



- (51) International Patent Classification:
A61B 17/00 (2006.01) A61B 90/00 (2016.01)
- (21) International Application Number:
PCT/US2018/029914
- (22) International Filing Date:
27 April 2018 (27.04.2018)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
62/491,668 28 April 2017 (28.04.2017) US
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,

(54) Title: SYSTEM AND METHOD FOR INDICATING MAPPING OF CONSOLE-BASED SURGICAL SYSTEMS

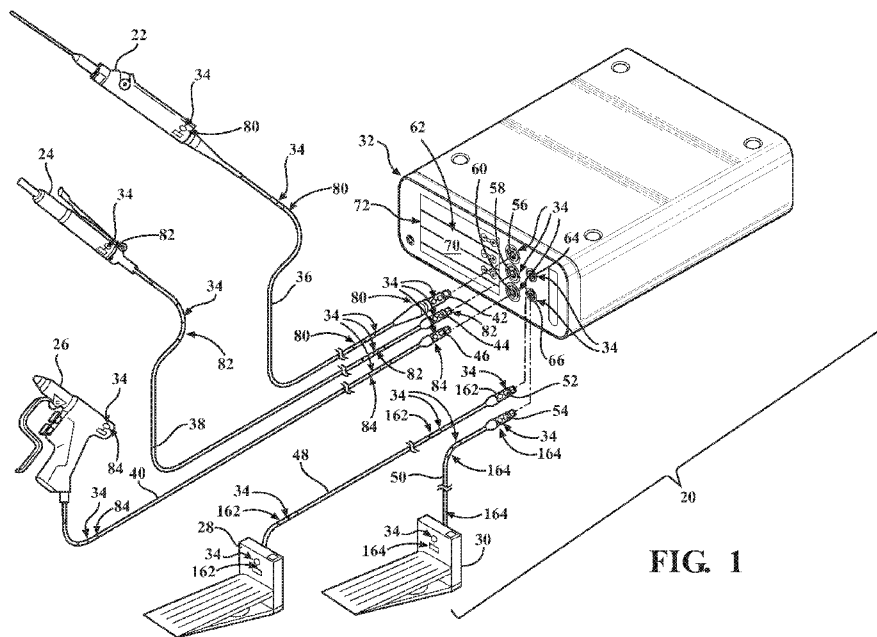


FIG. 1

(57) Abstract: A console-based surgical system comprises a plurality of handheld surgical instruments, each instrument having a connector line and an instrument visual indicator coupled to the instrument and/or connector line. The system further comprises a footswitch having a connector line and a footswitch visual indicator coupled the footswitch and/or connector line. The system further comprises a console, which in turn comprises a plurality of instrument ports, with the connector lines of the handheld instruments being connected to the instrument ports. The console further comprises a footswitch port, with the connector line of the footswitch connected to the footswitch port. The console further comprises a controller configured to associate the footswitch port with one of the instrument ports such that the footswitch is operable to actuate a function of the handheld surgical instrument connected to the associated instrument port. The controller is further configured to activate the footswitch visual indicator and the instrument visual indicator of the associated



SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*

SYSTEM AND METHOD FOR INDICATING MAPPING OF CONSOLE-BASED SURGICAL SYSTEMS

Cross Reference To Related Application

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 62/491,668, filed April 28, 2017, which is hereby incorporated by reference in its entirety.

Technical Field

[0002] This disclosure is related to a console-based surgical system and method for associating handheld surgical instruments with input devices and activating visual indicators to indicate the instruments and input devices that are associated with one another.

Summary Of The Disclosure

[0003] One embodiment of this disclosure relates to a new and useful console-based surgical system that associates handheld surgical instruments with input devices and activates visual indicators to indicate the instruments and input devices that are associated with one another. The system comprises a plurality of handheld surgical instruments, each instrument having a connector line and an instrument visual indicator coupled to the instrument and/or connector line. The system further comprises a footswitch having a connector line and a footswitch visual indicator coupled the footswitch and/or connector line. The system further comprises a console, which in turn comprises a plurality of instrument ports, with the connector lines of the handheld instruments being connected to the instrument ports. The console further comprises a footswitch port, with the connector line of the footswitch connected to the footswitch port. The console further comprises a controller configured to associate the footswitch port with one of the instrument ports such that the footswitch is operable to actuate a function of the handheld surgical instrument connected to the associated instrument port. The controller is further configured to

activate the footswitch visual indicator and the instrument visual indicator of the associated instrument port to display outputs that correspond with one another.

Brief Description Of The Drawings

[0004] Referring now to the drawings, exemplary illustrations are shown in detail. Although the drawings represent examples, the drawings are not necessarily to scale and certain features may be exaggerated or schematic in form to better illustrate and explain a particular aspect of an illustrative example. Any one or more of these aspects can be used alone or in combination within one another. Further, the exemplary illustrations described herein are not intended to be exhaustive or otherwise limiting or restricting to the precise form and configuration shown in the drawings and disclosed in the following detailed description. Exemplary illustrations are described in detail by referring to the drawings as follows:

[0005] Figure 1 is an exploded view of a console-based surgical system comprising a console, a plurality of handheld surgical instruments, and a plurality of input devices.

[0006] Figure 2 is a schematic view of the console-based surgical system of Figure 1, the system includes a first handheld surgical instrument, a second handheld surgical instrument, a third handheld surgical instrument, a first footswitch, and a second footswitch.

[0007] Figure 3 is an enlarged perspective view of the console of Figure 1, illustrating the console having a first instrument port, a second instrument port, a third instrument port, a first footswitch port, and a second footswitch port, which are respectively able to be operably coupled to the first handheld surgical instrument, the second handheld surgical instrument, the third handheld surgical instrument, the first footswitch, and the second footswitch.

[0008] Figure 4 is an enlarged view of illustrating first, second, and third instrument plugs capable of being connected to the first, second, and third instrument ports of the console shown in

Figure 1, with the first, second, and third instrument plugs comprising first, second, and third instrument visual indicators.

[0009] Figure 5 is an enlarged view of first, second, and third connector lines for the first, second, and third handheld surgical instruments shown in Figure 1, with the first, second, and third connector lines comprising first, second, and third instrument visual indicators.

[0010] Figure 6 is an enlarged view of the first, second, and third instruments shown in Figure 1, illustrating the first, second, and third instruments comprising first, second, and third instrument visual indicators.

[0011] Figure 7 is an enlarged view of the first, second, and third instrument ports and first and second footswitch ports of the console shown in Figure 3, illustrating first, second, and third instrument visual indicators and first and second footswitch visual indicators coupled to the console.

[0012] Figure 8 is an enlarged view of first and second footswitch plugs capable of being connected to the first and second footswitch ports of the console shown in Figure 1, with the first and second footswitch plugs comprising first and second footswitch visual indicators.

[0013] Figure 9 is an enlarged view of first and second connector lines for the first and second footswitches shown in Figure 1, with the first and second connector lines comprising first and second footswitch visual indicators.

[0014] Figure 10 is an enlarged view of the first and second footswitches shown in Figure 1, illustrating the first and second footswitches comprising first and second footswitch visual indicators.

[0015] Figure 11 is a front perspective view of the console of Figure 3, illustrating the first connector line of the first handheld surgical instrument coupled to the first instrument port.

[0016] Figure 12 is an enlarged view of the instrument ports and footswitch ports of Figure 11, illustrating first instrument visual indicators coupled to the first surgical handheld instrument, the connector line for the first surgical handheld instrument, and the console adjacent to the first instrument port to indicate that the first instrument port is not associated with any of the footswitch ports.

[0017] Figure 13 is a front perspective view of the console of Figure 3, illustrating the first connector line of the first handheld surgical instrument coupled to the first instrument port and the first connector line of the first footswitch coupled to the first footswitch port.

[0018] Figure 14 is an enlarged view of the instrument ports and footswitch ports of Figure 13, with an association between the first instrument port and the first footswitch port being indicated by first instrument visual indicators and first footswitch visual indicators coupled to the console.

[0019] Figure 15 is a front perspective view of the console of Figure 3, illustrating the second connector line of the second handheld surgical instrument coupled to the second instrument port and the second connector line of the first footswitch coupled to the first footswitch port.

[0020] Figure 16 is an enlarged view of the instrument ports and footswitch ports of Figure 15, with an association between the second instrument port and the first footswitch port being indicated by a plurality of second instrument visual indicators and a plurality of first footswitch visual indicators.

[0021] Figure 17 is a front perspective view of the console of Figure 3, illustrating the connector line of the third handheld surgical instrument coupled to the third instrument port and the connector line of the first footswitch coupled to the first footswitch port.

[0022] Figure 18 is an enlarged view of the instrument ports and footswitch ports of Figure 17, with an association between the third instrument port and the first footswitch port being indicated by a plurality of third instrument visual indicators and a plurality of first footswitch visual indicators.

[0023] Figure 19 is a front perspective view of the console of Figure 13, further illustrating the connector line of the second handheld surgical instrument coupled to the second instrument port and the connector line of the second footswitch coupled to the second footswitch port.

[0024] Figure 20 is an enlarged view of the instrument ports and footswitch ports of Figure 14, further including an association between the second instrument port and the second footswitch port indicated by a plurality of second instrument visual indicators and a plurality of second footswitch visual indicators.

[0025] Figure 21 is a front perspective view of the console of Figure 3, illustrating the connector line of the second handheld surgical instrument coupled to the second instrument port and the connector line of the second footswitch coupled to the second footswitch port.

[0026] Figure 22 is an enlarged view of the instrument ports and footswitch ports of Figure 21, with an association between the second instrument port and the second footswitch port being indicated by a plurality of second instrument visual indicators and a plurality of second footswitch visual indicators.

[0027] Figure 23 is a front perspective view of the console of Figure 3, illustrating the connector lines of the first, second, and third handheld surgical instruments coupled to a respective one of the first, second, and third instrument ports, and the connector lines of the first, second, and third footswitches coupled to a respective one of the first, second, and third footswitch ports.

[0028] Figure 24 is an enlarged view of the instrument ports and footswitch ports of Figure 16, with an association between the first instrument port and the first and second footswitch ports being indicated by the first instrument visual indicators and the first and second footswitch visual indicators.

Detailed Description

[0029] Referring to Figure 1, a console-based surgical system 20 may comprise first, second, and third handheld surgical instruments 22, 24, 26, first and second footswitches 28, 30, and a console 32 for associating one or more of the instruments 22, 24, 26 with one or more of the footswitches 28, 30 to control the associated instruments during a surgical procedure. The system 20 further comprises a plurality of visual indicators 34 for indicating which of the instruments 22, 24, 26 and footswitches 28, 30 correspond with one another. The system 20 is shown in FIG. 1 as, for exemplary purposes, controlling three handheld surgical instruments 22, 24, 26, but in other embodiments, the system can control one, two, four, five, or any suitable number and type of instruments. Furthermore, system 20 is shown as, for exemplary purposes, comprising two footswitches 28, 30, but in other embodiments, the system may comprise one, three, four, five, or any number of footswitches or other types of input devices. The system 20 is also shown as, for exemplary purposes, comprising twenty-five (25) visual indicators 34, but in other embodiments any number of visual indicators may be used to indicate the association between the instrument ports and footswitch ports.

[0030] Each one of the first, second, and third handheld surgical instruments 22, 24, 26 is configured to perform one or more predetermined functions in the treatment or care of a patient. Each instrument 22, 24, 26 can utilize one or more components that require electricity. As one example, one or more of the instruments may comprise a specialty drill such as one sold under the

brand name CORE UNIVERSAL SERIES by Stryker Instruments of Kalamazoo, Michigan, United States. Other examples of the instruments may comprise: a high-powered tapered drill, such as one sold under the brand name CORE SUMEX DRILL by Stryker Instruments; a modular handpiece such as one sold under the brand name CORE UNIVERSAL DRIVER by Stryker Instruments; a high-speed pencil-grip drill such as one sold under the brand name CORE MICRO DRILL by Stryker; a pneumatic drill such as one sold under the brand name MAESTRO DRILL by Stryker; a drill for intraoperative procedures such as one sold under the brand name ARIA MRI DRILL SYSTEM by Stryker; a drill for oral surgery such as one sold under the brand name CORE IMPACTION DRILL by Stryker; a drill for ENT surgery sold under the brand name SABER DRILL by Stryker; a sagittal saw, an oscillating saw, or a reciprocating saw, such as those sold under the brand name MICRO SAW by Stryker; various burs for small bone procedures such as those sold under the brand names ELITE BUR, ZYPHR BUR, MIS BUR, and TPS BUR; a microdebrider such as one sold under the brand name ESSX MICRODEBRIDER; an ultrasonic aspirator such as one sold under the brand name SONOPET ULTRASONIC ASPIRATOR by Stryker; a pair of bipolar forceps such as one sold under the brand name SILVERGLIDE BIPOLAR FORCEPS by Stryker.

[0031] Other handheld surgical instruments sold by Stryker or any manufacturer are also contemplated. For instance, electrosurgical devices, ultrasound devices, and other surgical devices may also be employed. Electrosurgical instruments and others like them can be of any suitable type known in the art, including those that use diathermy with either unipolar or bipolar current (commonly referred to simply as unipolar devices and bipolar devices), and advanced devices such as harmonic scissors and argon beam and laser devices. The illustrated shapes and other structural features of instruments 22, 24, 26 as depicted in Figure 1 are not intended to describe the

instruments specifically but rather are intended only to convey the general concept that various instruments can be used. Indeed, it is important to note that the present disclosure facilitates the integration of instruments that may have different functions and other characteristics in terms of how they respond to their associated device user controls (not shown) and in terms of the signals produced by their device user controls that characterize their operation. For example, the instruments 22, 24, 26 can have functions that differ from those of each other as a result of the first handheld surgical instrument 22 being, for example, a unipolar device, while second handheld surgical instrument 24 is, for example, a bipolar device, and the third handheld surgical instrument 26 is a harmonic device. In addition, it may be that, for example, the first and second handheld surgical instruments 22 and 24 have different operating characteristics from each other because they require signals of different voltages from each other. The various devices may be produced by different manufacturers or be different versions or models of a device. Regardless of any such differences, the system 20 ensures that any and all of the instruments to which it is connected can be controlled by the first and second footswitches 28, 30 or the console 32.

[0032] Additionally, while handheld surgical instruments are emphasized in this disclosure, other types of medical devices may also be used in place thereof in certain embodiments. For example, suitable medical devices that could be used in conjunction with the console, include, but are not limited to, patient therapy devices, patient monitoring devices, or surgical instruments that are not handheld, such as surgical robots, hospital beds, lighting systems, cameras, etc. As such, the term “handheld surgical instrument” may be interchanged with these medical devices throughout this disclosure.

[0033] The first, second, and third handheld surgical instruments 22, 24, 26 may comprise a corresponding one of connector lines 36, 38, 40. Each connector line 36, 38, 40 may terminate

at one end that is coupled to a corresponding one of the instruments 22, 24, 26 and terminate at an opposing end with a corresponding one of plugs 42, 44, 46 configured to engage the console 32 as provided in the description below for Figures 13-24. In other embodiments, the connector lines may terminate with a socket or any type of connector.

[0034] In the illustrated embodiment, footswitch 28 and/or footswitch 30 can comprise a footswitch sold under the brand name UNI-DIRECTIONAL FOOTSWITCH by Stryker, a footswitch sold under the brand name TPS FOOTSWITCH by Stryker, or any other type of input device sold by Stryker or another manufacturer. For example, the input device may be integral with the handheld surgical instruments, or may take the form of handswitches, voice-actuated switches, knee switches, or other types of switches that can be actuated by a user. Each input device may include one or more sensors, such as Hall effect sensors, magnetic sensors, or other suitable sensors, that generate signals in response to depression of the input device, such as the footswitch. As such, the term “footswitch” may be interchanged throughout this disclosure for input device.

[0035] The footswitches 28, 30 may comprise a corresponding one of connector lines 48, 50. Each connector line 48, 50 may terminate at one end that is coupled to a corresponding one of the footswitches 28, 30 and terminate at an opposing end with a corresponding one of plugs 52, 54 configured to engage the console 32 as provided in the description below for Figures 13-24. In other embodiments, the connector lines may terminate with a socket or any type of connector.

[0036] The console 32 comprises first, second, and third instrument ports 56, 58, 60. The plugs 42, 44, 46 of the connector lines 36, 38, 40 associated with the handheld surgical instruments 22, 24, 26 are capable of being connected to a corresponding one of the first, second, and third instrument ports 56, 58, 60. While Figure 3 illustrates that the console 32 has a display 62 with the first, second, and third instrument ports 56, 58, 60 positioned adjacent to the display 62, it is

contemplated that the system 20 can instead comprise one, two, four, or any number of instrument ports positioned on any suitable portion of the console 32. Furthermore, the console 32 comprises first and second footswitch ports 64, 66. The plugs 52, 54 of the connector lines 48, 50 associated with the footswitches 28, 30 are capable of being connected to the first and second footswitch ports 64, 66. The first and second footswitch ports 64, 66 are spaced apart from the display 62, such that the first, second, and third instrument ports 56, 58, 60 are positioned between the footswitch ports 64, 66 and the display 62. However, other configurations of the instrument ports 56, 58, 60, the footswitch ports 64, 66, and the display 62 are contemplated.

[0037] Referring to Figure 2, the console 32 further comprises a controller 68 configured to associate one of the first, second, and third instrument ports 56, 58, 60 with the first footswitch port 64, such that the first footswitch 28 is operable to actuate a function of the handheld surgical instruments connected to the associated instrument port. Similarly, the controller 68 is configured to associate another one of the first, second, and third instrument ports 56, 58, 60, with the second footswitch port 66 such that the second footswitch 30 is operable to actuate a function of the handheld surgical instrument connected with the associated instrument port. It is contemplated that the controller 68 may associate the same instrument port with both of the first and second footswitch ports 64, 66, such that the footswitches 28, 30 are operable to actuate a function of the same handheld surgical instrument connected to the associated instrument port. The association of instrument ports with footswitch ports is addressed in detail in the description for Figures 6-17. The console 32 is capable of being coupled to a power source (not shown) to receive power therefrom and deliver the same to any one or more of the instruments 22, 24, 26, and the footswitches 28, 30. In other embodiments, the connector lines for the handheld surgical

instruments and/or footswitches may be omitted and the console may be connected wirelessly therewith.

[0038] The system 20 may further comprise a user input device 70 coupled to the controller 68 and actuatable by a user to output one or more user output signals to cause the controller 68 to associate one of the instrument ports 56, 58, 60 with one of the footswitches 28, 30. In one embodiment, the user input device 70 can be a touchscreen panel 72 or any other user input device configured to permit a surgeon to indicate which footswitch assignments are wanted for the present operation. More specifically, the controller 68 may comprise a circuit (not shown) that, based on instructions from the touchscreen panel 72 or other user input device, generates energization signals transmitted to the motors (not shown) or other power-consuming units (not shown) internal to the instrument(s) coupled to the associated instrument port(s). The controller 68 can be simultaneously connected to the first, second, and third handheld surgical instruments 22, 24, 26 through the corresponding plugs 42, 44, 46 and connector lines 36, 38, 40. The controller 68 may provide data and receive instructions from the user input device 70 over a second SPI bus (not shown).

[0039] Referring to Figure 3, in this embodiment, the touchscreen panel 72 may comprise a plurality of icons 74, 76, 78 for the first, second, and third instrument ports 56, 58, 60 that are to be associated, assigned, or mapped to one or both of the footswitch ports 64, 66. Upon the surgeon touching the icon for each instrument port, the controller 68 may change the footswitch mapping for that instrument port. Specifically, the controller 68 cycles the mapping for each instrument port through the following sequence: the first footswitch port 64; the second footswitch port 66; dual control mode for both the first and second footswitch ports 64, 66; and no footswitch control. As the mapping changes, the color of the icon changes appropriately to indicate the new assignment

for the associated instrument. Acceptance of a specific footswitch assembly assignment map is performed by depressing an icon (not shown) for an accept (ACPT) button also presented on the user input device 70. Other embodiments without the accept button are contemplated, such that the icons 74, 76, 78 are toggle buttons that require no confirmation of the selected mapping.

[0040] In response to the surgeon depressing one or more of the icons 74, 76, 78 to select a footswitch assembly assignment association, the controller 68 records the new footswitch association into footswitch association tables (not shown). The surgeon(s) may then be able to use or actuate each instrument by depressing the appropriate pedal on the footswitch assigned to control the associated instrument.

[0041] Also in this embodiment, the footswitch assignment association can only be performed by depressing the icons 74, 76, 78 presented on the touchscreen panel 72. This prevents inadvertent depression of the footswitches for unintentionally transferring control of an instrument from one of the two footswitches 28, 30 to the other of the two footswitches 28, 30. However, it is contemplated that other embodiments of the system may include switches (not shown) for separating control of an instrument from a footswitch or transferring control from one footswitch to another, with those switches attached to the footswitches, instruments, connector lines, or any portion of the system. As one example, the surgeon may choose to actuate an instrument-mounted switch to regulate the actuation of the instrument. When this option is selected, the associated icon on the user input device 70 is presented as a grey, and none of the footswitches are operable to control the handheld surgical instrument.

[0042] Furthermore, the system 20 may be disposed in a “plug and play” mode for one footswitch, such that the controller 68 assigns instrument ports to footswitch ports according to a default scheme. Independent or in the absence of a user output signal from the user input device

70, the controller 68 can be configured to automatically associate one of the instrument ports 56, 58, 60 with one or more of the footswitch ports 64, 66. More specifically, under this default scheme, if there is just a single footswitch operably connected to either the first footswitch port 64 or the second footswitch port 66, each one of the first, second, and third instrument ports 56, 58, 60 is associated, assigned, or mapped to that connected footswitch port, such that the footswitch controls each one of the first, second, and third instruments 22, 24, 26.

[0043] Similarly, the system 20 may be further disposed in the “plug and play” mode for one instrument when the connector lines 48, 50 of the first and second footswitches 28, 30 are coupled to the first and second footswitch ports 64, 66 and the connector line of only one instrument is coupled to one of the first, second, or third instrument ports 56, 58, 60. The controller 68 performs default mapping for this version of the “plug and play” mode by mapping control for the instrument to each one of the first and second footswitches 28, 30. When both footswitches 28, 30 can control an instrument, the instrument is considered to be in a “dual-control” mode.

[0044] If the controller 68 determines that two or more instruments and the first and second footswitches 28, 30 are connected to the console 32, the system 20 is disposed in a “multiple” mode. Initially, when the system 20 enters the “multiple” mode, the controller 68 maps the footswitch assignments to what they were in the immediate past “plug and play” mode. Thus, if a single footswitch was controlling the plurality of instruments, that footswitch retains control of those instruments. Conversely, if both footswitches 28, 30 had a single instrument under dual control, both footswitches 28, 30 maintain this control.

[0045] The visual indicators 34 may comprise a plurality of instrument visual indicators 80, 82, 84 coupled to the corresponding instruments 22, 24, 26, connector lines 36, 38, 40 for the same, and/or portions of the console 32 adjacent to the first, second, and third instrument ports 56,

58, 60. The visual indicators 34 may further include a plurality of footswitch visual indicators 162, 164 coupled to the corresponding footswitches 28, 30, connector lines 48, 50, for the same, and/or portions of the console 32 adjacent to the first and second footswitch ports 64, 66. It is contemplated that the visual indicators may be coupled to any one or more of the instruments, footswitches, connector lines, or console (either the display, instrument ports, or footswitch ports) and may take a variety of forms, including but not limited to, light emitters, displays, electromechanical devices, etc. For example, if the visual indicator takes the form of the touchscreen panel or display, the display can show the icons 74, 76, 78, symbol, illustration, or verbal description of the type of association. Other embodiments of the visual indicators can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators.

[0046] Referring to Figure 4, one portion of the instrument visual indicators 80, 82, 84 may be coupled to the plugs 42, 44, 46 of the connector lines 36, 38, 40. Each one of these instrument visual indicators 80, 82, 84 on the plugs 42, 44, 46 may comprise a light emitter 86, 88, 90. More specifically, the light emitters 86, 88, 90 may comprise one or more LEDs 92, 94, 96, ring-shaped light guides 98, 100, 102, or combinations thereof. In this embodiment, each one of the LEDs 92, 94, 96 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicators 80, 82, 84 on the plugs 42, 44, 46 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. It is contemplated that the instrument visual indicators on the plugs 42, 44, 46 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments comprising any number or type of visual indicators coupled to any

portion(s) of the plugs 42, 44, 46 are contemplated. In addition, embodiments of any one or more of the plugs 42, 44, 46 without instrument visual indicators are also contemplated.

[0047] Referring to Figure 5, another portion of instrument visual indicators 80, 82, 84 may be integrated or embedded within one or both ends of each connector lines 36, 38, 40. In the illustrated embodiment, each end of the connector lines 36, 38, 40 comprises a light emitter 104, 106, 108. More specifically, the light emitters 104, 106, 108 may comprise one or more LEDs 110, 112, 114, fiber optic or light strips 116, 118, 120, or combinations thereof. In this embodiment, each one of the LEDs 110, 112, 114 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicators 80, 82, 84 on one or both ends of the connector lines 36, 38, 40 may take a variety of forms, including but not limited to, light emitters, ring-shaped light guides, displays, electromechanical devices, etc. It is contemplated that the instrument visual indicators on the connector lines 36, 38, 40 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the instrument visual indicators 80, 82, 84 are coupled to intermediate portions of the corresponding connector lines 36, 38, 40 between the opposing ends of those connector lines 36, 38, 40. Still other embodiments of the instrument visual indicators 80, 82, 84 may comprise a single visual indicator coupled to each corresponding connector line 36, 38, 40 and extending along the entire length, or a portion thereof. Other embodiments comprising any number or type of visual indicators coupled to any portion(s) of the connector lines 36, 38, 40 are contemplated. In addition, embodiments of any one or more of the connector lines 36, 38, 40 without any instrument visual indicators are also contemplated.

[0048] Referring to Figure 6, still another portion of instrument visual indicators 80, 82, 84 may be integrated or embedded within one or more of the first, second, or third handheld

surgical instruments 22, 24, 26. In the illustrated embodiment, each instrument visual indicator 80, 82, 84 may comprise a light emitter 122, 124, 126 in the form of LEDs 128, 130, 132, ring-shaped light guides 134, 136, 138, or combinations thereof. In this embodiment, each one of the LEDs 128, 130, 132 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicators 80, 82, 84 on one or more of the instruments 22, 24, 26 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the instrument visual indicator takes the form of the touchscreen panel or display, the display can show an icon, symbol, illustration, or verbal description of the type of association. It is contemplated that the instrument visual indicators on the instruments 22, 24, 26 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the instrument visual indicators 80, 82, 84 may comprise any number or type of visual indicators coupled to any portion(s) of the instruments 22, 24, 26. In addition, embodiments of any one or more of the instruments 22, 24, 26 without any instrument visual indicators are also contemplated.

[0049] Referring to Figure 7, a portion of instrument visual indicators 80, 82, 84 may be integrated or coupled to the console 32 adjacent to a corresponding one of the first, second, and third instrument ports 56, 58, 60. In the illustrated embodiment, each instrument visual indicator 80, 82, 84 may comprise the light emitter 140, 142, 144 in the form of LEDs 146, 148, 150, ring-shaped light guides 152, 154, 156, or combinations thereof. Each ring-shaped light guide 152, 154, 156 may be coupled to the console 32 and surround a corresponding one of the first, second, and third instrument ports 56, 58, 60. Each ring-shaped light guide 152, 154, 156 can comprise two arcuate light emitter portions 158, 160 on opposing sides of the corresponding port, with one light emitter portion 158 adjacent to the other light emitter portion 160. While Figure 1 illustrates

the light emitter portion 158 positioned above the light emitter portion 160 in a vertical arrangement, it is contemplated that the light emitter portions 158, 160 can be positioned lateral to one another in a side-by-side arrangement or in any other suitable arrangement. In this embodiment, each one of the light emitter portions 158, 160 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicators 80, 82, 84 on the console 32 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the instrument visual indicator takes the form of the touchscreen panel or display, the display can show an icon 74, 76, 78, symbol, illustration, or verbal description of the type of association. It is contemplated that the instrument visual indicators on the console 32 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the instrument visual indicators 80, 82, 84 may be coupled to a top side, a left side, a right side, a bottom side, a rear side, other portions of the front side, any portion of the console, or combinations thereof. Other embodiments comprising any number or type of visual indicators are contemplated. In addition, embodiments of the console 32 without any instrument visual indicators are also contemplated.

[0050] Referring to Figure 8, footswitch visual indicators 162, 164 may be coupled to the first and second plugs 52, 54 of the first and second connector lines 48, 50. Each one of these footswitch visual indicators 162, 164 on the first and second plugs 52, 54 comprises a light emitter 170, 172. More specifically, the light emitters 170, 172 may comprise one or more LEDs 174, 176, ring-shaped light guides 177, 179, or combinations thereof. In this embodiment, each one of the LEDs 174, 176 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the footswitch visual indicators 162, 164 on the plugs 52, 54 may take a variety

of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. It is contemplated that the footswitch visual indicators on the plugs 52, 54 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments comprising any number or type of visual indicators coupled to any portion(s) of the plugs 52, 54 are contemplated. In addition, embodiments of any one or more of the plugs 52, 54 without footswitch visual indicators are also contemplated.

[0051] Referring to Figure 9, another portion of footswitch visual indicators 162, 164 may be integrated or embedded within one or both ends of each connector lines 48, 50. In the illustrated embodiment, each end of the connector lines 48, 50 comprises a light emitter 178, 180. More specifically, the light emitters 178, 180 may comprise one or more LEDs 182, 184, fiber optic strips 186, 188, or combinations thereof. In this embodiment, each one of the LEDs 182, 184 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the footswitch visual indicators 162, 164 on one or both ends of the connector lines 48, 50 may take a variety of forms, including but not limited to, light emitters, ring-shaped light guides, displays, electromechanical devices, etc. It is contemplated that the footswitch visual indicators on the connector lines 48, 50 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the footswitch visual indicators 162, 164 are coupled to intermediate portions of the corresponding connector lines 48, 50 between the opposing ends of those connector lines 48, 50. Still other embodiments of the footswitch visual indicators 162, 164 may comprise one or more visual indicators coupled to each corresponding connector line 48, 50, such as light strips extending along the entire length, or a portion thereof. Other embodiments comprising any number or type of visual indicators coupled to any portion(s)

of the connector lines 48, 50 are contemplated. In addition, embodiments of any one or more of the connector lines 48, 50 without any footswitch visual indicators are also contemplated.

[0052] Referring to Figure 10, still another portion of footswitch visual indicators 162, 164 may be integrated or embedded within one or more of the first or second footswitches 28, 30. In the illustrated embodiment, each footswitch visual indicator 162, 164 comprises a light emitter 190, 192. More specifically, the light emitters 190, 192 may comprise one or more LEDs 194, 196, ring-shaped light guides 198, 200 or combinations thereof. In this embodiment, each one of the LEDs 194, 196 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the footswitch visual indicators 162, 164 on one or more of the footswitches 28, 30 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the footswitch visual indicator takes the form of the touchscreen panel or display, the display can show an icon, symbol, illustration, or verbal description of the type of association. It is contemplated that the footswitch visual indicators on the footswitches 28, 30 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the footswitch visual indicators 162, 164 may comprise any number or type of visual indicators coupled to any portion(s) of the footswitches 28, 30. In addition, embodiments of any one or more of the footswitches 28, 30 without any footswitch visual indicators are also contemplated.

[0053] Referring back to Figure 7, footswitch visual indicators 162, 164 may be integrated or coupled to the console 32 adjacent to a corresponding one of the first and second footswitch ports 64, 66. In the illustrated embodiment, each footswitch visual indicator 162, 164 may comprise a light emitter 202, 204. The light emitters 202, 204 may comprise series of LEDs 206, 208, ring-shaped light guides 210, 212, or combinations thereof. Each ring-shaped light guide

210, 212 may be coupled to the console 32 and surround a corresponding one of the footswitch ports 64, 66. Each ring-shaped light guide 210, 212 can comprise two arcuate light emitter portions 214, 216 on opposing sides of the corresponding port, with one light emitter portion 214 adjacent to the other light emitter portion 216. While Figure 1 illustrates the light emitter portion 214 positioned above the light emitter portion 216 in a vertical arrangement, it is contemplated that the light emitter portions 214, 216 can be positioned lateral to one another in a side-by-side arrangement or in any other suitable arrangement. In this embodiment, each one of the light emitter portions 214, 216 comprises a multi-colored light emitter configured to emit a plurality of colored lights. However, the footswitch visual indicators 162, 164 on the console 32 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the footswitch visual indicator takes the form of the touchscreen panel or display, the display can show the icons 74, 76, 78 (FIG. 3), symbol, illustration, or verbal description of the type of association. It is contemplated that the footswitch visual indicators on the console can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the footswitch visual indicators 162, 164 may be coupled to a top side, a left side, a right side, a bottom side, a rear side, other portions of the front side, any portion of the console, or combinations thereof. Other embodiments comprising any number or type of visual indicators are contemplated. In addition, embodiments of the console 32 without any footswitch visual indicators are also contemplated.

[0054] Referring now to Figures 11 and 12, there is illustrated the system 20 of Figure 3 comprising the first connector line 36 of the first instrument coupled to the first instrument port 56. In the illustrated embodiment, the system 20 does not comprise the connector line of any footswitch or other input device being connected to either one of the footswitch ports 64, 66.

Furthermore, the controller 68 has not associated the first instrument port 56 with either one of the unoccupied footswitch ports 64, 66. The controller 68 activates the first instrument visual indicators 80 of the first instrument port 56, the first plug 42, the connector line 36, the first instrument 22, and any combinations thereof to indicate that the first instrument port 56 is not associated with either one of the footswitch ports 64, 66.

[0055] More specifically, in the illustrated embodiment, the instrument visual indicator 80 on the console 32 may comprise the light emitter 140 in the form of the LEDs 146 and the ring-shaped light guide 152 coupled to the console 32 and surrounding the first instrument port 56. The ring-shaped light guide 152 may comprise the two arcuate light emitter portions 158, 160 on opposing sides of the first instrument port 56, with one light emitter portion 158 adjacent to the other light emitter portion 160. The controller 68 activates the LEDs 146 to emit white light through the light emitter portions 158, 160 to indicate that the first instrument port 56 is not associated with either one of the footswitch ports 64, 66. However, the instrument visual indicator 80 on the console 32 may emit any colored light and take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. to indicate that the first instrument port 56 is not associated with either one of the footswitch ports 56, 58. For instance, if the instrument visual indicator takes the form of the touchscreen panel or display, the display can show an icon 74, symbol, illustration, or verbal description of the type of association. It is contemplated that the instrument visual indicators can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the instrument visual indicator may be coupled to a top side, a left side, a right side, a bottom side, a rear side, other portions of the front side, any portion of the console, or combinations thereof. Still other embodiments comprising any number or type of visual indicators

are contemplated. In addition, embodiments of the console 32 not comprising any instrument visual indicators are also contemplated.

[0056] The instrument visual indicator 80 coupled to the plug 42 may comprise the light emitter 86 of Figure 4 in the form of the LEDs 92 and ring-shaped light guide 98. In this embodiment, the LED 92 comprises the multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicator 80 on the plug 42 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. It is contemplated that the instrument visual indicators on the plug 42 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments comprising any number or type of visual indicators coupled to any portion(s) of the plug 42 are contemplated. In addition, other embodiments of the plug 42 without the instrument visual indicator are also contemplated.

[0057] The instrument visual indicator 80 integrated or embedded within the connector line 36 may comprise the light emitter 104 of Figure 5 in the form of the LED 110 and/or fiber optic/light strip(s) 116. In the illustrated embodiment, the LED comprises the multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicator 80 on one or both ends of the connector line 36 may take a variety of forms, including but not limited to, light emitters, ring-shaped light guides, displays, electromechanical devices, etc. It is contemplated that the instrument visual indicators on the connector line 36 may comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the instrument visual indicator 80 are coupled to intermediate portions of the connector line 36 between the opposing ends of the connector line 36. Still other embodiments of the instrument visual indicator 80 may comprise a single visual indicator coupled to the

connector line 36 and extending along the entire length thereof. Other embodiments comprising any number or type of visual indicators coupled to any portion(s) of the connector lines 36 are contemplated. In addition, embodiments of the connector line 36 without any instrument visual indicators are also contemplated.

[0058] The instrument visual indicator 80 integrated or embedded within the first handheld surgical instrument 22 may comprise the light emitter 122 of Figure 6 in the form of the 128 LED and ring-shaped light guide 134. In the illustrated embodiment, the LED 128 may comprise a multi-colored light emitter configured to emit a plurality of colored lights. However, the instrument visual indicator on the first handheld surgical instrument 22 may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the instrument visual indicator takes the form of the touchscreen panel or display, the display can show an icon, symbol, illustration, or verbal description of the type of association. It is contemplated that the instrument visual indicators on the instruments 22 can comprise any suitable light emitter or mechanically-operated posts, flags, buttons, or other visual indicators. Other embodiments of the instrument visual indicator 80 may comprise any number or type of visual indicators coupled to any portion(s) of the instruments 22. In addition, other embodiments of the instrument 22 without any instrument visual indicators are also contemplated.

[0059] Referring generally to Figures 13-24, the controller is further configured to activate the footswitch visual indicators and the instrument visual indicators of the associated instrument port to display outputs that correspond with one another. More specifically, in the illustrated embodiments, the controller is further configured to activate the footswitch visual indicators 162, 164 on the footswitches 28, 30, connector lines 48, 50, plugs 52, 54, and footswitch ports 64, 66 and the instrument visual indicators 80, 82, 84 on the instruments 22, 24, 26, connector lines 36,

38, 40, plugs 42, 44, 46, and instrument ports 56, 58, 60 to display outputs that correspond with one another. In these embodiments, the footswitch visual indicators 162, 164 and the instrument visual indicators 80, 82, 84 are respective ones of the light emitters 104, 106, 86, 88, 90 of Figure 7, which display outputs that correspond with one another by emitting colored light that matches one another. It should be appreciated that the displaying outputs that correspond with one another should be broadly understood to mean that users seeing the outputs of the footswitch visual indicators and the instrument visual indicators would understand that there is a relation therebetween. As such, aside from matching of colors, correspondence should be understood to mean any pattern, text, symbol, or other visual-detectable element that would be understood to reveal an association between the two or more visual indicators.

[0060] More specifically, in Figures 13 and 14, the controller associates the first instrument port 56 with the first footswitch port 64, and the controller activates one or more of instrument visual indicators 80 of the associated first instrument port 56 and one or more of the footswitch visual indicators 162 of the first footswitch port 64 to display outputs corresponding with one another. In the illustrated embodiment, the controller activates the instrument visual indicators 80 of the associated first instrument port 56 and the footswitch visual indicators 162 of the first footswitch port 64 to emit colors that match one another.

[0061] The instrument visual indicator 80 of the associated first instrument port 56 on the console 32 may comprise the light emitter as shown in Figure 7 in the form of the LEDs 146 and ring-shaped light guide 152. The ring-shaped light guide 152 may be coupled to the console 32 and surround the first instrument port 56. The ring-shaped light guide 152 may comprise two arcuate light emitter portions 158, 160 on opposing sides of the first instrument port 56, with one light emitter portion 158 adjacent to the other light emitter portion 160. While Figure 14 illustrates

the light emitter portion 158 positioned above the light emitter portion 160 in a vertical arrangement, it is contemplated that the light emitter portions 158, 160 can be positioned lateral to one another in a side-by-side arrangement or in any other suitable arrangement. In this embodiment, each one of the LEDs 146 comprises a multi-colored light emitter configured to emit a plurality of colored lights. The controller 68 may activate the LEDs 146 to emit a colored light through both light emitter portions 158, 160 that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LEDs 146 to emit a blue light through both light emitter portions 158, 160 to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0062] The footswitch visual indicator 162 of the first footswitch port 64 on the console 32 may comprise a light emitter 202 as shown in Figure 7 in the form of the LEDs 206 and ring-shaped light guide 210. The ring-shaped light guide 210 may be coupled to the console 32 and surround the first footswitch port 64. The ring-shaped light guide 210 can comprise two arcuate light emitter portions 214, 216 on opposing sides of the first footswitch port 64, with one light emitter portion 214 adjacent to the other light emitter portion 216. While Figure 14 illustrates the light emitter portion 214 positioned above the light emitter portion 216 in a vertical arrangement, it is contemplated that the light emitter portions 214, 216 can be positioned lateral to one another in a side-by-side arrangement or in any other suitable arrangement. In this embodiment, each one of the LEDs 206 comprises a multi-colored light emitter configured to emit a plurality of colored lights. The controller may activate the LEDs 206 to emit a colored light that matches the colored light emitted by any one or more of the instrument visual indicators 80 on the console 32, the plug

42, the connector line 36, and the instrument 22. In the illustrated embodiment, the controller may activate the LEDs 206 to emit blue light through both light emitter portions 214, 216 to match the blue light emitted by the instrument visual indicators 80 on each one of the console 32, the plug 42, the connector line 36, and the footswitch 28.

[0063] The instrument visual indicators 80 coupled to the plug 42 of the first connector line 36 may comprise the light emitter 86 of Figure 4 in the form of LED 92 and ring-shaped light guide 98. The LED 92 may comprise the multi-colored light emitter configured to emit a plurality of colored lights. The controller may activate the LED 92 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and/or the footswitch 28. In the illustrated embodiment, the controller 68 activates the LED 92 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0064] The footswitch visual indicators 162 coupled to the plug 52 of the connector line 48 may comprise the light emitter 170 of Figure 8 in the form of the LED 174 and ring-shaped light guide 177. In the illustrated embodiment, the LED 174 may comprise the multi-colored light emitters configured to emit a plurality of colored lights. The controller 68 may activate the LED 174 to emit a colored light that matches the colored light emitted by any one or more of the instrument visual indicators 80 on the console 32, the plug 42, the connector line 36, and the instrument 22. In the illustrated embodiment, the controller 68 may activate the LED 174 to emit blue light to match the blue light emitted by the instrument visual indicators 80 on each one of the console 32, the plug 42, the connector line 36, and the footswitch 28.

[0065] Instrument visual indicators 80 integrated or embedded within one or both ends of the connector line may comprise the light emitter 104 of Figure 5 in the form of the LEDs 110 and/or fiber optic/light strips 116 coupled to opposing ends of the connector line 36. In the illustrated embodiment, the LEDs 110 may comprise multi-colored light emitters configured to emit a plurality of colored lights. The controller may activate the LEDs 110 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LEDs 110 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0066] Footswitch visual indicators 162 integrated or embedded within one or both ends of the connector line 48 may comprise the light emitters 178 of Figure 9 in the form of the LEDs 182 and fiber optic strips 186 coupled to opposing ends of the connector line 48. In the illustrated embodiment, the LEDs 182 may comprise multi-colored light emitter configured to emit a plurality of colored lights. The controller 68 may activate the LEDs 182 to emit a colored light that matches the colored light emitted by any one or more of the instrument visual indicators 80 on the console 32, the plug 42, the connector line 36, and the instrument 22. In the illustrated embodiment, the controller 68 may activate the LEDs 182 to emit blue light to match the blue light emitted by the instrument visual indicators 80 on each one of the console 32, the plug 42, the connector line 36, and the footswitch 28.

[0067] Instrument visual indicators 80 integrated or embedded within the first handheld surgical instrument 22 may comprise the light emitters 122 of Figure 6 in the form of the LED 128 and ring-shaped light guide 134. In the illustrated embodiment, the LED 128 may comprise a

multi-colored light emitter configured to emit a plurality of colored lights. The controller 68 may activate the LED 128 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LED 128 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0068] Footswitch visual indicators 162 integrated or embedded in the first footswitch 28 may comprise a light emitter 190 of Figure 10 in the form of the LED 194 and ring-shaped light guide 198. In the illustrated embodiment, the LED 194 may comprise a multi-colored light emitter configured to emit a plurality of colored lights. The controller 68 may activate the LEDs 194 to emit a colored light that matches the colored light emitted by any one or more of the instrument visual indicators 80 on the console 32, the plug 42, the connector line 36, and the instrument 22. In the illustrated embodiment, the controller 68 may activate the LEDs 194 to emit blue light to match the blue light emitted by the instrument visual indicators 80 on each one of the console 32, the plug 42, the connector line 36, and the footswitch 28.

[0069] It is contemplated that the visual indicators on any one or more of the console 32, plugs, connector lines, instruments, and/or footswitches may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the visual indicator takes the form of the touchscreen panel or display 62 on the console 32, the display 62 can show a colored icon 74, symbol, illustration, or verbal description of the type of association that corresponds with the output of the footswitch visual indicator. In the illustrated embodiment, the controller 68 may activate the display 62 to show the icon 74 in a position that is aligned with or adjacent to the associated first instrument port 56, and in a color

that matches the colored light emitted from the footswitch visual indicator 162. Other embodiments of the visual indicators may comprise any number or type of visual indicators coupled to any portion(s) of the console 32, plugs, connector lines, instruments, and/or footswitches. In addition, other embodiments of any one or more of the console 32, plugs, connector lines, instruments, and/or footswitches, which do not comprise visual indicators, are also contemplated.

[0070] Referring to Figures 15 and 16, the controller 68 associates the second instrument port 58 with the first footswitch port 64, and the controller 68 activates one or more instrument visual indicators 82 of the associated second instrument port 58 and one or more footswitch visual indicators 162 of the first footswitch port 64 to display outputs corresponding with one another. In the illustrated embodiment, the controller activates the instrument visual indicators 82 of the associated instrument port 58 and the footswitch visual indicator 162 of the first footswitch port 64 to emit colors that match one another. The first footswitch port 64, plug 52, connector line 48, footswitch 28, and footswitch visual indicators 162 may be similar to those provided in the description for Figures 13 and 14.

[0071] The instrument visual indicator 82 of the associated second instrument port 58 on the console 32 may comprise the light emitter 142 of Figure 7 in the form of the LEDs 148 and ring-shaped light guide 154. The ring-shaped light guide 154 may be coupled to the console 32 and surround the second instrument port 58. The ring-shaped light guide 154 can comprise two arcuate light emitter portions 158, 160 on opposing sides of the second instrument port 58, with one light emitter portion 158 adjacent to the other light emitter portion 160. While Figure 9 illustrates the light emitter portion 158 positioned above the light emitter portion 160 in a vertical arrangement, it is contemplated that the light emitter portions 158, 160 can be positioned lateral to

one another in a side-by-side arrangement or in any other suitable arrangement. In this embodiment, each one of the LEDs 148 comprises a multi-colored light emitter configured to emit a plurality of colored lights. The controller may activate the LEDs 148 to emit a colored light through both light emitter portions 158, 160 that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LEDs 148 to emit a blue light through both light emitter portions 158, 160 to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0072] The instrument visual indicator 82 coupled to the plug 44 may comprise the light emitter 88 of Figure 4 in the form of the LED 94 and ring-shaped light guide 100. The LED 94 may comprise the multi-colored light emitter configured to emit a plurality of colored lights. The controller may activate the LED 94 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LED 94 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0073] Instrument visual indicators 82 integrated or embedded within one or both ends of the connector line 38 may comprise the light emitter 106 of Figure 5 in the form of the LEDs 112 and fiber optic strips 118 coupled to opposing ends of the connector line 38. In the illustrated embodiment, the LEDs 112 may comprise multi-colored light emitters configured to emit a plurality of colored lights. The controller may activate the LEDs 112 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the

console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LEDs 112 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0074] Instrument visual indicators 82 integrated or embedded within the first handheld surgical instrument 24 may comprise the light emitter 124 of Figure 6 in the form of the LED 130 and ring-shaped light guide 136. In the illustrated embodiment, the LED 130 may comprise a multi-colored light emitter configured to emit a plurality of colored lights. The controller may activate the LED 130 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LED 130 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0075] It is contemplated that the visual indicators on any one or more of the console 32, plugs, connector lines, instruments, and/or footswitches may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the visual indicator takes the form of the touchscreen panel or display 62 on the console 32, the display 62 can show a colored icon 74, symbol, illustration, or verbal description of the type of association that corresponds with the output of the footswitch visual indicator. In the illustrated embodiment, the controller 68 may activate the display 62 to show the icon 74 in a position that is aligned with or adjacent to the associated first instrument port 56, and in a color that matches the colored light emitted from the footswitch visual indicator 162. Other embodiments of the visual indicators may comprise any number or type of visual indicators

coupled to any portion(s) of the console 32, plugs, connector lines, instruments, and/or footswitches. In addition, other embodiments of any one or more of the console 32, plugs, connector lines, instruments, and/or footswitches, which do not comprise visual indicators, are also contemplated.

[0076] Referring to Figures 17 and 18, the controller 68 associates the third instrument port 60 with the first footswitch port 64, and the controller 68 activates one or more instrument visual indicators 80 of the associated third instrument port 60 and one or more footswitch visual indicators 162 of the first footswitch port 64 to display outputs corresponding with one another. In the illustrated embodiment, the controller activates the instrument visual indicators 80 of the associated instrument port 60 and the footswitch visual indicator 162 of the first footswitch port 64 to emit colors that match one another. In the illustrated embodiment, the first footswitch port 64, plug 52, connector line 48, footswitch 28, and footswitch visual indicators 162 are similar to those provided in the description for Figures 13 and 14.

[0077] The instrument visual indicator 84 of the associated third instrument port 60 on the console 32 may comprise the light emitter 144 of Figure 7 in the form of the LEDs 150 and ring-shaped light guide 156. The ring-shaped light guide 156 may be coupled to the console 32 and surround the third instrument port 60. The ring-shaped light guide 156 can comprise two arcuate light emitter portions 158, 160 on opposing sides of the third instrument port 60, with one light emitter portion 158 adjacent to the other light emitter portion 160. While Figure 11 illustrates the light emitter portion 158 positioned above the light emitter portion 160 in a vertical arrangement, it is contemplated that the light emitter portions 158, 160 can be positioned lateral to one another in a side-by-side arrangement or in any other suitable arrangement. In this embodiment, each one of the LEDs 150 comprises a multi-colored light emitter configured to emit a plurality of colored

lights. The controller may activate the LEDs 150 to emit a colored light through both light emitter portions 158, 160 that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller 68 activates the LEDs 150 to emit a blue light through both light emitter portions 158, 160 to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0078] The instrument visual indicator 84 coupled to the plug 46 may comprise the light emitter 90 of Figure 4 in the form of LED 96 and ring-shaped light guide 102. The LED 96 may comprise multi-colored light emitters configured to emit a plurality of colored lights. The controller may activate the LEDs 96 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller activates the LED 96 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0079] Instrument visual indicators 84 integrated or embedded within one or both ends of the connector line 40 may comprise the light emitters 108 of Figure 5 in the form of the LEDs 114 and fiber optic strips 120 coupled to opposing ends of the connector line 40. In the illustrated embodiment, the LEDs 114 may comprise multi-colored light emitters configured to emit a plurality of colored lights. The controller may activate the LEDs 114 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller activates the LEDs 114 to emit a blue light to match the blue light

emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0080] Instrument visual indicators 84 integrated or embedded within the third handheld surgical instrument 26 may comprise the light emitter 126 of Figure 6 in the form of the LED 132 and ring-shaped light guide 138. In the illustrated embodiment, the LED 132 may comprise the multi-colored light emitter configured to emit a plurality of colored lights. The controller may activate the LED 132 to emit a colored light that matches a colored light emitted by any one or more of the footswitch visual indicators 162 on the console 32, the plug 52, the connector line 48, and the footswitch 28. In the illustrated embodiment, the controller activates the LED 132 to emit a blue light to match the blue light emitted by the footswitch visual indicators 162 on each one of the console 32, the plug 52, the connector line 48, and the footswitch 28.

[0081] It is contemplated that the visual indicators on any one or more of the console 32, plugs, connector lines, instruments, and/or footswitches may take a variety of forms, including but not limited to, light emitters, fiber optic strips, displays, electromechanical devices, etc. For instance, if the visual indicator takes the form of the touchscreen panel or display 62 on the console 32, the display 62 can show a colored icon 74, symbol, illustration, or verbal description of the type of association that corresponds with the output of the footswitch visual indicator. In the illustrated embodiment, the controller 68 may activate the display 62 to show the icon 74 in a position that is aligned with or adjacent to the associated first instrument port 56, and in a color that matches the colored light emitted from the footswitch visual indicator 162. Other embodiments of the visual indicators may comprise any number or type of visual indicators coupled to any portion(s) of the console 32, plugs, connector lines, instruments, and/or footswitches. In addition, other embodiments of any one or more of the console 32, plugs,

connector lines, instruments, and/or footswitches, which do not comprise visual indicators, are also contemplated.

[0082] Referring to Figures 19 and 20, the system 20 has a similar configuration as the one illustrated in Figures 13 and 14 because the system 20 includes connector 48, 36 coupled to the footswitch port 64 and the associated instrument port 56. More specifically, as described above, the controller activates the footswitch visual indicators 162 on the console 32, plug 52, connector line 48, and footswitch 28 and the instrument visual indicators 80 on the associated instrument port 56 of the console 32, the plug 42, to display outputs that correspond with one another to indicate the mapping between the ports 64, 56.

[0083] Furthermore, in Figures 19 and 20, the system 20 may include a second footswitch connector line 50 for a second footswitch 30 being connected to the second footswitch port 66, and the second connector line 38 for the second instrument 24 being connected to the second instrument port 58. The controller 68 may associate the second instrument port 58 with the second footswitch port 66. The controller may activate the second footswitch visual indicators 164 for the second footswitch port 66, second plug 54, second connector line 50, and/or second footswitch 30 and the second instrument visual indicators 82 for the associated second instrument port 58, second plug 44, second connector line 38, and/or second instrument 24 to display outputs that correspond with one another to indicate the association between the ports 66, 58. In the illustrated embodiment, the controller may activate the LEDs 208 of the second footswitch visual indicator 164 to emit a colored light, and the controller 68 may activate the LEDs 148 of the instrument visual indicator 82 to emit a colored light that matches the colored light emitted by the LEDs 208. More specifically, in the illustrated embodiment, the controller 68 may activate the LEDs 208, 148 to emit orange light to indicate that the ports 58, 66 are associated with one another.

[0084] Referring to Figures 21 and 22, the system 20 is disposed in a configuration similar to the one illustrated in Figures 19 and 20. However, while Figures 19 and 20 illustrate connector lines 48, 36 coupled to a respective one of the footswitch port 64 and the associated instrument port 56, the system illustrated in Figures 14 and 15 does not comprise the connector lines 48, 36. The footswitch port 64 is not associated with the instrument port 56, and the footswitch visual indicator 162 of the footswitch port 64 and the instrument visual indicator 80 of the instrument port 56 do not emit any light.

[0085] Referring to Figures 23 and 24, the system 20 may be disposed in dual control mode. While the system 20 may be configured similar to the one illustrated in Figures 19 and 20, the system 20 associates the first instrument port 56 with both the first and second footswitch ports 64, 66. In addition, the system 20 activates the first footswitch visual indicator 162 of the first footswitch port 64 to emit blue light, the second footswitch visual indicator 82 of the second footswitch port 66 to emit orange light, and the first instrument visual indicator 80 of the associated first instrument port 56 to emit blue light and orange light to indicate that the associated instrument port 56 is associated with the first and second footswitch ports 64, 66. While the system of Figures 23 and 24 further includes second and third connector lines 38, 40 of second and third instruments 24, 26 being connected to the second and third instrument ports 58, 60, the controller does not associate the second and third instrument ports 58, 60 with either one of the footswitch ports 64, 66. Furthermore, the controller 68 activates the second and third instrument visual indicators 82, 84 on the second and third instrument ports 58, 60, second and third plugs 44, 46, second and third connector lines 38, 40, and second and third instruments 24, 26 to emit white light to indicate that the second and third instrument ports 58, 60 are not associated with either one of the footswitch ports 64, 66.

[0086] It will be further appreciated that the terms “include,” “includes,” and “including” have the same meaning as the terms “comprise,” “comprises,” and “comprising.”

[0087] Several embodiments have been discussed in the foregoing description. However, the embodiments discussed herein are not intended to be exhaustive or limit the disclosure to any particular form. The terminology which has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations are possible in light of the above teachings and the disclosure may be practiced otherwise than as specifically described.

[0088] Embodiments of the disclosure can be described with reference to the following numbered clauses.

I. A surgical console comprising
a plurality of instrument ports,
a footswitch port and

a controller configured to associate said footswitch port with one of said instrument ports such that said footswitch is operable to actuate a function of said handheld surgical instrument connected to said associated instrument port;

said controller further configured to activate a footswitch visual indicator and a instrument visual indicator of said associated instrument port to display outputs that correspond with one another.

II. A console-based surgical system comprising:

a plurality of handheld surgical instruments, each instrument having an instrument visual indicator coupled to said instrument;

a footswitch having a footswitch visual indicator coupled to said footswitch; and
a console comprising:

a plurality of instrument ports, said connector lines of said plurality of handheld instruments being connected to said plurality of instrument ports;

a footswitch port; and

a controller configured to associate said footswitch port with one of said instrument ports such that said footswitch is operable to actuate a function of said handheld surgical instrument connected to said associated instrument port;

said controller further configured to activate said footswitch visual indicator and said instrument visual indicator of said associated instrument port to display outputs that correspond with one another.

CLAIMS

What is claimed is:

1. A console-based surgical system comprising:
 - a plurality of handheld surgical instruments, each instrument having a connector line and an instrument visual indicator coupled to one of said instrument and said connector line;
 - a footswitch having a connector line and a footswitch visual indicator coupled one of said footswitch and said connector line; and
 - a console comprising:
 - a plurality of instrument ports, said connector lines of said plurality of handheld instruments being connected to said plurality of instrument ports;
 - a footswitch port, said connector line of said footswitch connected to said footswitch port; and
 - a controller configured to associate said footswitch port with one of said instrument ports such that said footswitch is operable to actuate a function of said handheld surgical instrument connected to said associated instrument port;
 - said controller further configured to activate said footswitch visual indicator and said instrument visual indicator of said associated instrument port and associated footswitch port to display outputs that correspond with one another.
2. The console-based surgical system of claim 1 wherein each one of said instrument visual indicator and said footswitch visual indicator comprises a light emitter.

3. The console-based surgical system of claim 2 wherein said light emitter of one of said instrument visual indicator and said footswitch visual indicator comprises a ring-shaped light guide.
4. The console-based surgical system of any one of claims 2 or 3 wherein said light emitters of said footswitch visual indicator and said instrument visual indicator are configured to emit colors that match one another when said footswitch visual indicator and said instrument visual indicator display outputs that correspond with one another.
5. The console-based surgical system of any one of claims claim 2, 3, or 4, wherein said light emitter comprises at least one of a LED, a fiber optic, and combinations thereof.
6. The console-based surgical system of any one of the preceding claims further comprising a user input device coupled to the controller and actuatable by a user to output a user output signal to cause said controller to associate said footswitch port with said associated instrument port.
7. The console-based surgical system of any one of the preceding claims further comprising:
 - a second footswitch having a connector line and a second footswitch visual indicator coupled one of said second footswitch and said connector line;
 - said console further comprising a second footswitch port, said connector line of said second footswitch connected to said second footswitch port;
 - said controller further configured to associate said second footswitch port with said associated instrument port such that said second footswitch is operable to actuate said function of said handheld surgical instrument connected to said associated instrument port; and
 - said controller further configured to activate said second footswitch visual indicator and

said instrument visual indicator of said associated instrument port to display outputs that correspond with one another.

8. The console-based surgical system of any one of claim 7 further comprising:

a third footswitch visual indicator coupled to a portion of said console adjacent to said footswitch port;

a fourth footswitch visual indicator coupled to a portion of said console adjacent to said second footswitch port;

a second instrument visual indicator coupled to said console adjacent to a first instrument port of said plurality of instrument ports;

a third instrument visual indicator coupled to said console adjacent to a second instrument port of said plurality of instrument ports; and

a fourth instrument visual indicator coupled to said console adjacent to a third instrument port of said plurality of instrument ports;

said controller further configured to associate at least one of said footswitch port and second footswitch port with at least one of said first instrument port, said second instrument port, and said third instrument port, such that at least one of said first footswitch and said second footswitch is operable to actuate said function of said handheld surgical instrument connected to one of said first instrument port, said second instrument port, and said third instrument port; and

said controller further configured to activate said third footswitch visual indicator, said fourth footswitch visual indicator, said second instrument visual indicator, and said third instrument visual indicator to display outputs that correspond with one another.

9. The console-based surgical system of claim 8 wherein each one of said footswitch visual indicator, said second footswitch visual indicator, said third footswitch visual indicator, said fourth footswitch visual indicator, said instrument visual indicator, said second instrument visual indicator, said third instrument visual indicator, and said fourth instrument visual indicator comprises a light emitter.

10. The console-based surgical system of claim 9 wherein said light emitter comprises a ring-shaped light guide.

11. The console-based surgical system of any one of claims 9 or 10 wherein said light emitters are configured to emit colors that match one another when said footswitch visual indicator, said instrument visual indicator, said second footswitch visual indicator, said third footswitch visual indicator, said fourth footswitch visual indicator, said second instrument visual indicator, and said third instrument visual indicator display outputs that correspond with one another.

12. The console-based surgical system of any one of claims 9, 10, or 11 wherein said light emitter of said footswitch visual indicator is configured to emit a first colored light, said light emitter of said second footswitch visual indicator is configured to emit a second colored light, and said light emitter of said instrument visual indicator for said associated instrument port is configured to emit said first colored light and said second colored light when said footswitch visual indicator, said second footswitch visual indicator, and said instrument visual indicator of said associated instrument port display outputs that correspond with one another.

13. The console-based surgical system of any one of claims 9, 10, or 11 wherein said light emitter of said third footswitch visual indicator is configured to emit a first colored light, said light emitter of said fourth footswitch visual indicator is configured to emit a second colored light, and said light emitter of said second instrument visual indicator for said first instrument port is configured to emit said first colored light and said second colored light when said third footswitch visual indicator, said fourth footswitch visual indicator, and said second instrument visual indicator of said associated instrument port display outputs that correspond with one another.

14. The console-based surgical system of any one of claims 9, 10, 11, 12, or 13 wherein said light emitter of at least one of said first instrument port, said second instrument port, and said third instrument port comprises two light emitter portions with one of said light emitter portions adjacent to the other of said light emitter portions.

15. The console-based surgical system of claim 14 wherein each one of said light emitter portions comprises a multi-colored light emitter configured to emit a plurality of colored lights.

16. The console-based surgical system of any one of the preceding claims further comprising an input visual indicator coupled to at least one of said footswitch and said connector line coupled thereto.

17. The console-based surgical system of claim 16 wherein said controller is configured to activate said input visual indicator and said footswitch visual indicator to display outputs that correspond with one another.

18. The console-based surgical system of any one of the preceding claims further comprising an output visual indicator coupled to at least one of said handheld surgical instruments and said connector lines coupled thereto.

19. The console-based surgical system of claim 18 wherein said controller is configured to activate said output visual indicator and said instrument visual indicator of said associated instrument port to display outputs that correspond with one another.

20. A method of operating a console based surgical system, the console-based surgical system including a plurality of handheld surgical instruments, each instrument having a connector line and an instrument visual indicator coupled one of the instrument and the connector line, a footswitch having a connector line and a footswitch visual indicator coupled one of the footswitch and the connector line, a console including a plurality of instrument ports, the connector lines of the plurality of handheld instruments being connected to the plurality of instrument ports, the console further including a footswitch port, the connector line of the footswitch being connected to the footswitch port, and the console further including a controller, the method comprising:

associating the footswitch port to the instrument port such that the footswitch is operable actuate a function of the handheld surgical instrument connected to said associated instrument port; and

activating the footswitch visual indicator and the instrument visual indicator of the associated instrument port to display outputs that correspond with one another.

21. The method of claim 20 further comprising emitting colors from the footswitch visual indicator and the instrument visual indicator of the associated instrument port, with the colors matching one another.

22. The method of any one of claims 20 or 21 further comprising actuating a user input device to generate a user output signal to the controller to cause the controller to associate the footswitch port to the associated instrument port.

23. The method of claim 22, the system further comprising a second footswitch having a connector line and a second footswitch visual indicator coupled one of the second footswitch and the connector line, the console further comprising a second footswitch port, the connector line of the second footswitch connected to the second footswitch port, the method comprising:

associating the second footswitch port with the associated instrument port such that the second footswitch is operable actuate a second function of the handheld surgical instrument connected to the associated instrument port; and

activating the footswitch visual indicator, the second footswitch visual indicator, and the instrument visual indicator of the associated instrument port to display outputs that correspond with one another.

24. The method of claim 23 further comprising actuating said user input device to generate a second user output signal to associate the second footswitch port with the instrument port.

25. The method of any one of claims 23 or 24 further comprising emitting colors from the footswitch visual indicator, the second footswitch visual indicator, and the instrument visual indicator of the associated instrument port, with the colors matching one another.
26. The method of any one of claims 23, 24, or 25 further comprising:
emitting a first colored light from the footswitch visual indicator;
emitting a second colored light from the second footswitch visual indicator; and
emitting the first colored light and the second colored light from the instrument visual indicator of the associated instrument port.
27. The method of any one of the preceding claims further comprising:
activating a second footswitch visual indicator coupled to the console adjacent to the footswitch port of the console; and
activating a second instrument visual indicator coupled to the console adjacent to the one of the instrument ports of the console.
28. A console-based surgical system comprising:
a plurality of handheld surgical instruments, each of said instruments having a connector line;
a footswitch having a connector line; and
a console comprising:

a plurality of instrument ports, each of said of instrument ports having an instrument visual indicator, said connector lines of said plurality of handheld instruments being connected to said plurality of instrument ports;

a footswitch port having a footswitch visual indicator, said connector line of said footswitch being connected to said footswitch port; and

a controller configured to associate said footswitch port with one of said instrument ports such that said footswitch is operable to actuate a function of said handheld surgical instrument connected to said associated instrument port;

said controller further configured to activate said footswitch visual indicator and said instrument visual indicator of said associated instrument port and said associated footswitch port to display outputs that correspond with one another;

wherein each of said footswitch visual indicator and said instrument visual indicators comprises a light emitter, each of said light emitter and a ring shaped light guide coupled to said console to surround a corresponding one of said footswitch port and said instrument ports.

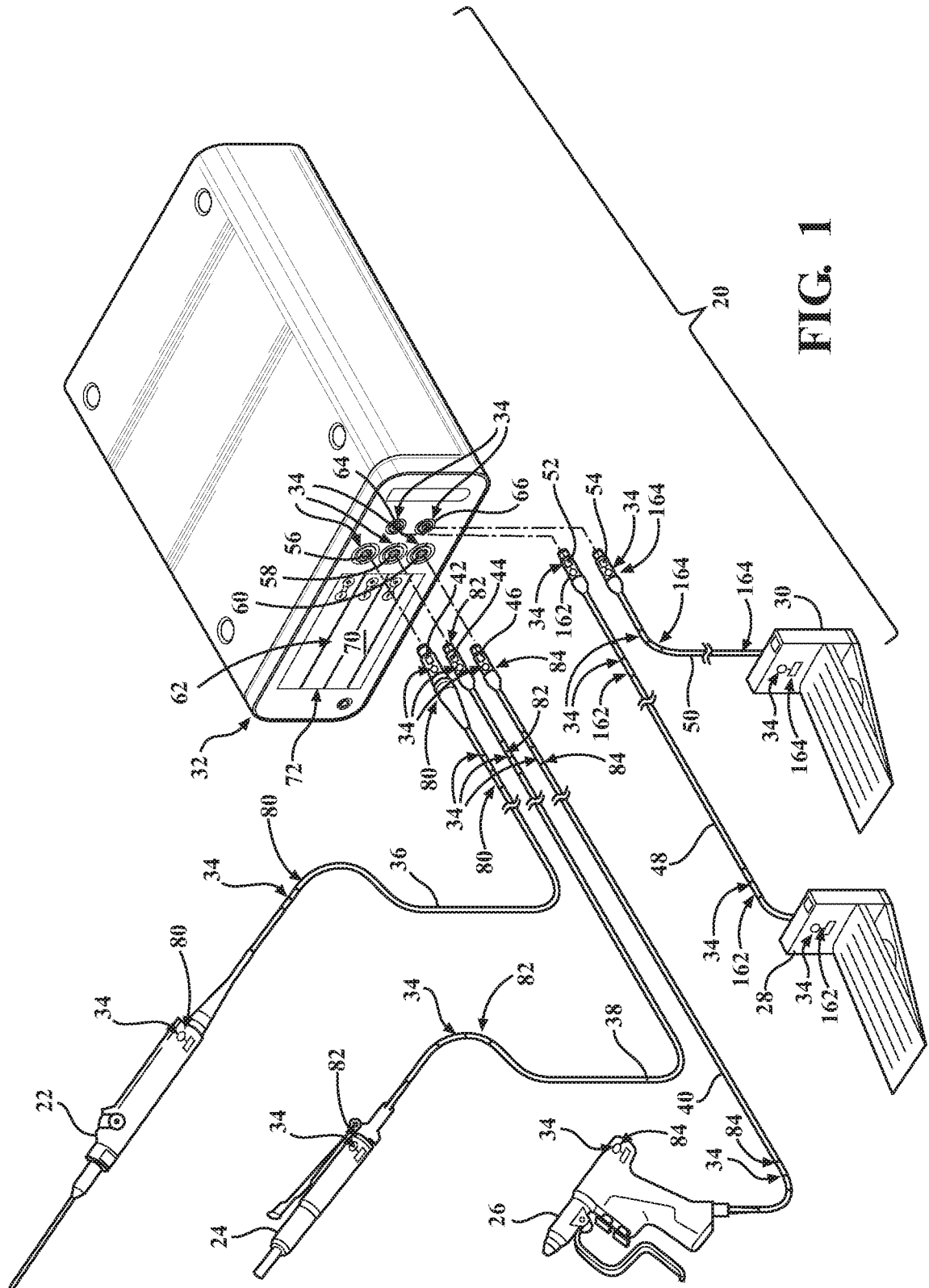
29. The console-based surgical system of claim 28 wherein said controller activates said light emitter of one of said instrument visual indicators to emit a colored light to match a colored light emitted by said footswitch visual indicator when said controller associates said footswitch port with said associated instrument port such that said footswitch is operable to actuate a function of said handheld surgical instrument connected to said associated instrument port.

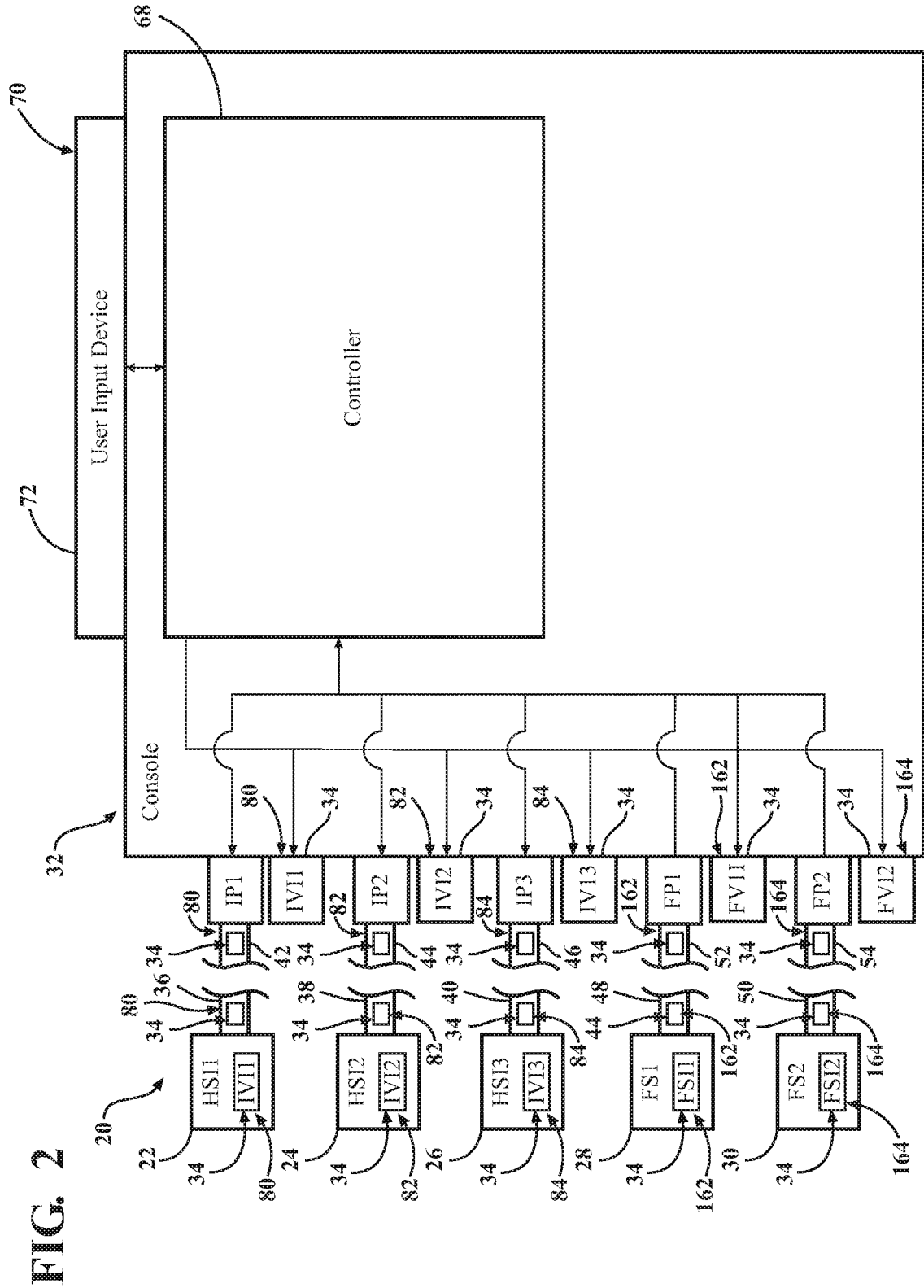
30. The console-based surgical system of claim 29 wherein said controller activates said light emitter of the other one of said instrument visual indicators to emit white light to indicate that said instrument port is not associated with said footswitch port.

31. The console-based surgical system of claim 28 wherein each of said ring-shaped light guide comprises two arcuate light emitter portions on opposing sides of the corresponding footswitch port and said instrument ports.

32. The console-based surgical system of claim 31 wherein each of said arcuate light emitter portions angularly extends approximately 180 degrees.

33. The console-based surgical system of claim 31 wherein at least one of said light emitters is a multi-colored light emitter configured to emit a plurality of colors .





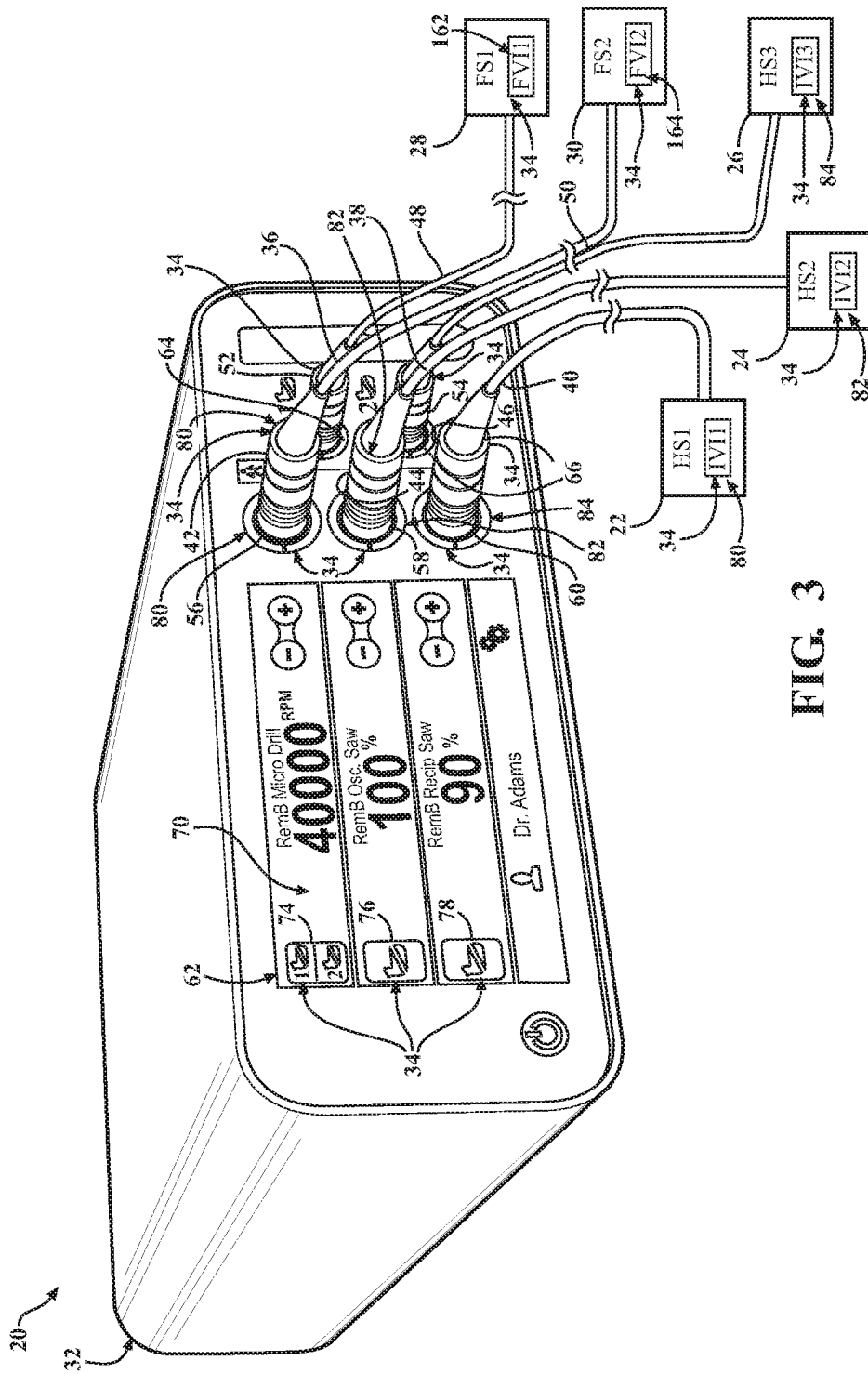


FIG. 3

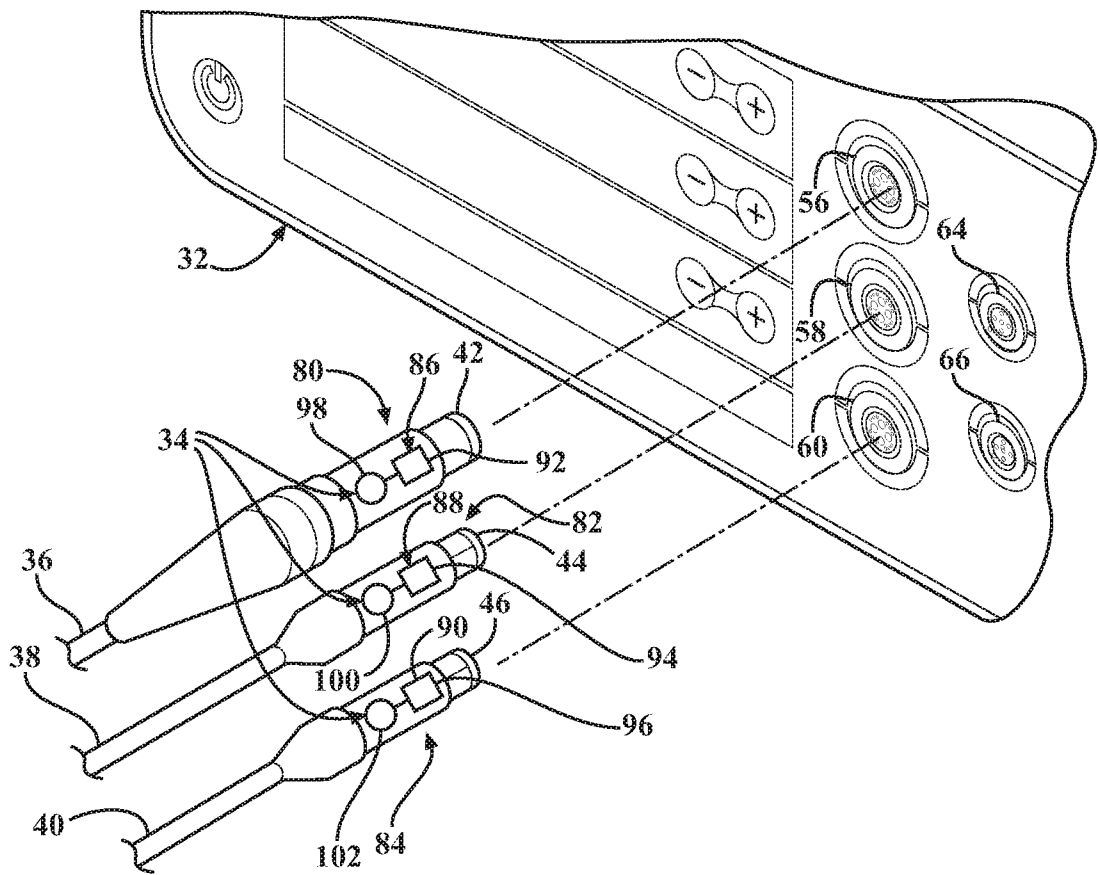


FIG. 4

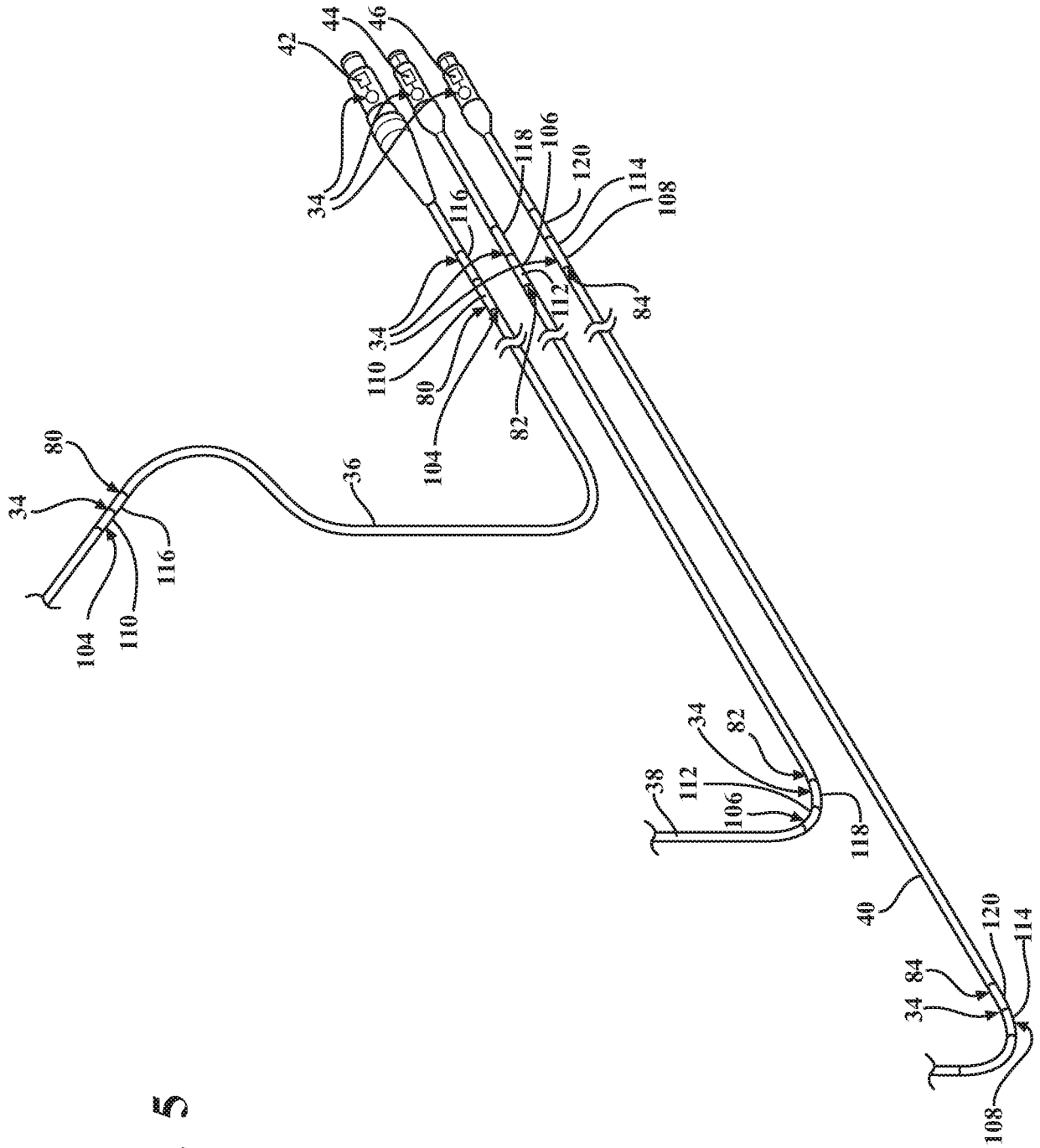


FIG. 5

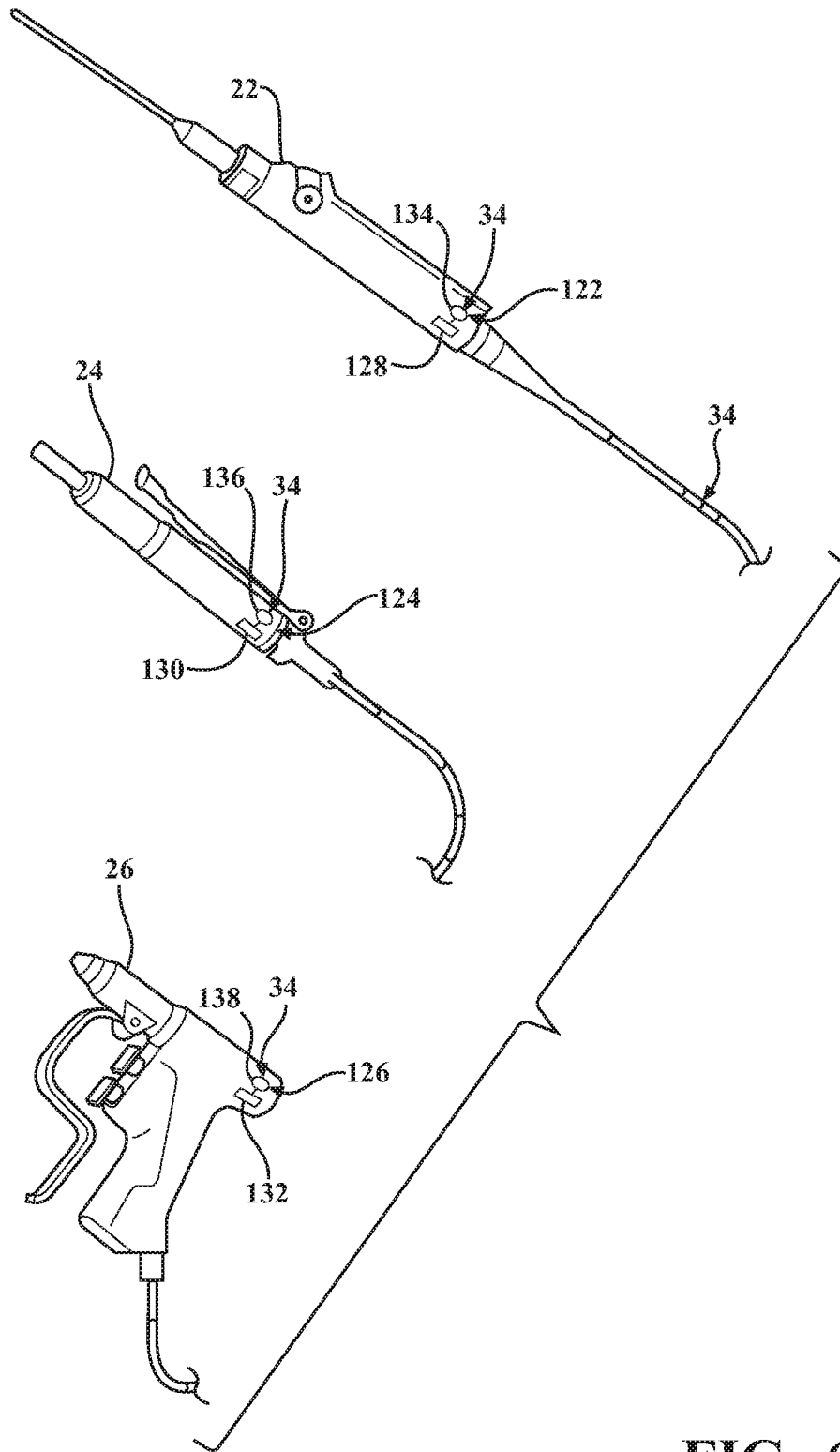


FIG. 6

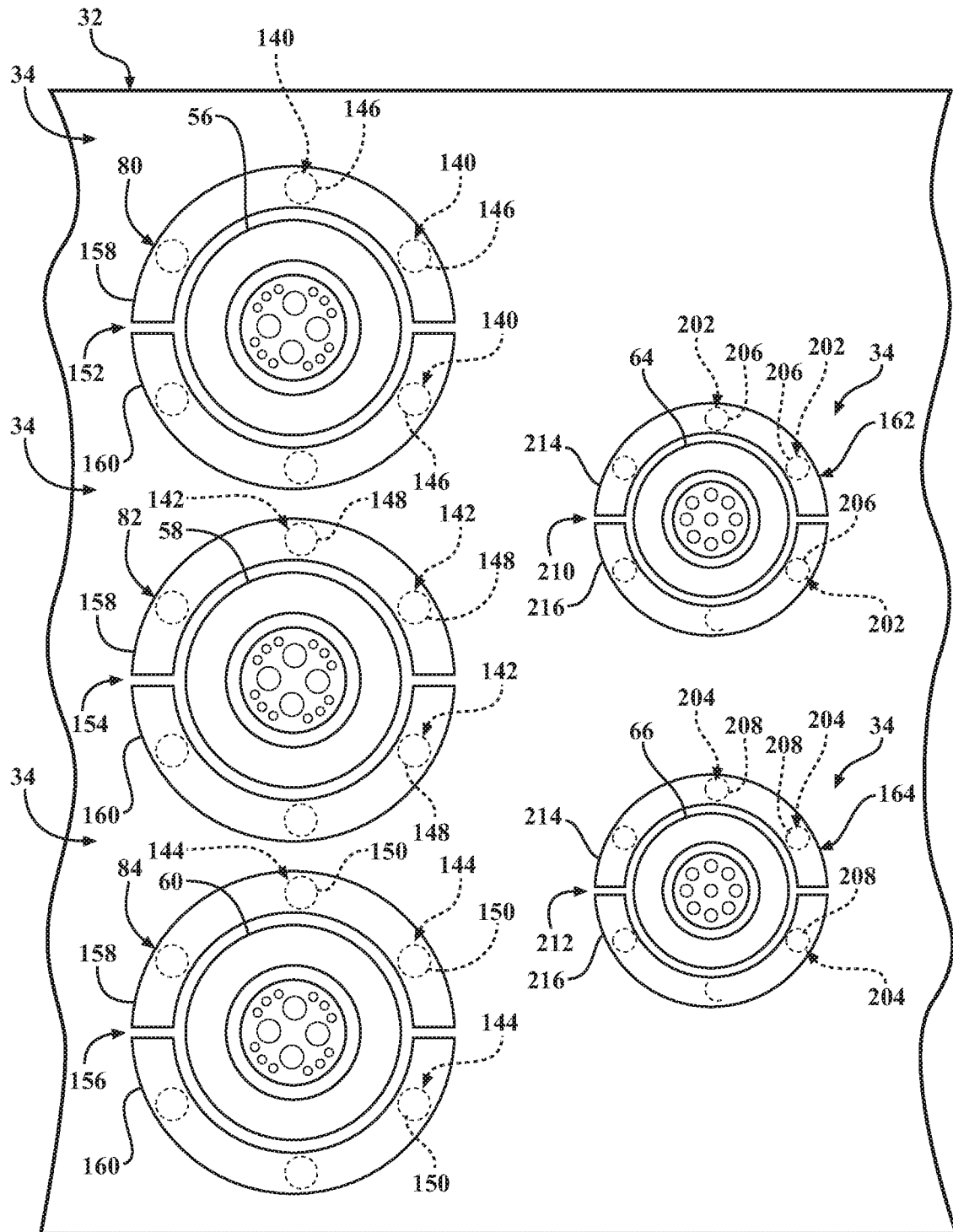


FIG. 7

FIG. 8

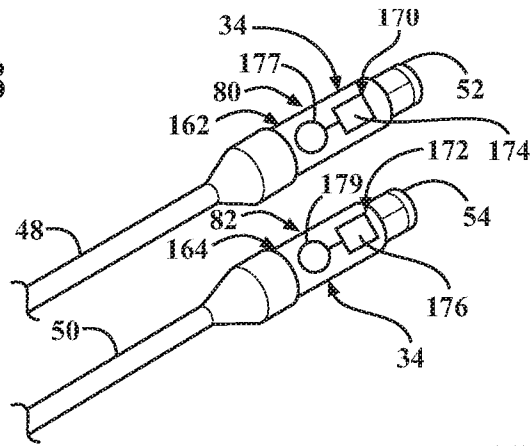


FIG. 9

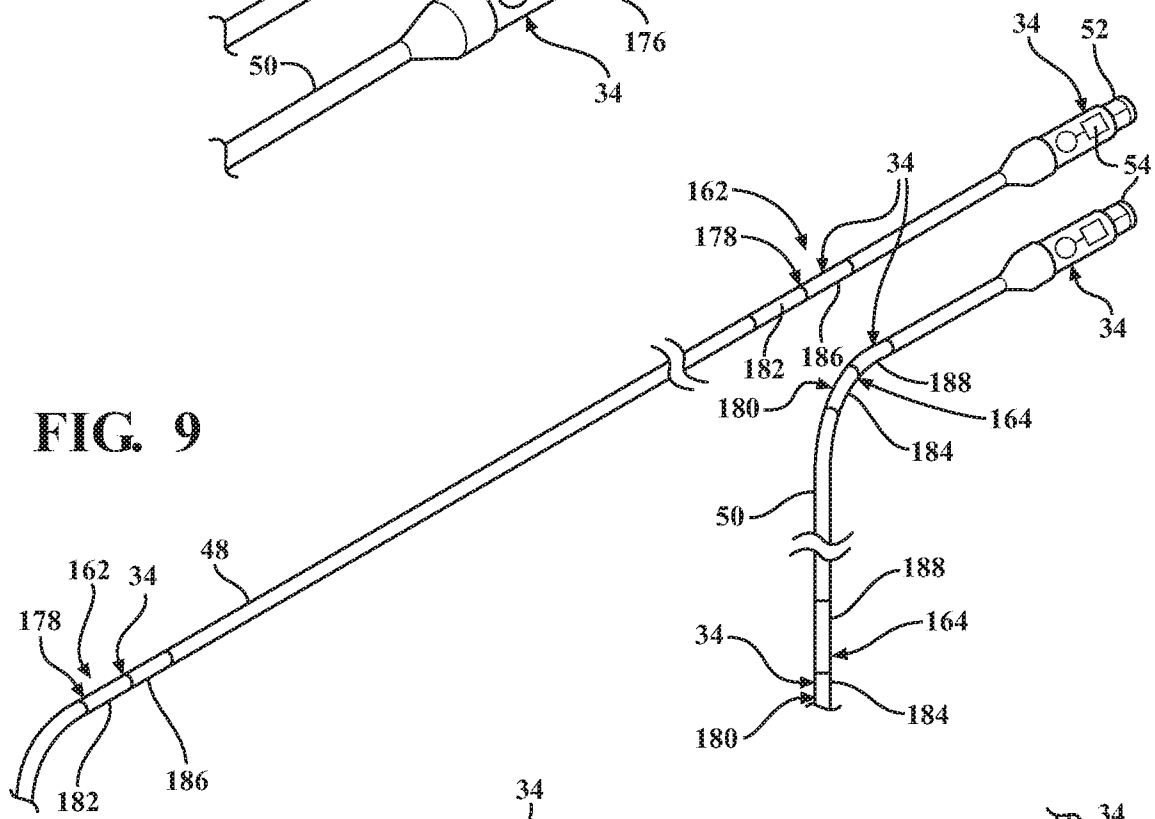


FIG. 10

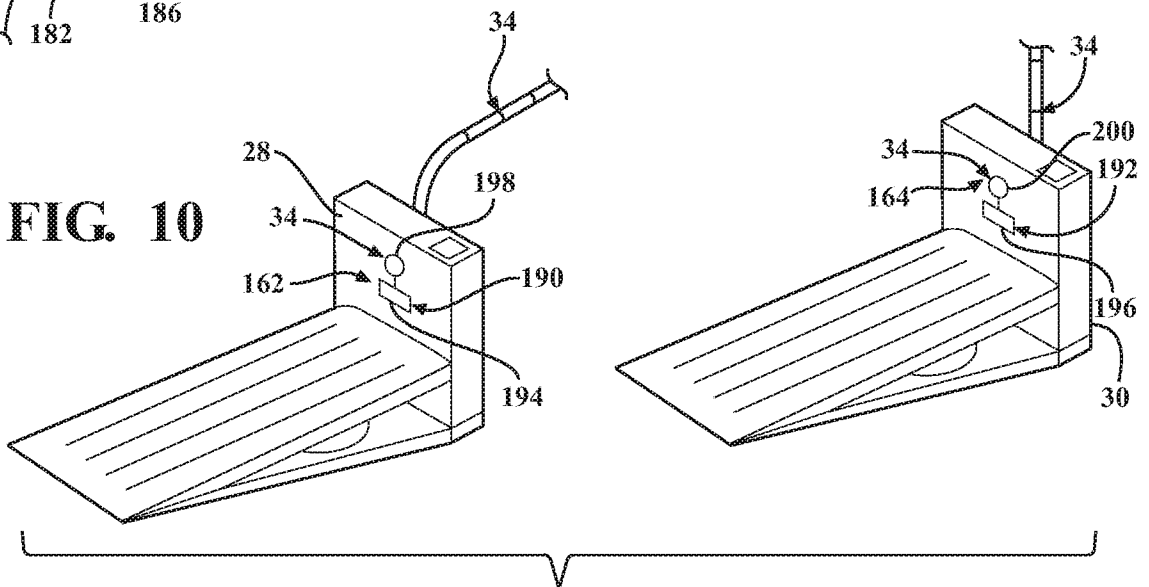


FIG. 11

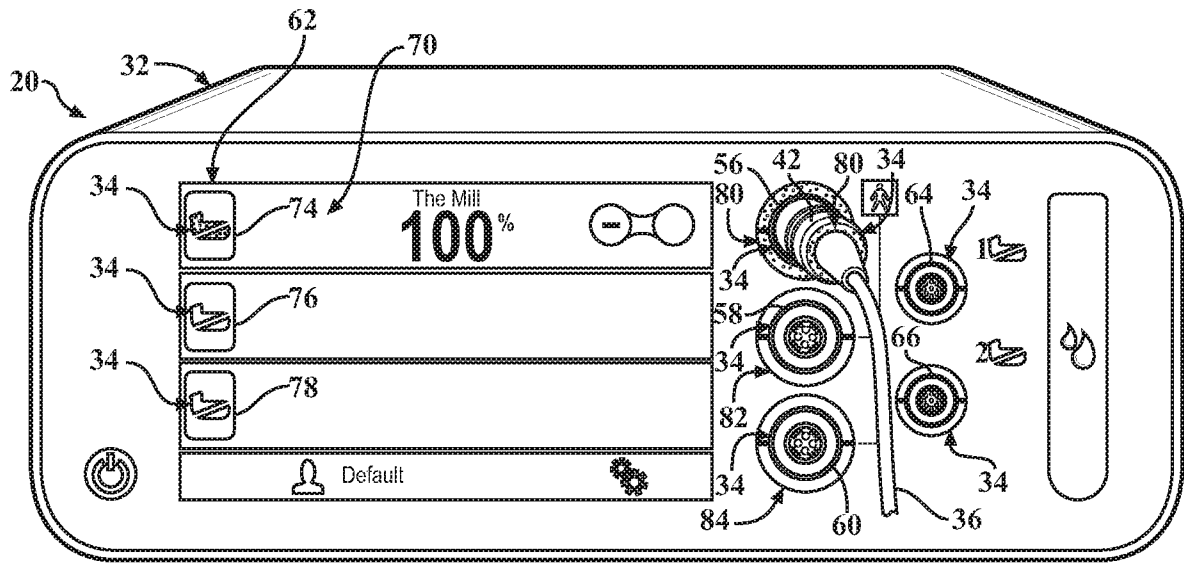


FIG. 12

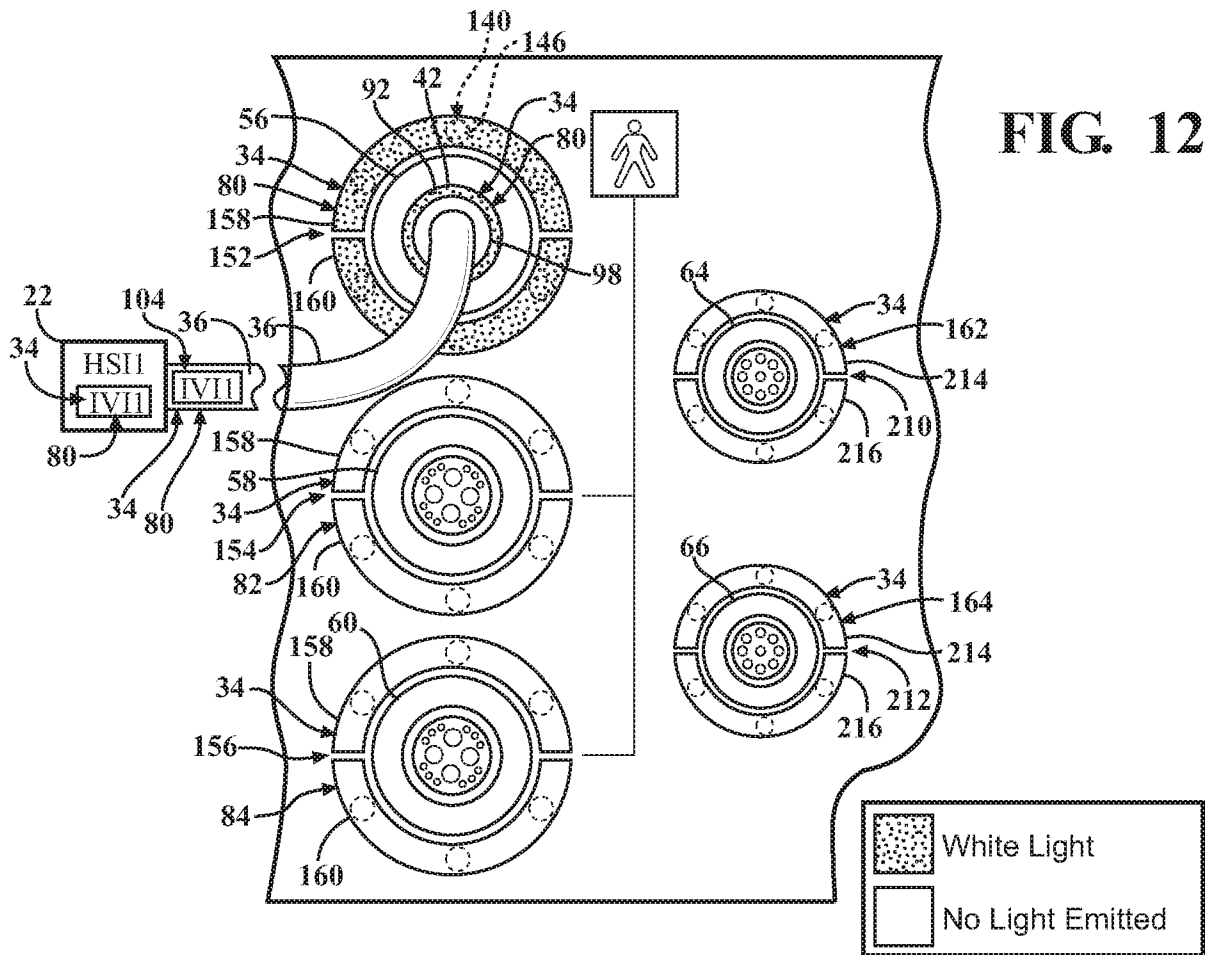


FIG. 13

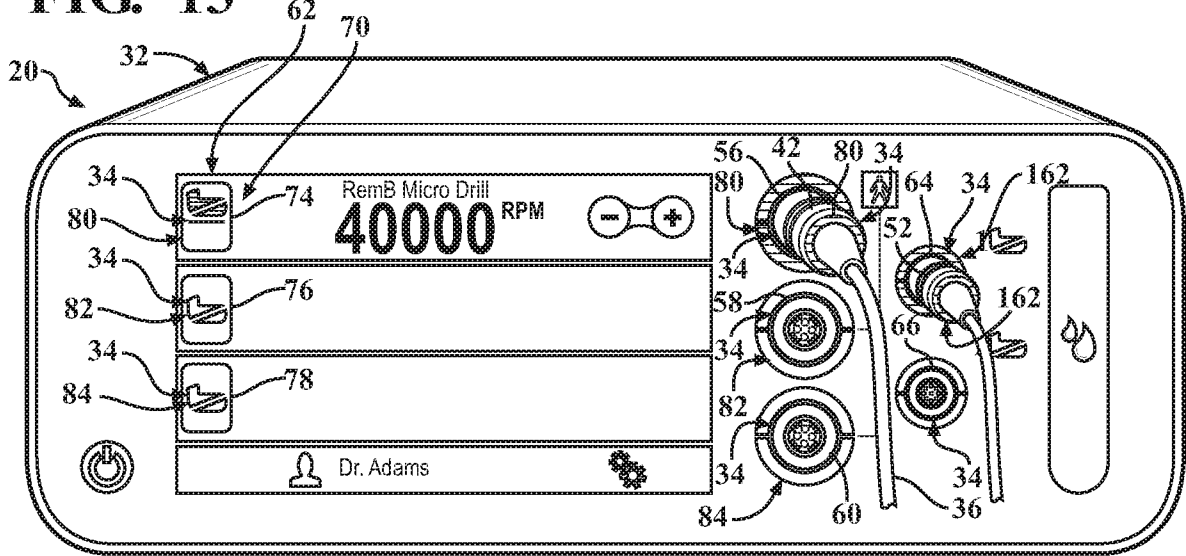


FIG. 14

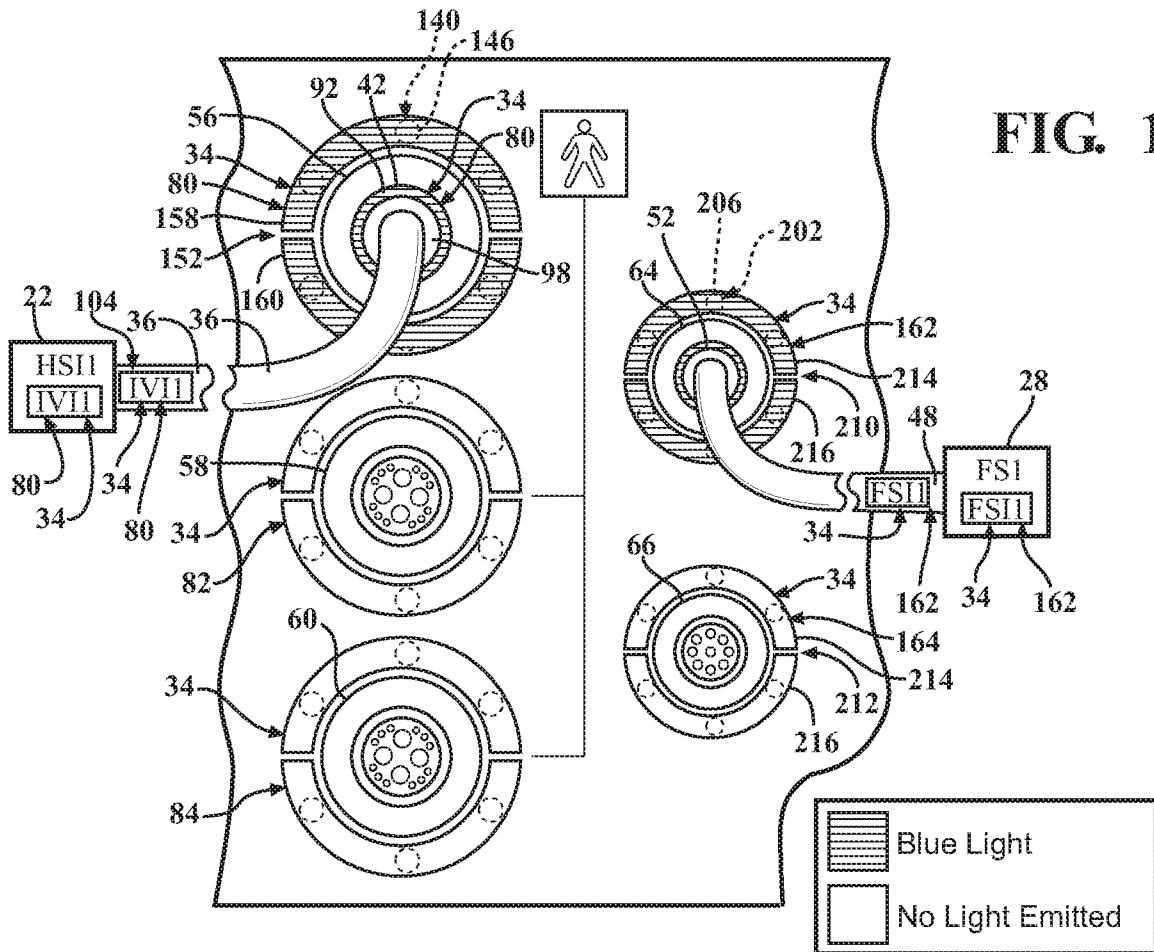


FIG. 15

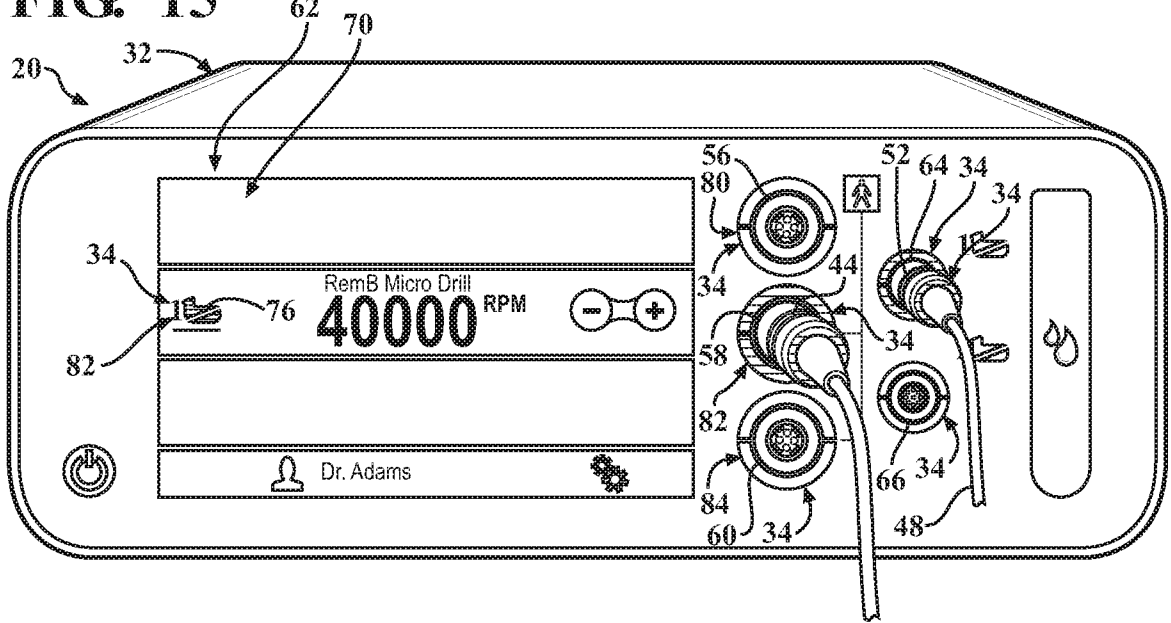


FIG. 16

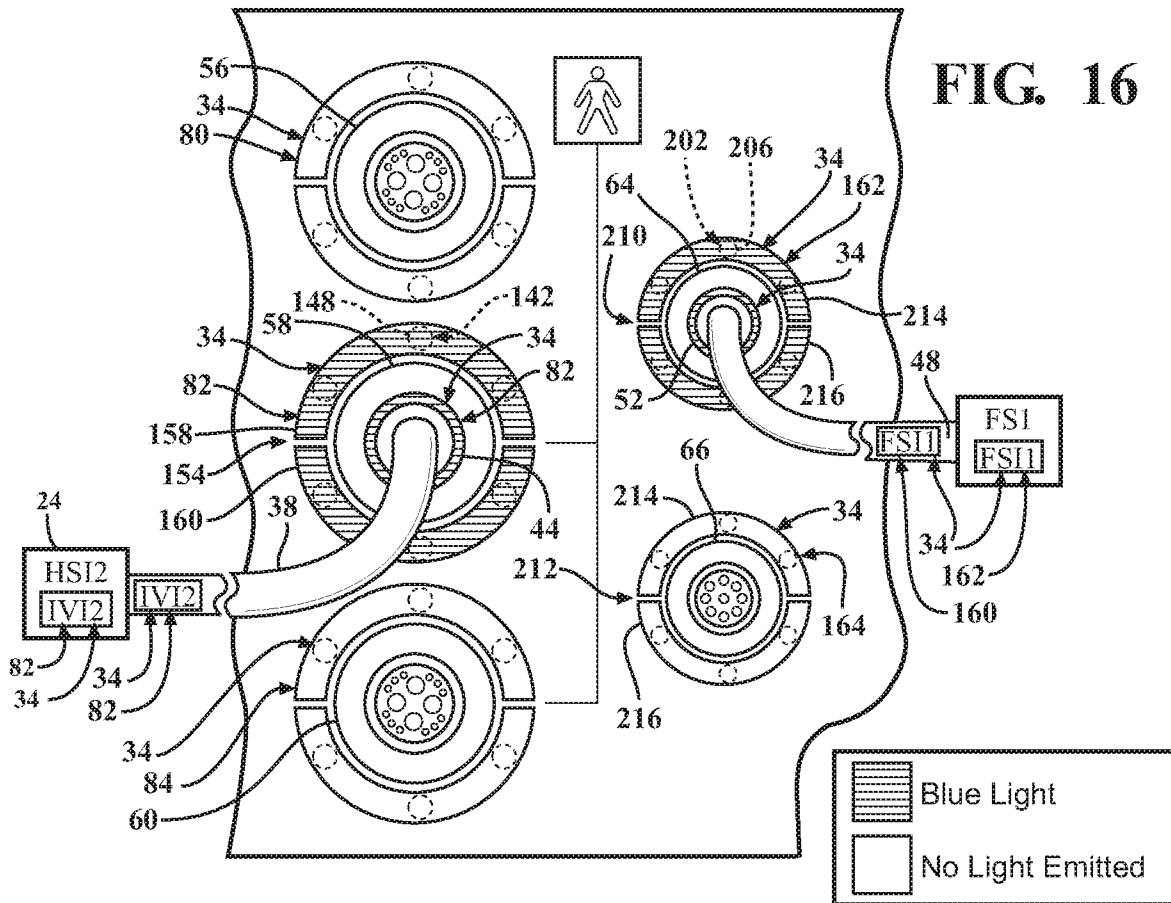


FIG. 17

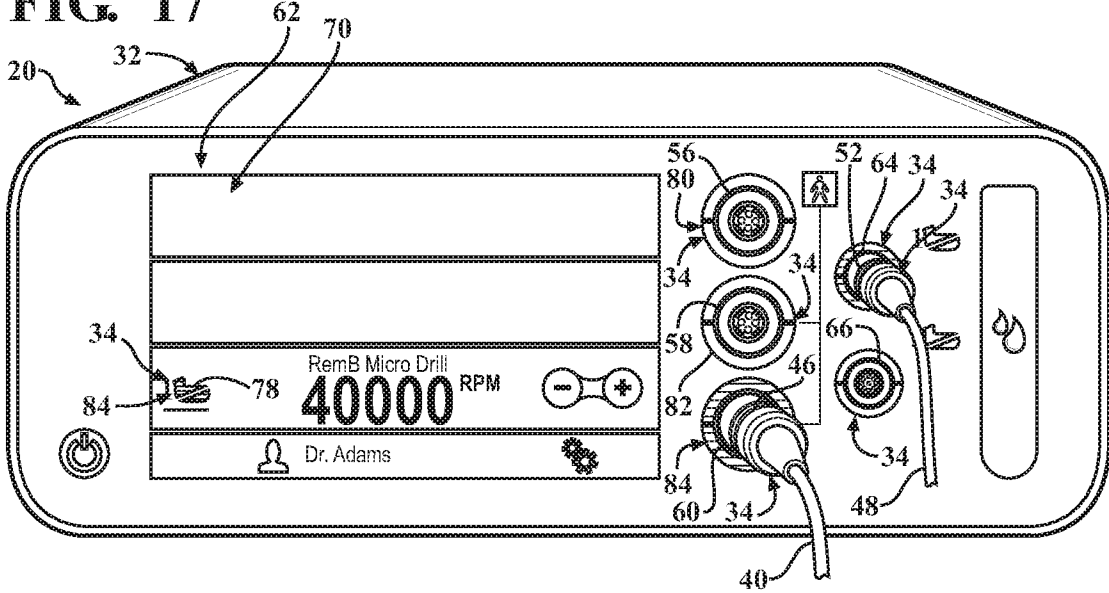


FIG. 18

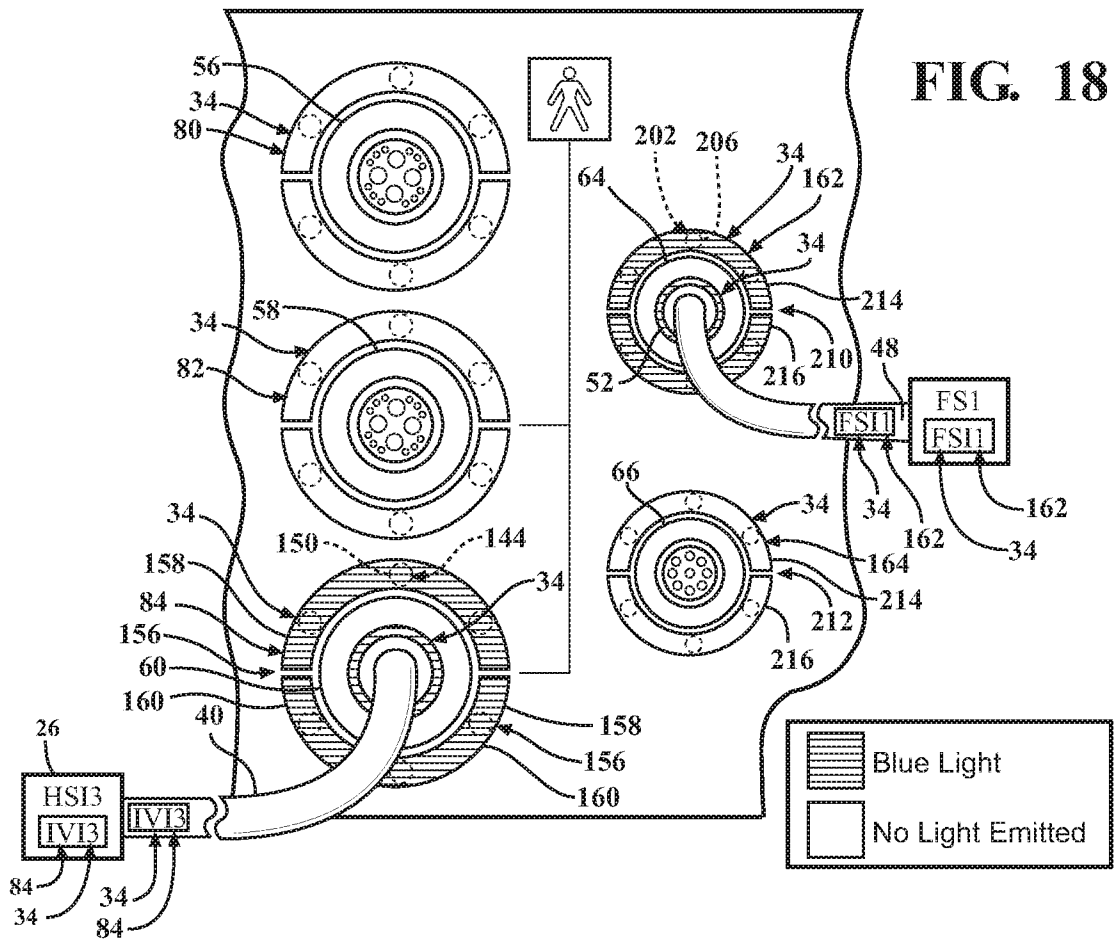


FIG. 21

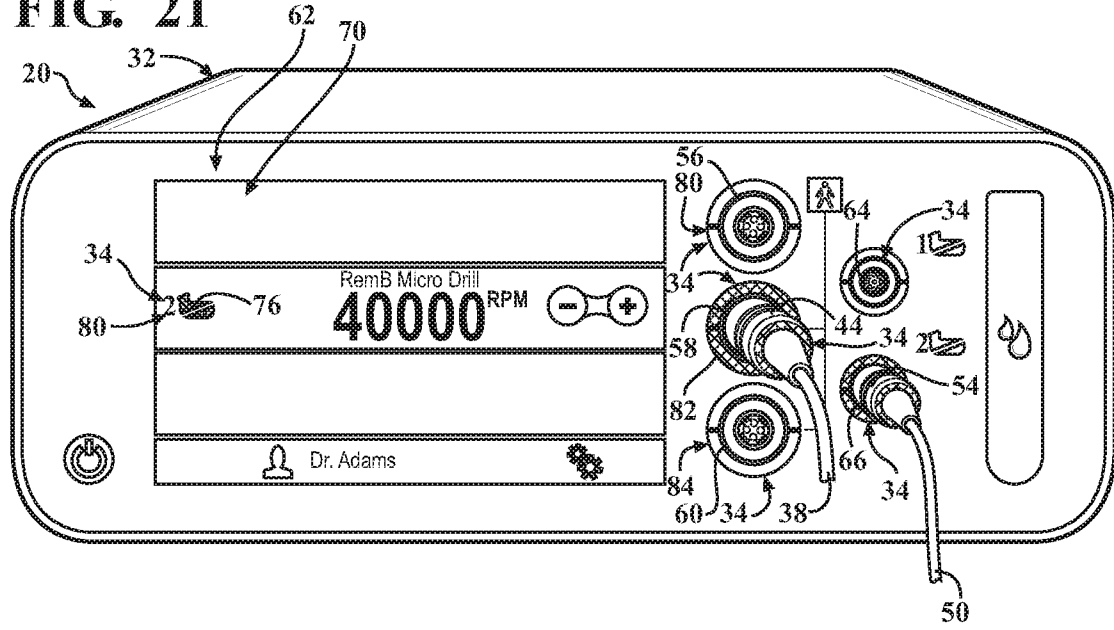


FIG. 22

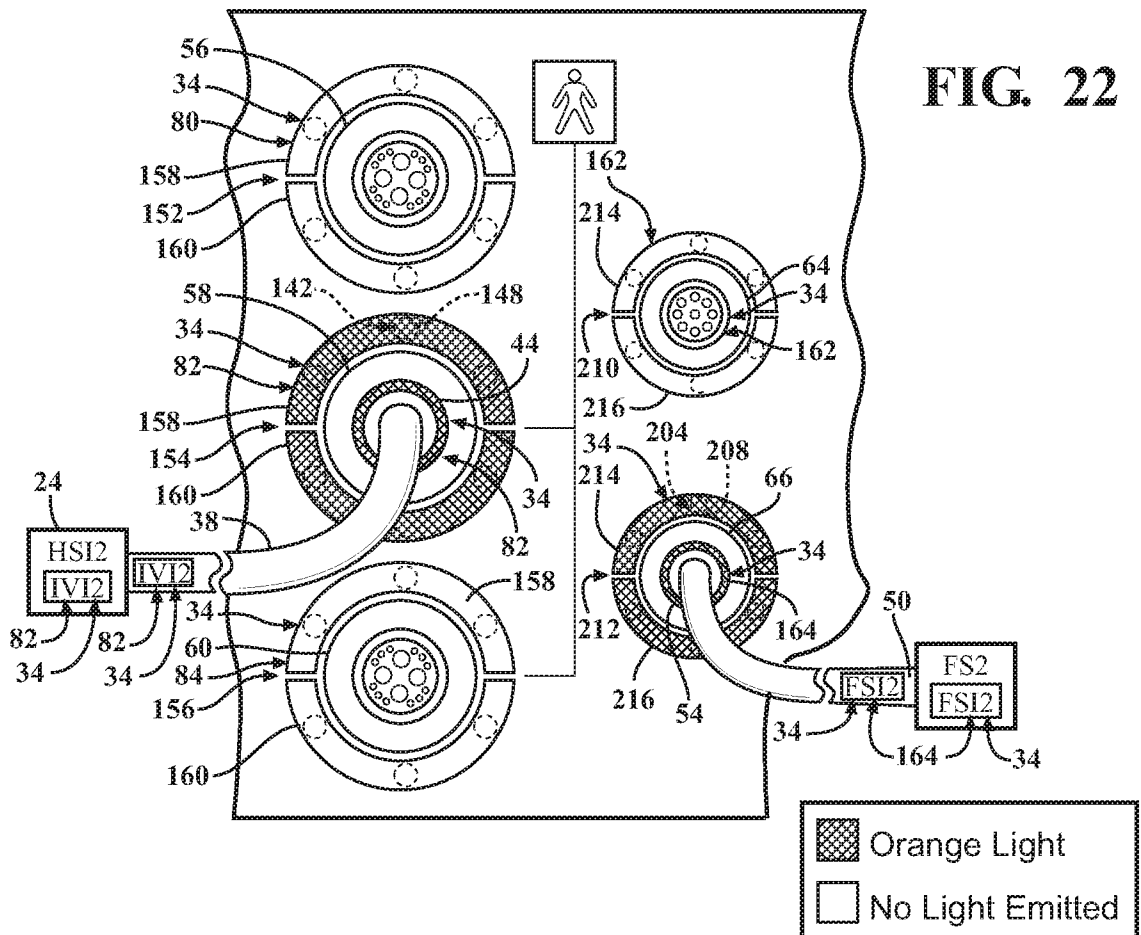


FIG. 23

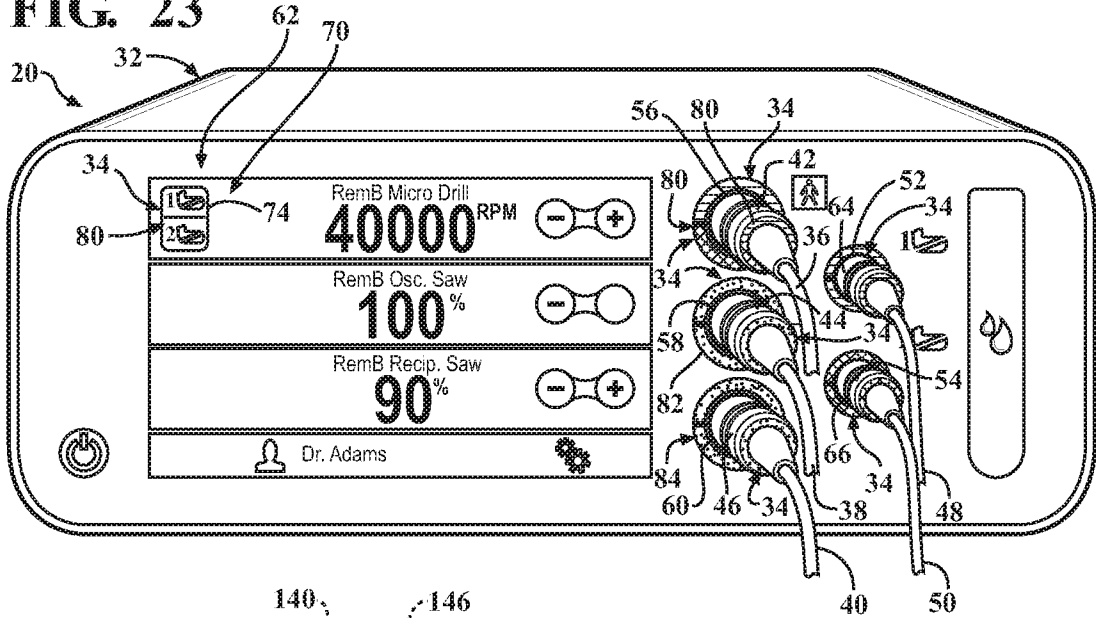
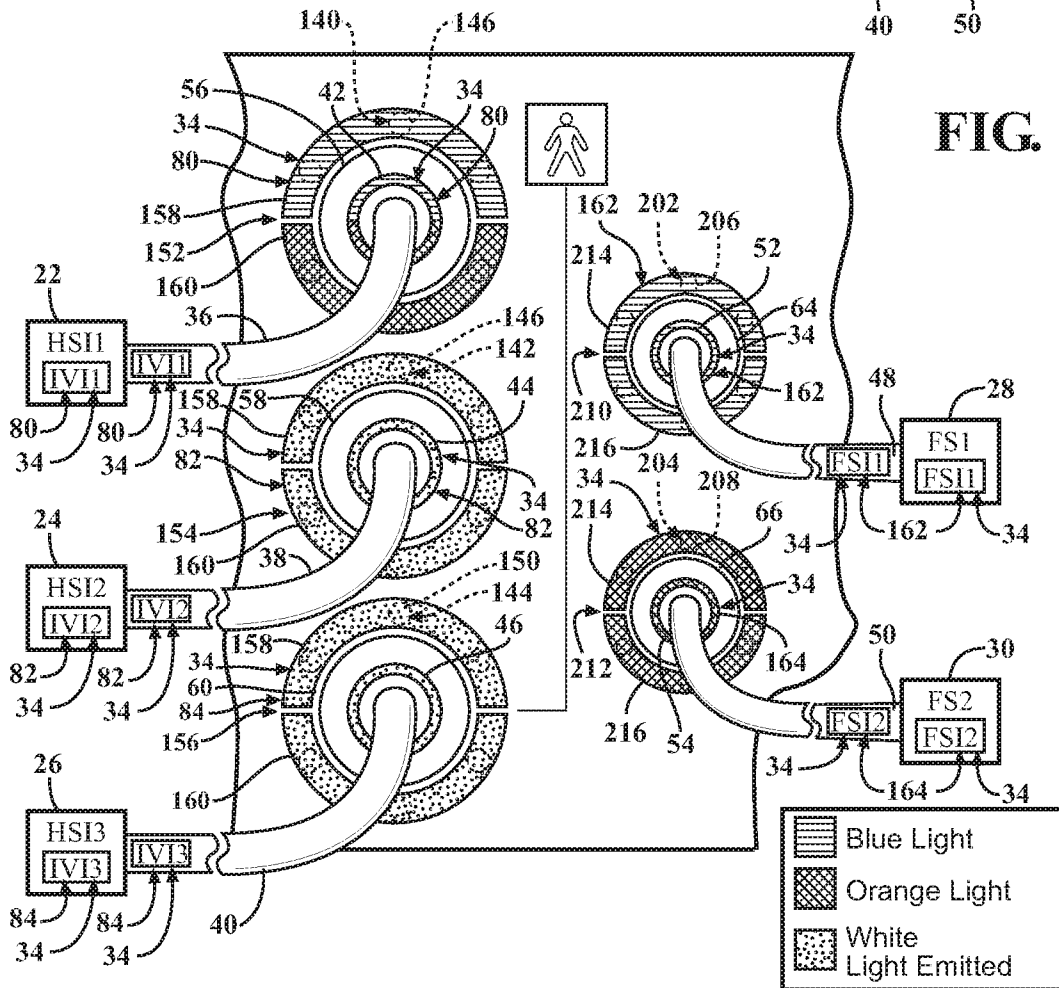


FIG. 24



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/029914

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/00 A61B90/00
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2009/105488 A2 (UAB RESEARCH FOUNDATION [US]; ALEXANDER DAVID AUSTIN [US]; EL-GALLEY R) 27 August 2009 (2009-08-27) figures 1,37,38 paragraph [0138]	1,2,4-7, 16-26 8-15,27
X A	US 2010/198200 A1 (HORVATH CHRISTOPHER [US]) 5 August 2010 (2010-08-05) paragraphs [0007], [0038] - [0044], [0048], [0085] figures 1,8a	1-6,20 8-15, 28-33
X	US 2006/074405 A1 (MALACKOWSKI DON [US] ET AL) 6 April 2006 (2006-04-06) figure 12 paragraphs [0101] - [0102] paragraphs [0052], [0093], [0098]	1-7, 16-20, 23,27

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

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- "&" document member of the same patent family

Date of the actual completion of the international search

3 July 2018

Date of mailing of the international search report

12/07/2018

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Authorized officer

Erbel, Stephan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/029914

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 2006074405 A1	06-04-2006	AU 2005292140 A1 CA 2582053 A1 EP 1793746 A2 EP 2335616 A1 JP 2008514367 A KR 20070073830 A US 2006074405 A1 US 2007250098 A1 US 2017172583 A1 WO 2006039331 A2	13-04-2006 13-04-2006 13-06-2007 22-06-2011 08-05-2008 10-07-2007 06-04-2006 25-10-2007 22-06-2017 13-04-2006
