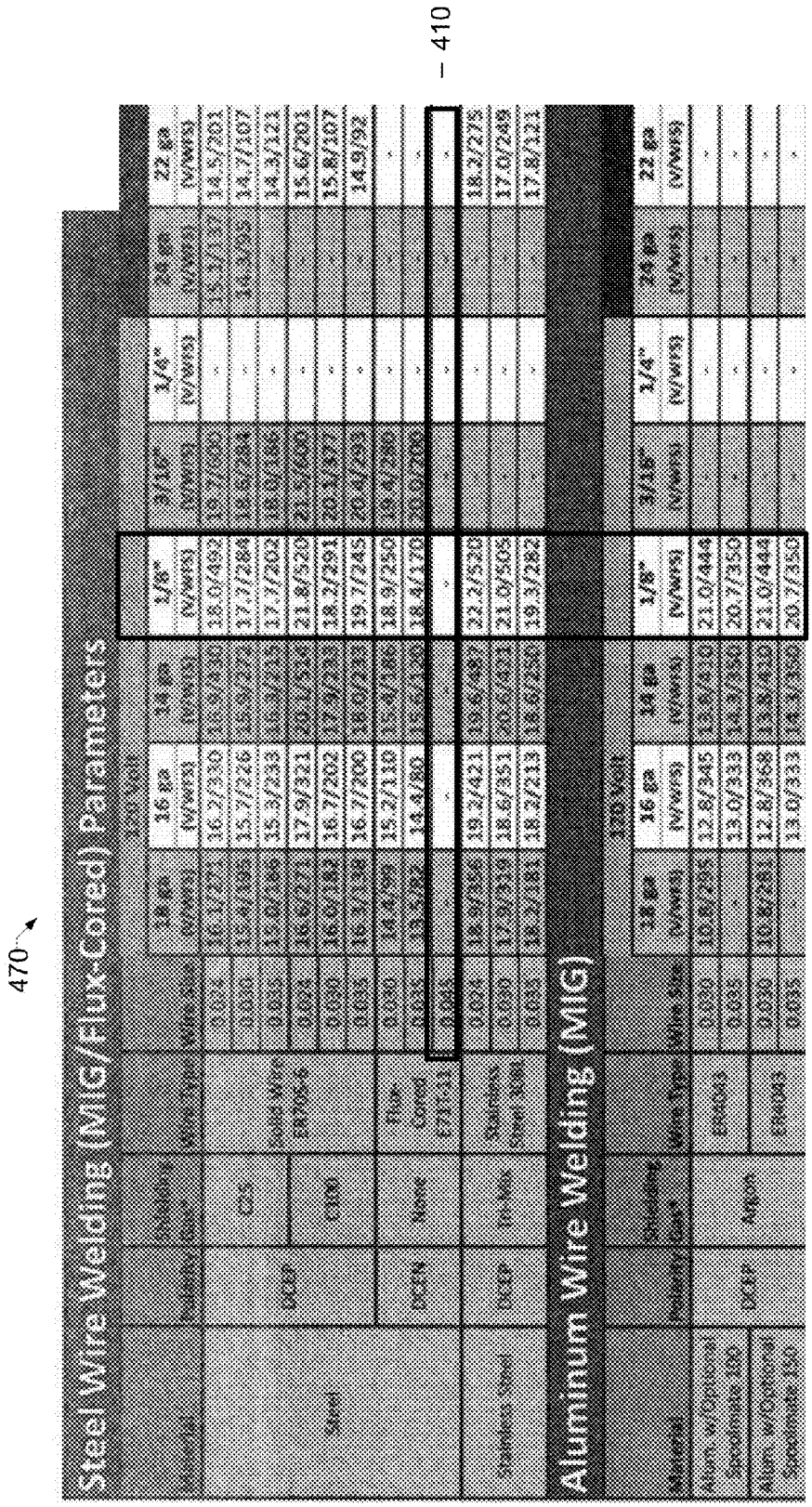
470
410
420
Steel Wire Welding (MIG/Flux-Cored) Parameters
Aluminum Wire Welding (MIG)

FIG. 4D

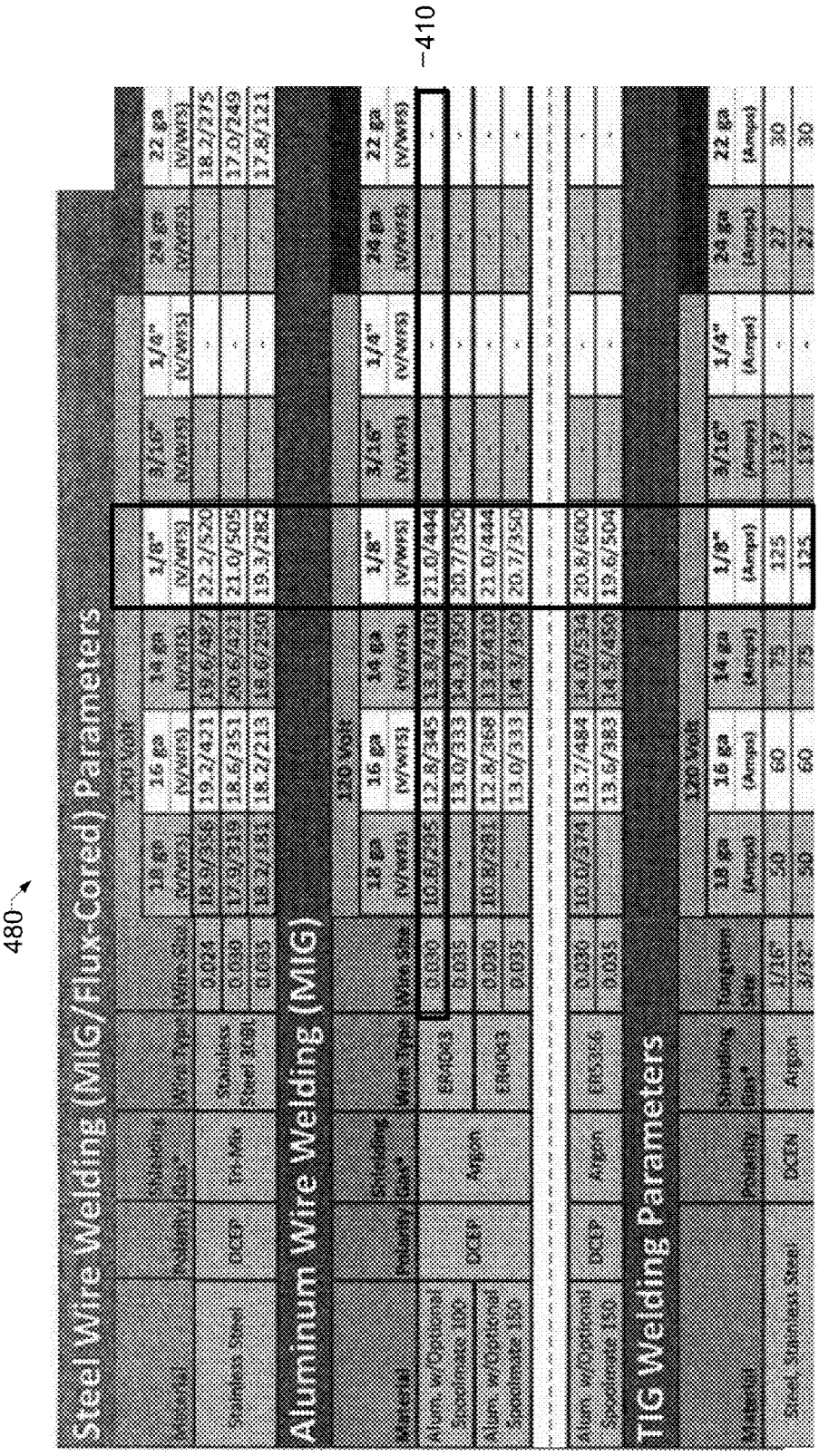
480
410
420
Steel Wire Welding (MIG/Flux-Cored) Parameters
Aluminum Wire Welding (MIG)
TIG Welding Parameters

FIG. 4E

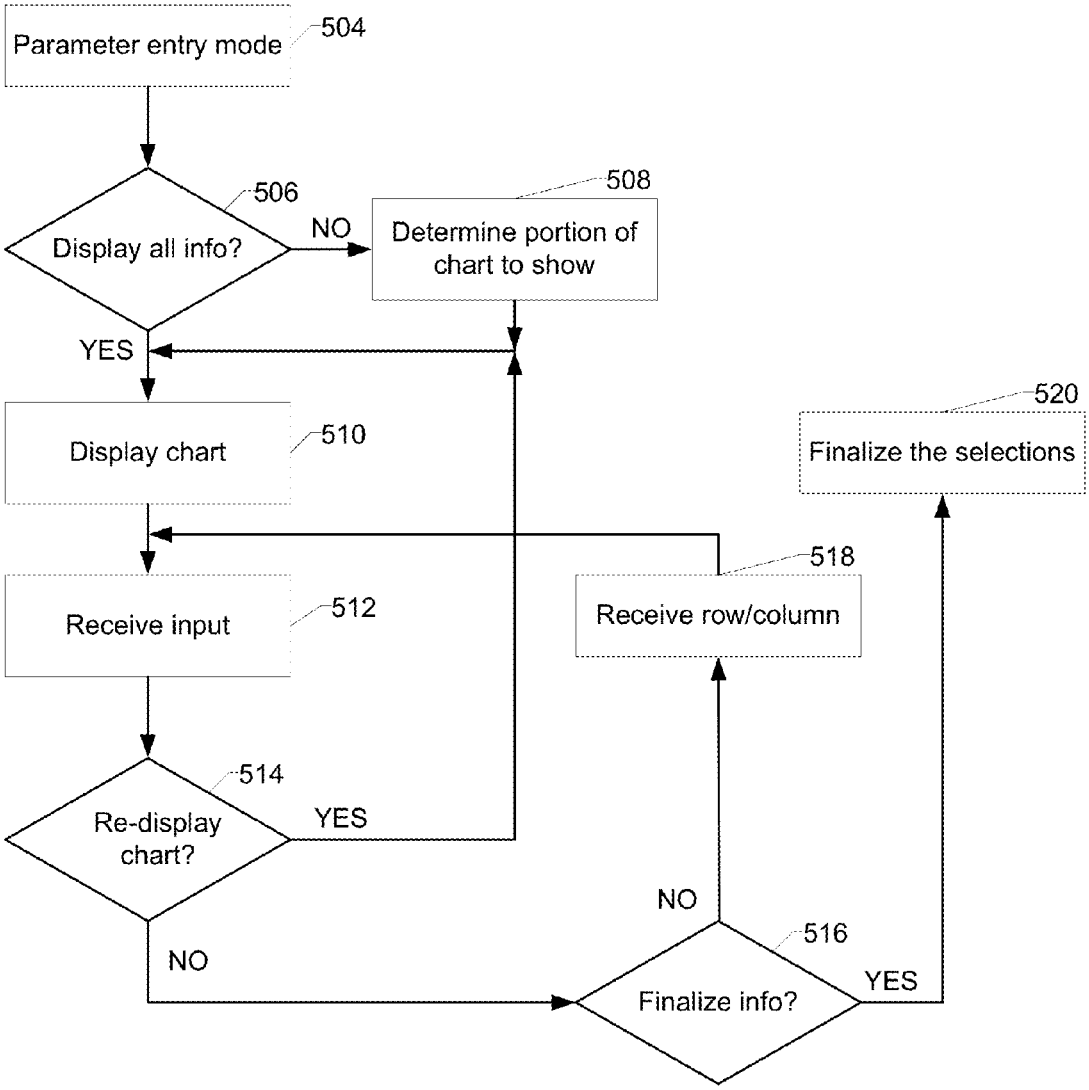
Parameter entry mode
504
Display all info?
506
NO
Determine portion of chart to show
508
YES
Display chart
510
Finalize the selections
520
Receive input
512
Receive row/column
518
Re-display chart?
514
YES
NO
NO
Finalize info?
516
YES

FIG. 5

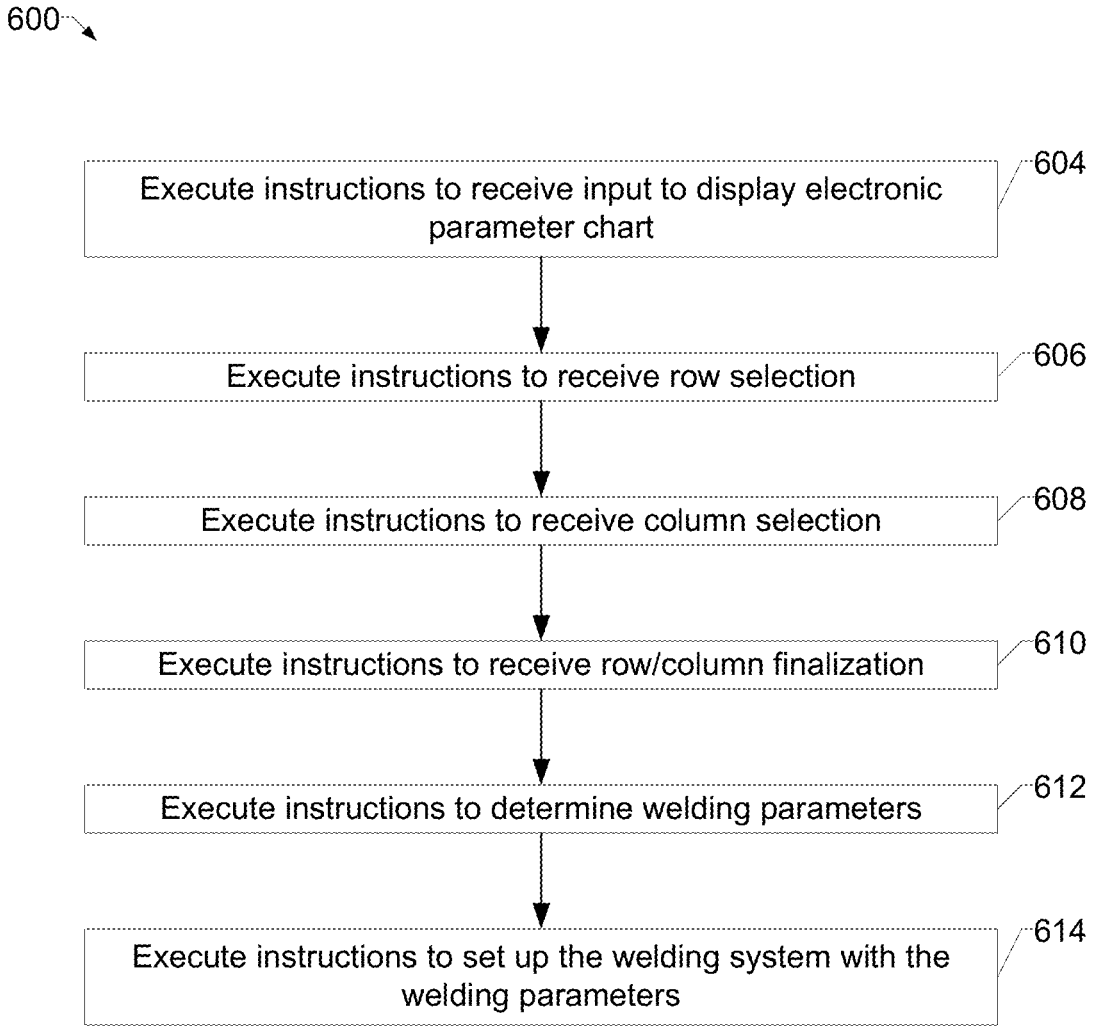
600
Execute instructions to receive input to display electronic parameter chart
604
Execute instructions to receive row selection
606
Execute instructions to receive column selection
608
Execute instructions to receive row/column finalization
610
Execute instructions to determine welding parameters
612
Execute instructions to set up the welding system with the welding parameters
614

FIG. 6

METHOD AND APPARATUS FOR SETTING UP WELDING PARAMETERS

BACKGROUND

[0001] The present disclosure relates to a welding machine, and more particularly, to a method and apparatus for setting up welding parameters.

[0002] Limitations and disadvantages of conventional approaches to welding will become apparent to one of skill in the art, through comparison of such approaches with some aspects of the present method and system set forth in the remainder of this disclosure with reference to the drawings.

SUMMARY

[0003] Methods and systems are provided for setting up welding parameters, substantially as illustrated by and described in connection with at least one of the figures, and as set forth more completely in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] These and/or other aspects will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings.

[0005] FIG. **1** shows an exemplary welding system in accordance with aspects of this disclosure.

[0006] FIG. **2** is a block diagram of an exemplary user interface, in accordance with aspects of this disclosure.

[0007] FIG. **3** is a diagram of an exemplary user interface, in accordance with aspects of this disclosure.

[0008] FIG. **4**A is an illustration of an output display of a user interface displaying an exemplary electronic parameter chart, in accordance with aspects of this disclosure.

[0009] FIG. **4**B is an illustration of an output display of a user interface displaying an exemplary electronic parameter chart, in accordance with aspects of this disclosure.

[0010] FIG. **4**C is an illustration of an output display of a user interface displaying a portion of an exemplary electronic parameter chart, in accordance with aspects of this disclosure.

[0011] FIG. **4**D is an illustration of an output display of a user interface displaying a portion of an exemplary electronic parameter chart, in accordance with aspects of this disclosure.

[0012] FIG. **4**E is an illustration of an output display of a user interface displaying a portion of an exemplary electronic parameter chart, in accordance with aspects of this disclosure.

[0013] FIG. **5** is an exemplary flow diagram of operations for setting up welding parameters with an electronic parameter chart, in accordance with aspects of this disclosure.

[0014] FIG. **6** is a flowchart illustrating example instructions **600** that may be executed by a welding processor for setting up welding parameter, in accordance with aspects of this disclosure.

DETAILED DESCRIPTION

[0015] Welding power, as used herein, refers to power suitable for welding, plasma cutting, induction heating, air carbon-arc cutting and/or gouging (CAC-A), cladding, and/or hot wire welding/preheating (including laser welding and laser cladding).

[0016] A welding system, as used herein, may comprise any device capable of supplying welding power suitable for welding, plasma cutting, induction heating, CAC-A and/or hot wire welding/preheating (including laser welding and laser cladding), including inverters, converters, choppers, resonant power supplies, quasi-resonant power supplies, etc., as well as control circuitry and other ancillary circuitry associated therewith.

[0017] Various embodiments of the disclosure can comprise a welding system that includes a display device configured to display an electronic parameter chart and a user interface configured to receive a row input to select a row of the electronic parameter chart and/or a column input to select a column of the electronic parameter chart. The welding system also includes a welding power supply configured to provide welding power, and a welding processor configured to control welding parameters based on the selected row and the selected column. The welding system can also comprise a wire feeder configured to feed electrode wire. The welding parameters can comprise at least one of welding voltage, wire feed speed, and welding current (welding amperage).

[0018] The display device is configured to display at least a portion of the electronic parameter chart. The display device may be further configured to display a first portion of the electronic parameter chart, and to display a different portion of the electronic parameter chart based on display input received via the user interface. The different portion of the electronic parameter chart can include a portion of the first portion of the electronic parameter chart.

[0019] The display input may comprise at least one of a first display input for controlling display of the rows of the electronic parameter chart and a second display input for controlling display of the columns of the electronic parameter chart.

[0020] The welding processor is configured to control a welding operation according to the welding parameters, and the welding processor may also be configured to update the electronic parameter chart. The welding processor may also be configured to format the electronic parameter chart for the display device based on a readability setting.

[0021] The row input can be a first selection of at least one of a workpiece material, a tungsten type, a tungsten size, an electrode type, an electrode size, an electrode wire type, a shielding gas composition, a shielding gas flow rate, an electrode wire diameter, arc start, wire inductance, and a workpiece thickness. The column input can be a second selection of at least one of the workpiece material, the tungsten type, the tungsten size, the electrode type, the electrode size, the electrode wire type, the shielding gas composition, the shielding gas flow rate, the electrode wire diameter, arc start, wire inductance, and the workpiece thickness, where the second selection is different from the first selection. That is, the first selection and the second selection do not include the same variable(s). The order of selection may also be column input first, and row input second or vice versa depending on an embodiment.

[0022] The welding processor can be configured to finalize the selected row and the selected column in one of many different ways. Finalization of the selected row and the selected column can be used to set the welding parameters. For example, the selected row and the selected column may be finalized immediately upon selection of one or both of the row and the column, or after a pre-determined time after

receiving one or both of the selected row and the selected column. The finalization may also occur, for example, when the user enters a selection input via the user interface. The welding processor may also finalize after receiving at least one of the selected row and selected column and receiving a selection input via the user interface.

[0023] In some embodiments, the welding processor may set the welding parameters whenever the selection input is received even without having received a selected row or column. The welding parameters may then correspond to the initial row and column that are shown highlighted on the display. Alternatively, the welding processor may display an error message, or warning, asking the user to select at least one of the row and column if the selection input is received without having received a selected row or a selected column.

[0024] Various embodiments of the disclosure may also comprise a non-transitory machine-readable medium storing machine executable instructions that when executed causes a computing system to control operations for setting up and controlling a welding system, comprising displaying an electronic parameter chart on a display device of the welding system. The electronic parameter chart relates at least one of welding voltage, wire feed speed, and welding current (welding amperage) to characteristics of a welding operation. The executed instructions can also control receiving, via a user interface of the welding system, a row input to select a row of the electronic parameter chart displayed on the display device, and a column input to select a column of the electronic parameter chart displayed on the display device. The selected row and the selected column may indicate the characteristics of the welding operation. The executed instructions also allow a welding processor to set welding parameters comprising at least one of a welding voltage, a wire feed speed, and welding current (welding amperage) based on the selected row and the selected column.

[0025] The executed instructions allow displaying the electronic parameter chart, which may comprise displaying at least a portion of the electronic parameter chart. The welding processor can execute the machine executable instructions to control the welding operation according to the welding parameters and/or to update the electronic parameter chart. The executed instructions may also allow for finalizing the welding parameters via at least one of a pre-determined time after receiving both of the selected row and the selected column, and receiving a selection input via the user interface of the welding system.

[0026] FIG. **1** is a block diagram illustrating an example welding system **10** including a power source **40**. The power source **40** converts input power to AC and/or DC power suitable for use in welding operations, such as metal inert gas (MIG) welding, tungsten inert gas (TIG) welding, stick welding, and/or Submerged Arc Welding (SAW), and/or in gouging operations such as air carbon arc gouging. The power source **40** permits an operator to use the power source **40** for gouging and/or welding by selecting the appropriate operation via a user interface **44**, and attaching the appropriate welding equipment, (e.g. a gouging torch and gas supply for air carbon arc gouging, wire feeder for MIG welding, a torch, gas supply for TIG welding, an electrode holder for STICK welding, etc.).

[0027] The power source **40** includes a power converter **46**. The power converter **46** receives input power from a power input **48** and converts the power input **48** to either AC and/or DC welding power for output to a torch **50** connected to power outputs **42**, **43**. In the example of FIG. **1**, the torch **50** is connected to the power output **42** and a work clamp **52** is connected to a power output **43** to form an electrical circuit with a workpiece **54** when an electrical arc is started. The arc voltage/current monitor **66** monitors the current and/or voltage of the power to the torch **50**.

[0028] The power converter **46** is a phase-controlled power source, which may use silicon controlled rectifiers (SCRs) to convert power received at power input **48** to usable welding and/or gouging power. Additionally or alternatively, the power converter **46** may use DC chopper circuity and/or any other power conversion topology.

[0029] The power source **40** includes a controller **56** that is operatively coupled to the power converter **46**. The controller **56** may also be referred to as a welding processor. The controller **56** may be implemented using one or more logic circuits, such as one or more "general-purpose" microprocessors, one or more special-purpose microprocessors and/or application-specific integrated circuits (ASIC), field programmable gate arrays (FPGA)s, digital signal processors (DSPs), and/or any other type of logic and/or processing device. For example, the controller **56** may include one or more digital signal processors (DSPs). Alternatively, the controller **56** could include discrete component control circuitry to perform these control functions. The controller **56** controls the output power from power converter **46** by generating control signals **57** to control switching components (e.g., the SCRs) in power converter **46**.

[0030] The controller **56** receives user-selected operating parameters from user interface **44**, such as welding current (welding amperage) selection. For example, the user interface **44** includes selectors (not shown) operable by the user to select a welding process (e.g., gouging, MIG, TIG, STICK, etc.), a welding current (welding amperage) control (PANEL/REMOTE), an output control (ON/REMOTE), a start mode (OFF/LIFT/HFSTART/HFCONT), a positive/negative balance control for AC TIG welding, a DIG control for STICK welding, a welding current (welding amperage) level, a spot welding operation, and/or a sequence selection such as start current, final (crater) current, or both. The controller **56** also transmits to the user interface **44** information about the welding operation that is valuable to the welder, including arc voltage, arc current (arc amperage), and/or preferred selector settings. The example user interface **44** may include any type of interface device, such as a keyboard, a pointing device (e.g., a mouse, a trackpad), a microphone, a camera (e.g., gesture-based input), a touchscreen, and/or any other type of user input and/or output device.

[0031] The controller **56** may also be configured to control various aspects of the welding system **10**. For example, the controller **56** may control input and output via the user interface **44** and/or the communications interface **45**. As described above, the controller **56** may generically refer to a plurality of devices, including processors, which work in concert to control various aspects of the welding system **10**.

[0032] In some examples, the welding system **10** may receive information via the communication interface **45**. The communication interface **45** may receive information such as, for example, updates to any software/firmware that may be used by the welding system **10** or the welding current (welding amperage) parameter from another device instead of via the user interface **44**. For example, the information

such as the welding current (welding amperage) parameter may be received via a wired and/or wireless communication from a computing device (e.g., a computer, a server, a mobile device, cloud storage, etc.), a wired and/or wireless point-to-point connection (e.g., Bluetooth®, near-field communications, USB, etc.), a control cable communication with another welding device, a weld cable communication from another welding device, a communication with a storage device such as a portable storage device (e.g., a FLASH drive or other USB-capable storage, a secure digital (SD) card, etc.), and/or via any other communications method.

[0033] Various embodiments of the disclosure may also transmit information via wired and/or wireless communication. The transmitted information may be, for example, commands, status, and/or other information that may be requested by other devices/servers/etc. The information communicated between the welding system **10** and another device may also be, for example, to allow control of the welding system **10** by another device.

[0034] A memory device **58** and a storage device **60** are coupled to the controller **56** for storing data including the settings of the selectors on user interface **44** for future retrieval after power-down and/or between welding cycles. The memory device **58** may include a volatile memory, such as random access memory (RAM), and/or a nonvolatile memory, such as read-only memory (ROM). The storage device **60** may include magnetic media such as a hard disk, solid state storage, optical media, and/or any other short and/or long term storage device. The memory device **58** and/or the storage device **60** may store information (e.g., data) for any purpose and/or transmit stored data upon request by the controller **56**. For example, the memory device **58** and/or the storage device **60** may store processor executable instructions (e.g., firmware or software) for the controller **56** to execute. In addition, one or more control schemes for various welding processes, along with associated settings and parameters, may be stored in the memory device **58** and/or the storage device **60**, along with code configured to provide a specific output (e.g., initiate wire feed, enable gas flow, capture welding current data, detect short circuit parameters, determine amount of spatter) during operation.

[0035] The memory device **58** may include a volatile memory, such as random access memory (RAM), and/or a nonvolatile memory, such as read-only memory (ROM). The memory device **58** may store a variety of information and may be used for various purposes. For example, the memory device **58** may store processor executable instructions (e.g., firmware or software) for the controller **56** to execute. In addition, one or more control regimes for various welding processes, along with associated settings and parameters, may be stored in the memory device **58** and/or the storage device **60**, along with code configured to provide a specific output (e.g., initiate wire feed, enable gas flow, capture welding current data, detect short circuit parameters, determine amount of spatter) during operation.

[0036] The controller **56** also receives remote control inputs **85** from an input device **84** through a remote control circuit **86**. The input device **84** is user-operable and can be used to control welding power output. The flow of shield gas and/or gouging gas may also be controlled by controller **56**. In this embodiment, a control signal **88** is sent from controller **56** via a path through a flow control circuit **92** to a flow control meter **90**. Flow control meter **90** is coupled to a gas supply (not shown) for regulating the flow of shield gas and/or gouging gas from the gas supply to a welding site (e.g., to the torch **50**). The flow control meter **90** may be internal or external to the power source **40** with a gas flow channel (not shown) extending from the gas supply, through power source **40**, through flow control meter **90**, then out to the **50** for provision to the site of the operation. The flow control circuit **92** could also be a submerged arc flux controller or a flux hopper controller.

[0037] The welding system **10** may also comprise a wire feeder **55** that is configured to feed electrode wire to the torch **50** as needed. For example, during metal inert gas (MIG) welding the wire feeder **55** can feed welding electrode wire to the torch **50**. The wire feeding rate may be determined by, for example, the controller **56**.

[0038] FIG. **2** is a block diagram of an exemplary user interface, in accordance with aspects of this disclosure. Referring to FIG. **2**, there is shown the user interface **200** comprising the input interface **210** and the output interface **220**. The user interface **200** may be similar to the user interface **44** of FIG. **1**. The input interface **210** can comprise many typed of interface devices, such as a keyboard, a pointing device (e.g., a mouse, a trackpad), a microphone, a camera (e.g., gesture-based input), a touchscreen, buttons that can be rotated and/or pushed, sliding knobs, and/or any other type of user input device. The output interface **220** can comprise any type of visual output device such as, for example, an LCD display, an LED display, etc., tactile feedback devices that may vibrate, audio output device such as speakers, and any other output devices that may be used to provide information or notice.

[0039] While the user interface **200** shows the input interface **210** and the output interface **220** as being separate, this depiction is strictly for ease of explanation and is not meant to limit various embodiments of the disclosure.

[0040] FIG. **3** is a diagram of an exemplary user interface, in accordance with aspects of this disclosure. The exemplary user interface **300** of FIG. **3** may be similar to the user interfaces **44** and **200**. The user interface **300** comprises, for example, an on/off switch **304**, selector buttons **306**, **308**, **310**, **320**, **322**, **324**, and **326**, the control knobs **312** and **314**, and the display **330**.

[0041] The on/off switch **304** is used to turn the welding system **10** on or off. The selector buttons **306**, **308**, and **310** enable selection and/or deselection of, for example, a specific type of welding process. The welding process selected may be, for example, metal inert gas (MIG), tungsten inert gas (TIG), etc. In some embodiments pushing one of the selector buttons **306**, **308**, **310** deselects the other two selector buttons. Other embodiments may operate each selector button semi-independently where the present selector button that is selected needs to be deselected before another selector button can be selected.

[0042] The control knob **312** adjusts the welding voltage, and the control knob **314** adjusts the wire feed speed or welding current (welding amperage) if applicable. The functions of the control knobs **312** and **314** may vary depending on situations. For example, if a parameter entry mode is selected by, for example, pressing the selector button **326** below the text "Parameter Chart," an electronic parameter chart may be displayed on the display **330**. The control knobs **312** and **314** can then be used, for example, to control the portion of the electronic parameter chart **400** that is

displayed on the display **330** (to be described in FIG. **4**A to FIG. **5**). The control knobs **312** and **314** may be turned in either direction, or may be toggled in either direction. When toggled, the control knobs **312** and **314** scroll the electronic parameter chart **400** one or more rows and/or columns, respectively, with each toggle.

[0043] Various embodiments of the disclosure allow the control knobs **312** and **314** to select the appropriate variables and finalize those variables without further input to determine the welding parameters. Other embodiments of the disclosure may have the user press a button, such as, for example, the selector button **324** or the selector button **326** in order to finalize the variables for determining the welding parameters for use with the welding system **10**.

[0044] The selector buttons **320**, **322**, **324**, and **326** may be "soft" selector buttons that can be programmed to different functions. For example, the selector buttons **320** and **322** may control jog and purge functionalities, respectively, of the welding system **10**. The selector button **324** may be used display different options for the soft buttons **320**, **322**, **324**, and **326**. The selector button **326** may be used to display an electronic parameter chart on the display **330**.

[0045] The display **330** outputs status and/or instructions for the user of the welding system **10**. The display **330** can output, as stated above, the electronic parameter chart **400** where a user can make selections of variables for determining the welding parameters for use in the operation of the welding system **10**. In various embodiments of the disclosure, the electronic parameter chart **400** is displayed to allow the user to select a row and a column with appropriate variables, and the intersection of the row and the column may be used to determine the welding parameters to be used for operation of the welding system **10**. The row can display, for example, the type of material being welded (material the workpiece is made of), the type of wire and its size, the shielding gas and its flow rate, and/or the polarity of the power to the welding torch. The column can display, for example, the thickness of the workpiece to be welded. Other variables, such as, for example, arc starts and inductance that may each be specific for each row can also be specified as needed. Arc starts and inductance can be selected to optimize the transfer of welding arc and its penetration and weld profile.

[0046] When in a normal operating mode, the display **330** can show, for example, the presently set welding voltage and wire feed speed parameters for the welding system as appropriate when MIG welding is being performed. As shown in an example in FIG. **3**, the present welding voltage is 18.0 volts and the present wire feed speed is 250 inches per minute. Various embodiments may display welding current (welding amperage) when TIG welding is being performed. Other parameters may be displayed as appropriate for the type of welding being performed.

[0047] While some variables to be specified for a welding job are mentioned above, it should be understood that various embodiments of the disclosure may update the electronic parameter chart **400** to add and/or change the variables for the rows and columns.

[0048] FIG. **4**A is an illustration of an output display of a user interface displaying an exemplary electronic parameter chart, in accordance with aspects of this disclosure. Referring to FIG. **4**A, the electronic parameter chart **400** output on the display **330** of the welding system **10** comprises a plurality of rows where each row indicates the workpiece material type, tungsten type, tungsten size, electrode type, electrode size, the electrode wire type, the shielding gas composition, the shielding gas flow rate, and the electrode wire diameter, and the plurality of columns each indicate the workpiece thickness. Depending on the type of welding to be performed, there may be other variables indicated in the rows and columns.

[0049] In an embodiment of the disclosure, the electronic parameter chart **400** displayed on the display **550** comprises a highlighted row portion **410** and a highlighted column portion **420**. The intersection of the highlighted row portion **410** and the highlighted column portion **420** is used to determine the welding parameters. Accordingly, a user would move the electronic parameter chart **400** up or down, and sideways to align the desired row with the highlighted row portion **410** and the desired column with the highlighted column portion **420**.

[0050] For example, if 16 gauge stainless steel is to be welded, there are 4 rows **402**, **404**, **406**, and **408** shown on the exemplary electronic parameter chart **400** that correspond to welding stainless steel and one column **422** corresponding to 16 gauge stainless steel. In this case, there is one suggested electrode wire type and one shielding gas composition at one flow rate. The user may then select the electrode wire diameter. The electrode wire diameters presented for stainless steel are 0.023", 0.030", 0.035", and 0.045" corresponding to rows **402**, **404**, **406**, and **408**. The user may select, for example, row **406** for the electrode wire diameter of 0.035" and column **422** for the 16 gauge stainless steel workpiece that is to be welded.

[0051] Accordingly, the user would move the rows up until the row **406** aligns with the highlighted row portion **410**, and the columns sideways until the column **422** aligns with the highlighted column portion **420**. After the user finalizes the selected row and the selected column, the controller **56**, for example, of the welding system **10** may set the welding voltage and wire feed speed to appropriate values.

[0052] Although certain variables are mentioned above, the disclosure need not be limited to only these variables. Other variables may be introduced as welding technology/methodology changes, as new material are added to the list of materials that can be welded, as new welding wires are developed, etc. Accordingly, the electronic parameter chart **400** may be updated in part, or replaced entirely. For example, if different thicknesses are to be supported, the electronic parameter chart **400** may be updated with the additional information. However, if a whole new set of materials are to be supported, or a new type of welding technique is to be used, the electronic parameter chart **400** may be updated in its entirety. Alternatively, an electronic parameter chart **400** may be supplemented with one or more of the electronic parameter charts so that an appropriate electronic parameter chart can be displayed on the display **330** for different needs.

[0053] Additionally, while a specific configuration was described for entering command/information, the disclosure need not be limited so. The entry mode may use any of the different entry modes that are presently known or may be developed in the future. For example, the entry may be via voice, or mouse or track ball, a touch screen that is a part of the display **330**, a keyboard, etc.

[0054] FIG. **4**B is an illustration of an output display of a user interface displaying an exemplary electronic parameter

chart, in accordance with aspects of this disclosure. Referring to FIG. **4**B, there is shown an electronic parameter chart **450** output on the display **330** of the welding system **10** that is different than the electronic parameter chart **400** of FIG. **4**A. There is shown the highlighted row portion **410** and the highlighted column portion **420**. The electronic parameter charts **400** and **450** may have been downloaded to the welding system **10** and stored in the memory device **58** or the storage device **60**. When there are multiple welding parameter charts stored in the welding system **10**, an embodiment of the disclosure may allow, for example, the selector button **324** to display a different electronic parameter chart each time the selector button **324** is pressed. Accordingly, since there are two electronic parameter charts **400** and **450**, each press of the selector button **324** will display the electronic parameter charts **400** and **450** in turn. Various embodiments may have different methods of displaying the multiple welding parameter charts.

[0055] FIG. **4**C is an illustration of an output display of a user interface displaying a portion of an exemplary electronic parameter chart, in accordance with aspects of this disclosure. Referring to FIG. **4**C, there is shown a portion of the electronic parameter chart **450**. This may occur, for example, if the display **330** is not large enough to show the entire electronic parameter chart **450**. Various embodiments may also allow a larger font to be used for better viewing, thereby limiting the amount of the electronic parameter chart **450** that can be displayed on the display **330**. There is also shown the highlighted row portion **410** and the highlighted column portion **420**.

[0056] FIG. **4**D is an illustration of an output display of a user interface displaying a portion of an exemplary electronic parameter chart, in accordance with aspects of this disclosure. Referring to FIG. **4**D, there is shown a different portion of the electronic parameter chart **450** than shown in FIG. **4**C. This portion is shown when the user moves to the columns on the right by, for example, manipulating the control knob **314**.

[0057] FIG. **4**E is an illustration of an output display of a user interface displaying a portion of an exemplary electronic parameter chart, in accordance with aspects of this disclosure. Referring to FIG. **4**E, there is shown a different portion of the electronic parameter chart **450** than shown in FIG. **4**D. This portion is shown when the user moves to the rows below by, for example, manipulating the control knob **312**.

[0058] FIG. **5** is an exemplary flow diagram for setting up welding parameters with an electronic parameter chart, in accordance with aspects of this disclosure. Referring to FIG. **5**, there is shown exemplary process to implement setting up parameters for a welding system such as the welding system **10**. Specific operations referring to an instruction will be with respect to the previously described descriptions and with respect to FIG. **1** through FIG. **4**E.

[0059] At **504** the user presses the selector button **326** to display an electronic parameter chart so that parameter entries may be made. The electronic parameter chart may be similar to the electronic parameter chart **400** of FIG. **4**A or **450** of FIG. **4**B. The electronic parameter chart may be shown in its entirety, or a portion of the electronic parameter chart may be shown as explained with respect to FIGS. **4**C, **4**D, and **4**E. The amount of the electronic parameter chart shown may depend on the size of the electronic parameter chart and/or a display setting for the electronic parameter chart. For example, different users may desire to have the electronic parameter chart displayed in different sized fonts or scale/magnification depending on their vision or clarity of the environment. For example, if the air is smoky or hazy, the user may want to have larger fonts to make the electronic parameter chart easier to see.

[0060] The size of text/graphics on the display **330** may be controlled by, for example, two selector buttons **320** and **322**. Each press of the selector button **320** may decrease the size of the text/graphics and each press of the selector button **322** may increase the size of the text/graphics. Any of various methods presently known, and different methods that may be developed in the future, may be used to change the size of the text/graphics displayed on the display **330**.

[0061] At **506** a determination is made whether to display the entire electronic parameter chart or a portion of the electronic parameter chart. If a portion of the electronic parameter chart is to be shown, at **508** a determination is made of the portion to show. A default mode when showing a portion of the electronic parameter chart may be to show, for example, the top-left portion as illustrated in FIG. **5**C. The electronic parameter chart is then shown at **510**, whether in full when coming from **506** or a portion when coming from **508**.

[0062] At **512** the user may operate input commands via the user interface **300**. This may be to indicate a different part of the electronic parameter chart to be displayed, to move a row to the highlighted row portion **410** or a column to the highlighted column portion **420**, or to finalize the selections of the row and column. The commands may be entered via, for example, the control knobs **312** and **314**. The control knob **312** may be used, for example, to scroll vertically to view different portions of the electronic parameter chart. The control knob **314** may be used, for example, to scroll horizontally to view different portions of the electronic parameter chart **400**. Accordingly, a user may be able to display all or a portion of the electronic parameter chart **400** on the display **330**, and when viewing a portion of the electronic parameter chart **400**, the user may be able to control showing portions of the electronic parameter chart **400** on the display **330**. Various embodiments may use the control knob **314** to scroll vertically and the control knob **312** to scroll horizontally.

[0063] At **514** it is determined whether the electronic parameter chart needs to be redisplayed. If so, then the electronic parameter chart is re-displayed at **510**. If not, it is determined in **516** whether the input was a finalize command from the user (e.g., by a selector button being pressed). If so, the selection(s) are finalized. If not, then at **518** the row or column information is saved and the next user input is received at **512**. As explained above, in various embodiments of the disclosure, the display **330** may show, for example, a highlighted row portion **410** and a highlighted column portion **420** in the display **330**. Moving a row and a column to the highlighted row portion **410** and highlighted column portion **420**, respectively, may act to select that row and column. Accordingly, the inputs received from the user at **512** can indicate the desired row and the desired column.

[0064] If the received input is determined at **518** to be the finalize command, the controller **56** of the welding system **10** may then determine the appropriate parameters, such as, for example, the welding voltage and the wire feed speed, based on the finalized row and column.

[0065] Some embodiments of the disclosure do not require pressing a selector button to finalize the row and column selections. For example, some embodiments of the disclosure may finalize the row and column after the row has been moved to the highlighted row and the column has been moved to the highlighted column, either immediately upon selection of both the row and column, or after some pre-determined time following the selection of the row and column. In some embodiments, the row and column are automatically selected after a pre-determined time. Accordingly, the controller **56** of the welding system **10** finalizes the row and column after a pre-determined time, which may include a time of zero seconds, for selection of the welding parameters even with no movement of the row or column. For example, if the desired row and column are already highlighted, the pre-determined time may elapse and the row and column can be finalized. Or, even if only the row or the column is moved, the row and column can be finalized after a pre-determined time. If there is enough delay before moving a row and/or a column, there may be multiple finalizations. The last finalization will be used for operation of the welding system **10**. As described, the user may also push, for example, a selector button to finalize the displayed row and column to determine the welding parameters.

[0066] Various embodiments of the disclosure may implement finalizing the row and column when, for example, a selector button is pushed or after a pre-determined time, which may include a time of zero seconds. However, some embodiments of the disclosure may not, for example, allow finalizing the row and column with pushing a selector button without selection of at least one of the row and column. This may be to ensure that a user did not press a selector button by mistake. Accordingly, the welding system **10** may provide a notice or a warning via the output interface **220**. For example, the notice may be one or more of a message displayed on the display **330**, a tone via a speaker (not shown) in the output interface **220**, an indicator light, which may be flashing, via an LED (not shown) in the output interface **220**, and/or a vibration output via a haptic feedback device (not shown) in the output interface **220**. Various embodiments of the disclosure may also use these and/or other means of notification.

[0067] Although some specific embodiments of the disclosure have been described in this specification and drawings, it should be understood that the disclosure is not limited to these specific embodiments.

[0068] FIG. **6** is a flowchart illustrating example instructions **600** that may be executed by a welding processor for setting up welding parameter(s), in accordance with aspects of this disclosure. The example instructions **600** may be stored on any of the non-transitory machine readable media described in FIG. **1**, and/or executed by the controller **56** of FIG. **1**. The example instructions **600** may be executed to perform a similar process as described in FIG. **5**. Therefore, only a simplified description will be made with respect to FIG. **6**.

[0069] The controller **56** may execute the example instructions **600** to set up welding parameters for the welding system **10** for use in welding a workpiece. At **604**, the controller **56** executes instructions that detect a request to display, for example, the electronic parameter chart **400**. The request may be, for example, pressing of the selector button **326**. Accordingly, the controller **56** may execute instructions to display the electronic parameter chart **400**. The controller **56** may also receive input, as described previously and with respect to previous FIGS. **1-5**, for displaying different parts of the electronic parameter chart **400**.

[0070] At **606**, the controller **56** executes instructions that detect selection of a row, and at **608** the controller executes instructions that detect selection of a column. At **610**, the controller **56** executes instructions to finalize the selected row and column by, for example, detecting pressing of a selector button and/or waiting a pre-determined time as described above with respect to FIG. **5**. At **612**, the controller **56** executes instructions to determine the welding parameters based on the finalized row and column. At **614**, the controller **56** executes instructions to set up the welding system **10** with the appropriate welding parameters for welding the workpiece.

[0071] FIG. **6** shows a simplified flowchart for executing example instructions **600** for the sake of ease of illustration. As explained above with respect to FIGS. **1-6**, instructions for various other functionalities may be executed for different embodiments of the disclosure. Accordingly, the example instructions **600** should not be construed to be limiting to any specific embodiment of the disclosure.

[0072] The present methods and systems may be realized in hardware, software, and/or a combination of hardware and software. The present methods and/or systems may be realized in a centralized fashion in at least one computing system or in a distributed fashion where different elements are spread across several interconnected computing systems. Any kind of computing system or other apparatus adapted for carrying out the methods described herein is suited. A combination of hardware and software may include a general-purpose computing system with a welding specific program or other code that, when being loaded and executed, controls the computing system such that it carries out the methods described herein. Another implementation may comprise one or more application specific integrated circuit or chip designed for welding. Some implementations may comprise a non-transitory machine-readable (e.g., computer readable) medium (e.g., FLASH memory, optical disk, magnetic storage disk, or the like) having stored thereon one or more lines of code executable by a machine, thereby causing the machine to perform processes as described herein. As used herein, the term "non-transitory machine-readable medium" is defined to include all types of machine readable storage media and to exclude propagating signals.

[0073] As utilized herein the terms "circuits" and "circuitry" refer to physical electronic components (i.e. hardware) and any software and/or firmware ("code") that may configure the hardware, be executed by the hardware, and or otherwise be associated with the hardware. As used herein, for example, a particular processor and memory may comprise a first "circuit" when executing a first set of one or more lines of code and may comprise a second "circuit" when executing a second set of one or more lines of code. As utilized herein, "and/or" means any one or more of the items in the list joined by "and/or." As an example, "x and/or y" means any element of the three-element set {(x), (y), (x, y)}. In other words, "x and/or y" means "one or both of x and y." As another example, "x, y, and/or z" means any element of the seven-element set {(x), (y), (z), (x, y), (x, z), (y, z), (x, y, z)}. In other words, "x, y and/or z" means "one or more of x, y and z." As utilized herein, the term "exemplary" means serving as a non-limiting example, instance, or illustration. As utilized herein, the terms "e.g." and "for

example" set off lists of one or more non-limiting examples, instances, or illustrations. As utilized herein, circuitry is "operable" to perform a function whenever the circuitry comprises the necessary hardware and code (if any is necessary) to perform the function, regardless of whether performance of the function is disabled or not enabled (e.g., by a user-configurable setting, factory trim, etc.).

[0074] The present methods and/or systems may be realized in hardware, software, or a combination of hardware and software. The present methods and/or systems may be realized in a centralized fashion in at least one computing system or in a distributed fashion where different elements are spread across several interconnected computing systems. Any kind of computing system or other apparatus adapted for carrying out the methods described herein is suited. A typical combination of hardware and software may be a general-purpose computing system with a program or other code that, when being loaded and executed, controls the computing system such that it carries out the methods described herein. Another typical implementation may comprise an application specific integrated circuit or chip. Some implementations may comprise a non-transitory machine-readable (e.g., computer readable) medium (e.g., FLASH drive, optical disk, magnetic storage disk, or the like) having stored thereon one or more lines of code executable by a machine, thereby causing the machine to perform processes as described herein.

[0075] While the present method and/or system has been described with reference to certain implementations, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the present method and/or system. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from its scope. Therefore, the present method and/or system are not limited to the particular implementations disclosed. Instead, the present method and/or system will include all implementations falling within the scope of the appended claims, both literally and under the doctrine of equivalents.

What is claimed:

1. A welding system comprising:

a display device configured to display an electronic parameter chart;

a user interface configured to receive at least one of a row input to indicate a selected row of the electronic parameter chart and a column input to indicate a selected column of the electronic parameter chart;

a welding power supply configured to provide welding power; and

a welding processor configured to determine, based on the selected row and the selected column, welding parameters.

2. The welding system of claim **1**, wherein the welding parameters comprise at least one of welding voltage, wire feed speed, and welding current.

3. The welding system of claim **1**, wherein the display device is configured to display at least a portion of the electronic parameter chart.

4. The welding system of claim **1**, wherein the display device is configured to display a first portion of the electronic parameter chart, and to display a different portion of the electronic parameter chart based on at least one display input received via the user interface.

5. The welding system of claim **4**, wherein the display input comprises at least one of a first display input for controlling displaying of rows of the electronic parameter chart and a second display input for controlling displaying of columns of the electronic parameter chart.

6. The welding system of claim **1**, wherein the welding processor is configured to control a welding operation according to the welding parameters.

7. The welding system of claim **1**, wherein the welding processor is configured to update the electronic parameter chart.

8. The welding system of claim **1**, wherein the welding processor is configured to format the electronic parameter chart for the display device based on a readability setting.

9. The welding system of claim **1**, wherein the row input comprises a first selection of at least one of a workpiece material, a tungsten type, a tungsten size, an electrode type, an electrode size, an electrode wire type, a shielding gas composition, a shielding gas flow rate, an electrode wire diameter, arc start, wire inductance, and a workpiece thickness.

10. The welding system of claim **9**, wherein the column input comprises a second selection of at least one of the workpiece material, the tungsten type, the tungsten size, the electrode type, the electrode size, the electrode wire type, the shielding gas composition, the shielding gas flow rate, the electrode wire diameter, arc start, wire inductance, and the workpiece thickness, the second selection being different from the first selection.

11. The welding system of claim **1**, wherein the welding processor is configured to determine the welding parameters using the selected row and the selected column via at least one of a pre-determined time and receiving a selection input via the user interface.

12. The welding system of claim **1**, wherein the welding processor is configured to determine the welding parameters after a pre-determined time after receiving at least one of the selected row and selected column.

13. The welding system of claim **1**, wherein the welding processor is configured to determine the welding parameters after receiving a selection input via the user interface after receiving at least one of the selected row and selected column.

14. The welding system of claim **1**, wherein the welding processor is configured to determine the welding parameters after receiving a selection input via the user interface without receiving first at least one of the selected row and selected column.

15. The welding system of claim **1**, wherein the welding processor is configured to output a message indicating that the welding parameters are not determined after receiving a selection input via the user interface without receiving first at least one of the selected row and selected column.

16. The welding system of claim **1**, further comprising a wire feeder configured to feed electrode wire.

17. A non-transitory machine-readable medium storing machine executable instructions that when executed causes a computing system to control operations for setting up and controlling a welding system, comprising:

displaying an electronic parameter chart on a display device of the welding system, the electronic parameter chart relating at least one of voltage, wire feed speed, and welding current to characteristics of a welding operation;

receiving, via a user interface of the welding system, a row input to indicate a selected row of the electronic parameter chart displayed on the display device;

receiving, via the user interface of the welding system, a column input to indicate a selected column of the electronic parameter chart displayed on the display device; and

setting, using a welding processor, welding parameters comprising at least one of a welding voltage, a wire feed speed, and welding current based on the selected row and the selected column.

18. The non-transitory machine-readable medium of claim **17**, further comprising instructions for controlling the welding operation according to the welding parameters.

19. The non-transitory machine-readable medium of claim **17**, further comprising instructions for updating the electronic parameter chart.

20. The non-transitory machine-readable medium of claim **17**, further comprising instructions for determining the welding parameters after at least one of an elapsed pre-determined time and receiving a selection input via the user interface of the welding system.

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