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(54) STERILE SURGICAL TRAY

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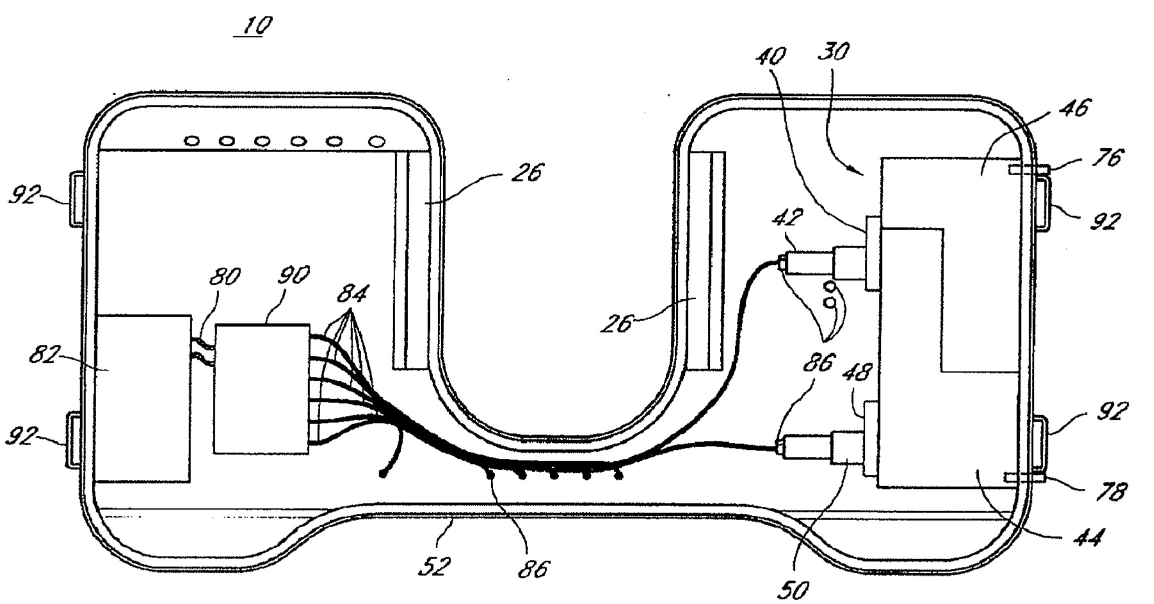
A61B 17/00	(2006.01)

(52) U.S. Cl. **700/282**; 206/370; 700/295; 710/303; 700/90; 137/560; 137/565.17; 606/1; 700/90

(57) ABSTRACT

A sterile surgical tray includes structure for receiving a plurality of surgical instruments. The sterile surgical tray also may include electrical input and output connectors attached to tray.



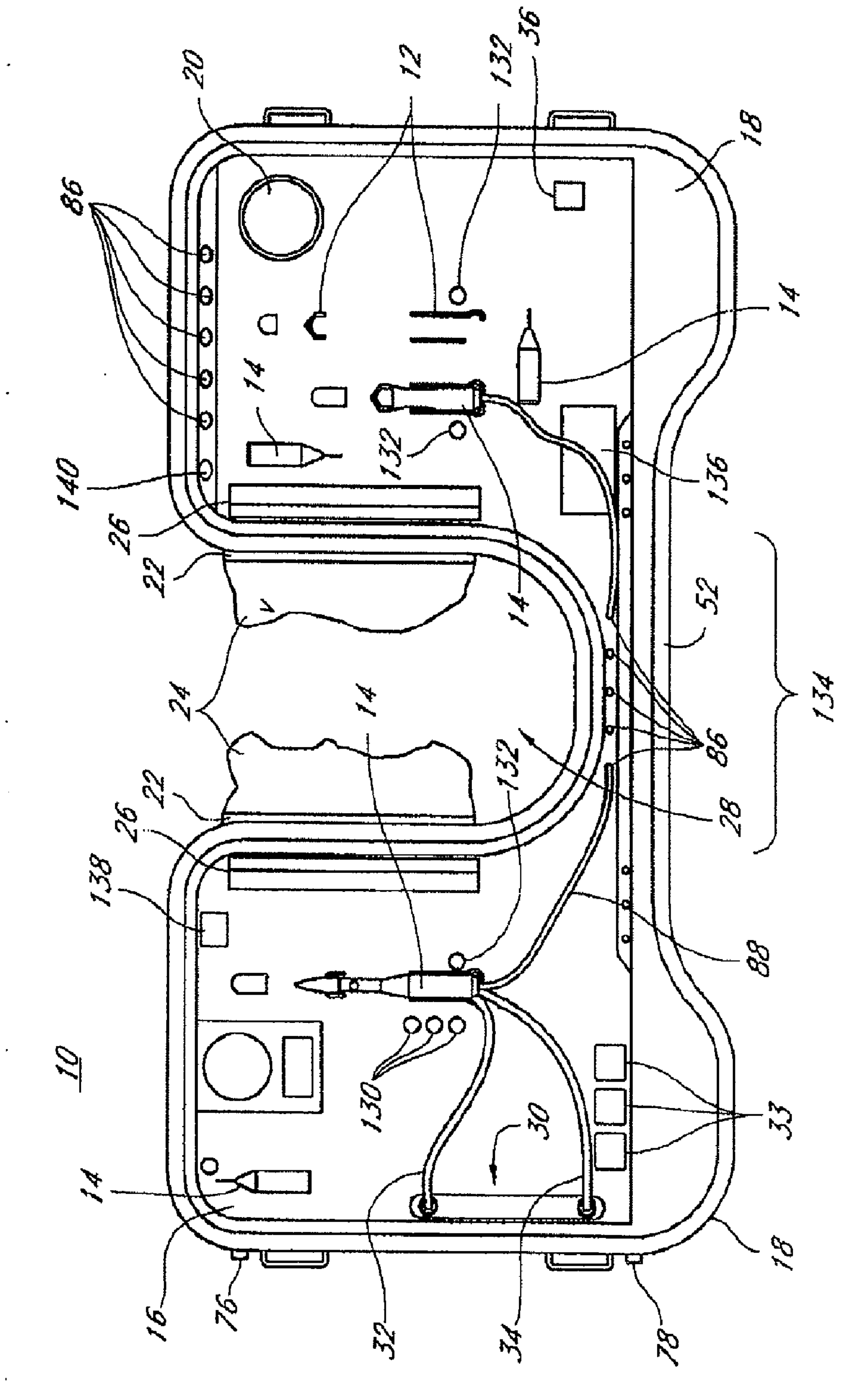

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FIG. 1

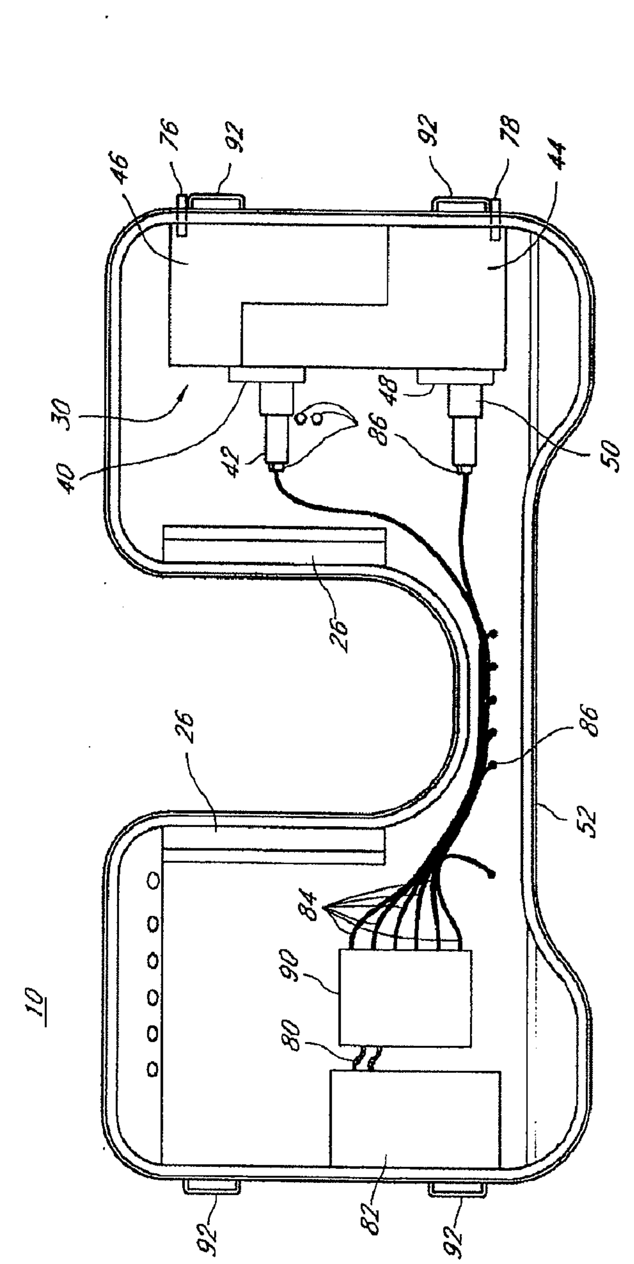

FIG. 2

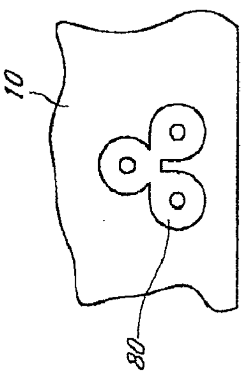

FIG. 7

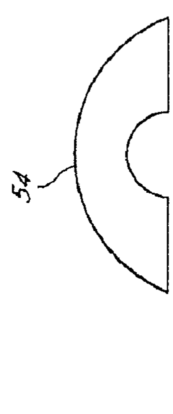

FIG. 3

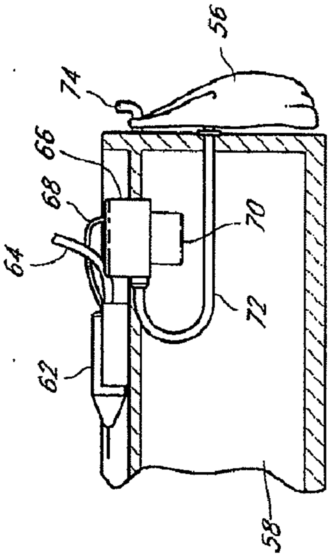

FIG. 5

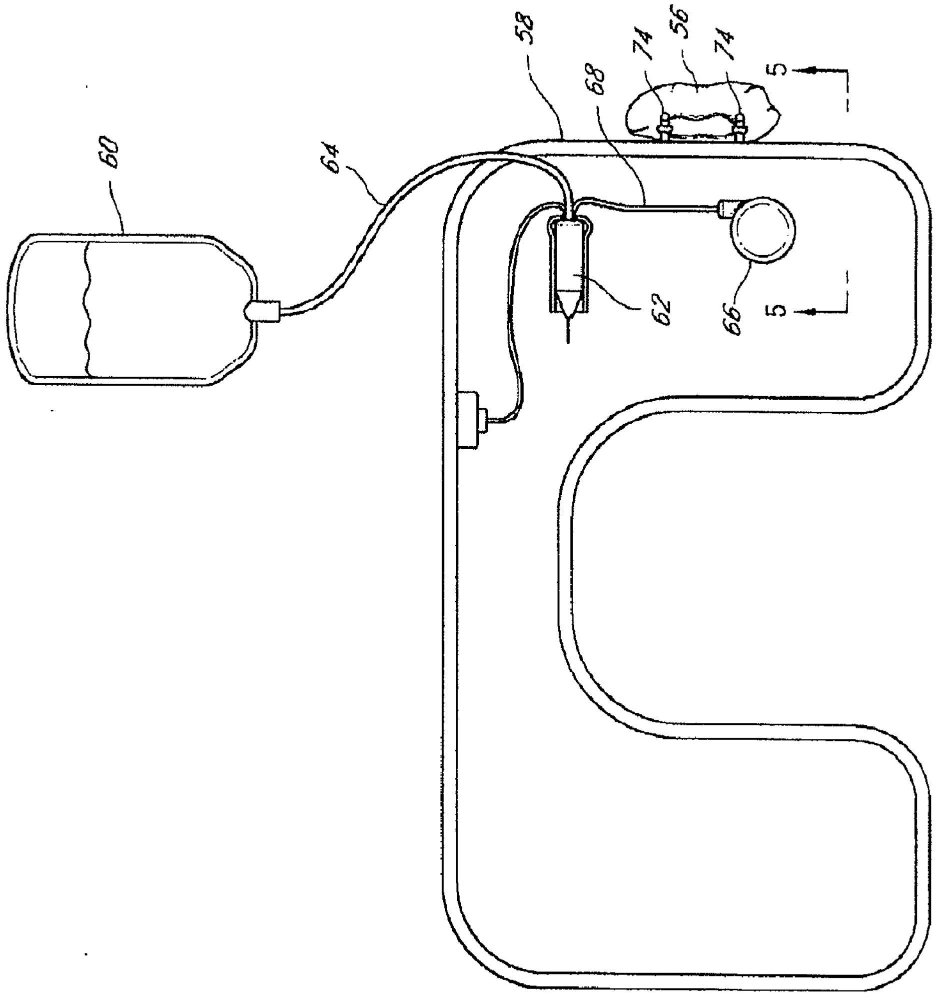

FIG. 4

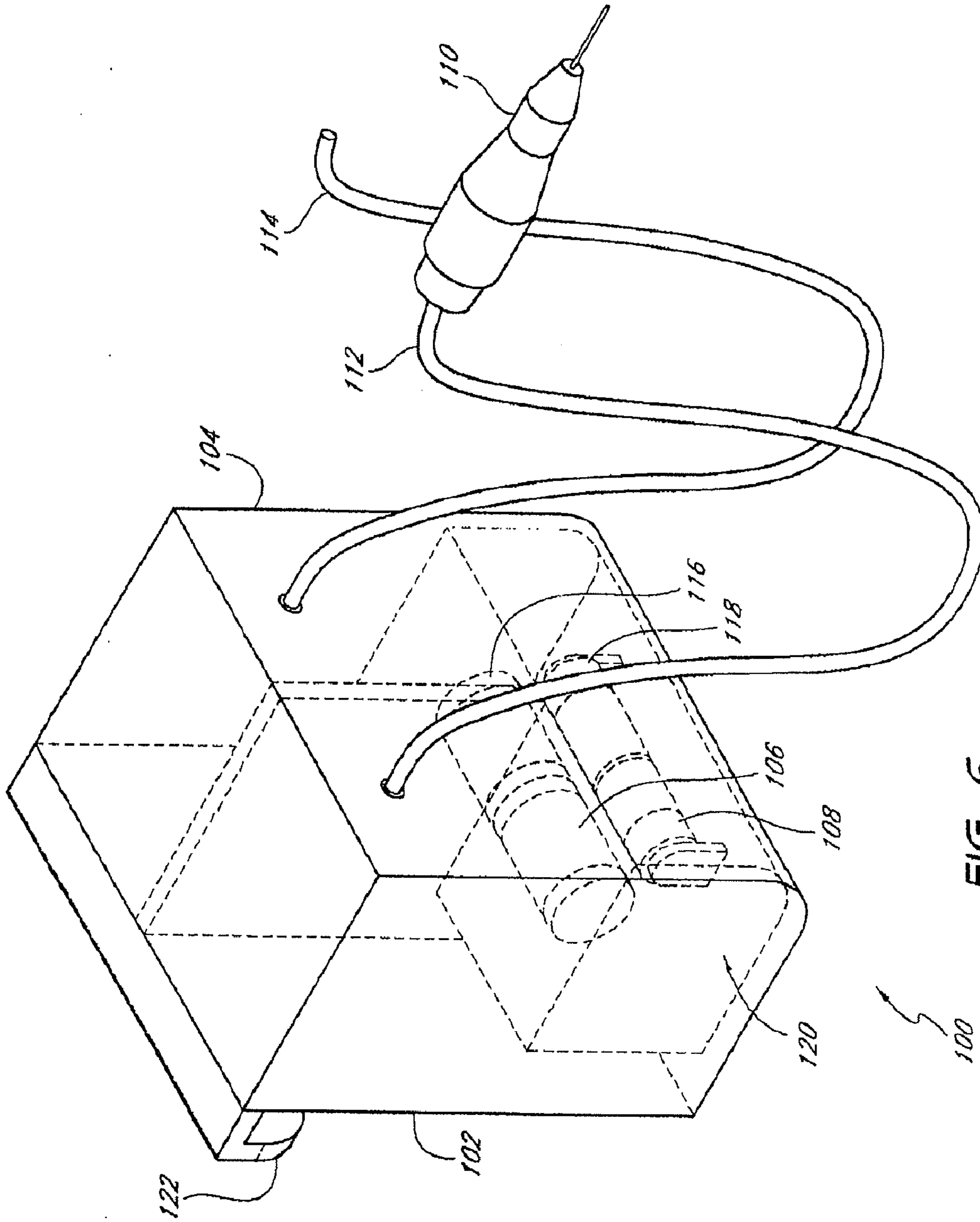

FIG. 6

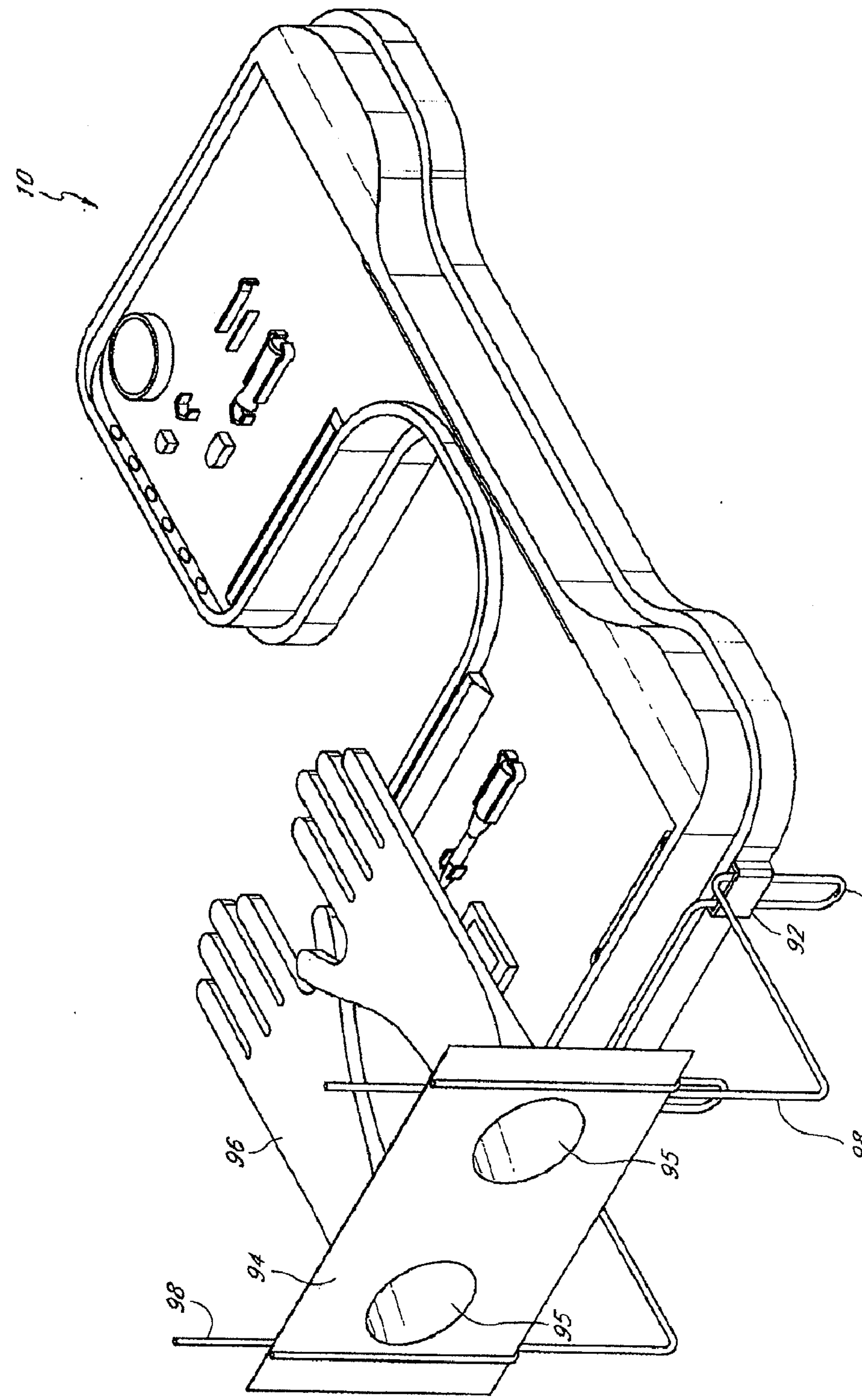

FIG. 8

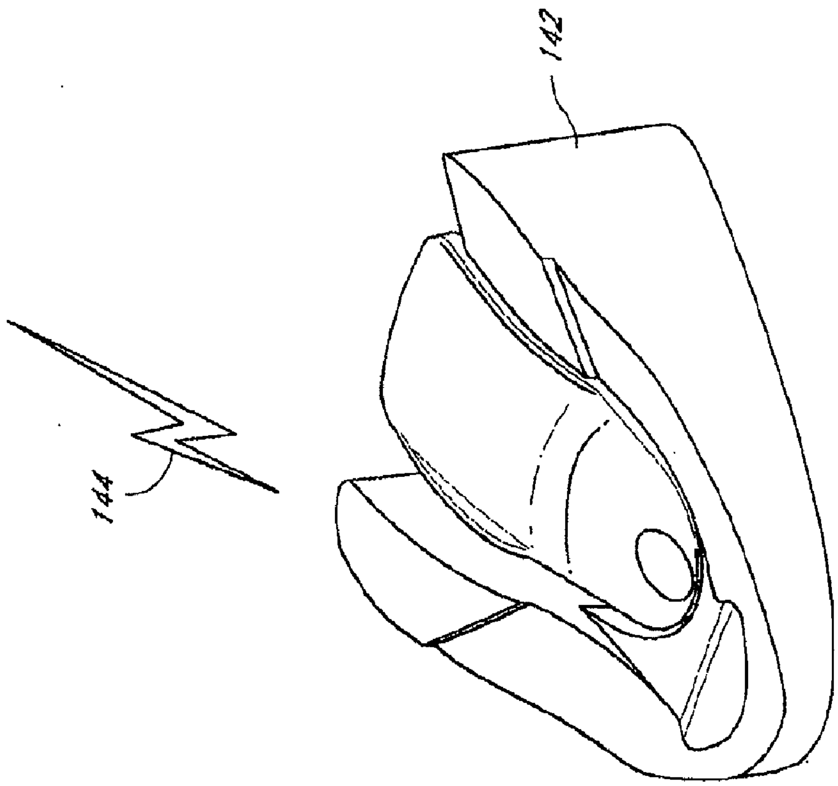

FIG. 9

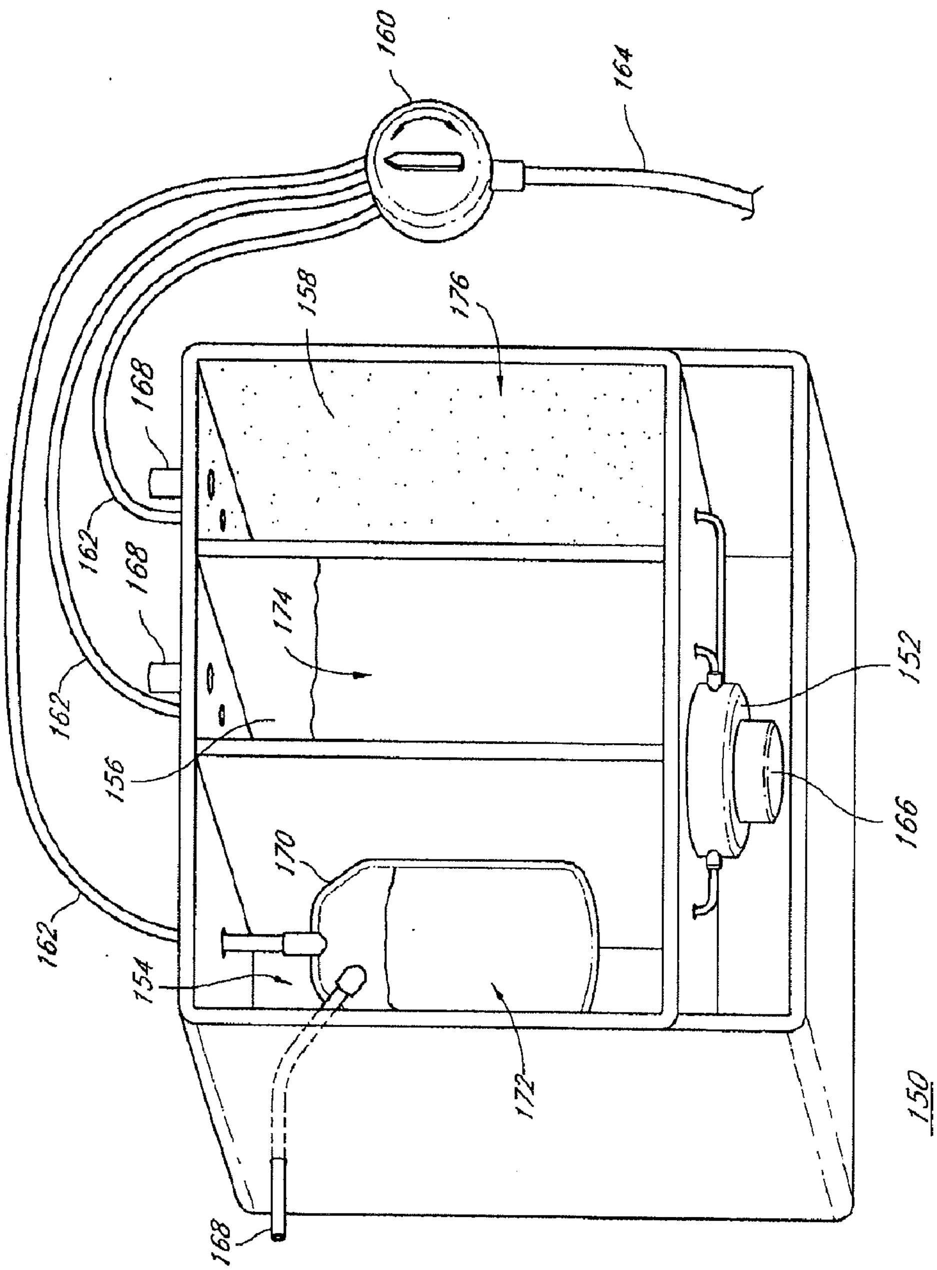
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FIG. 10

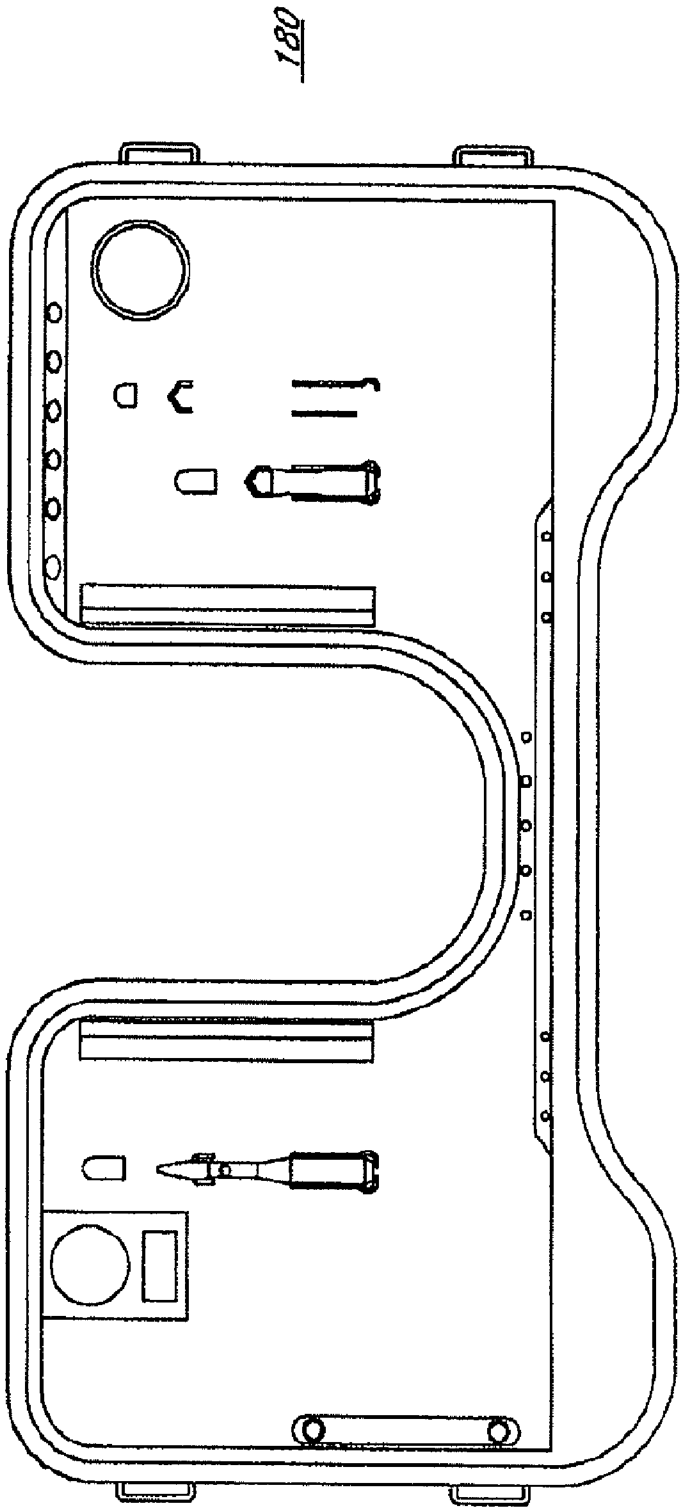


FIG. 11

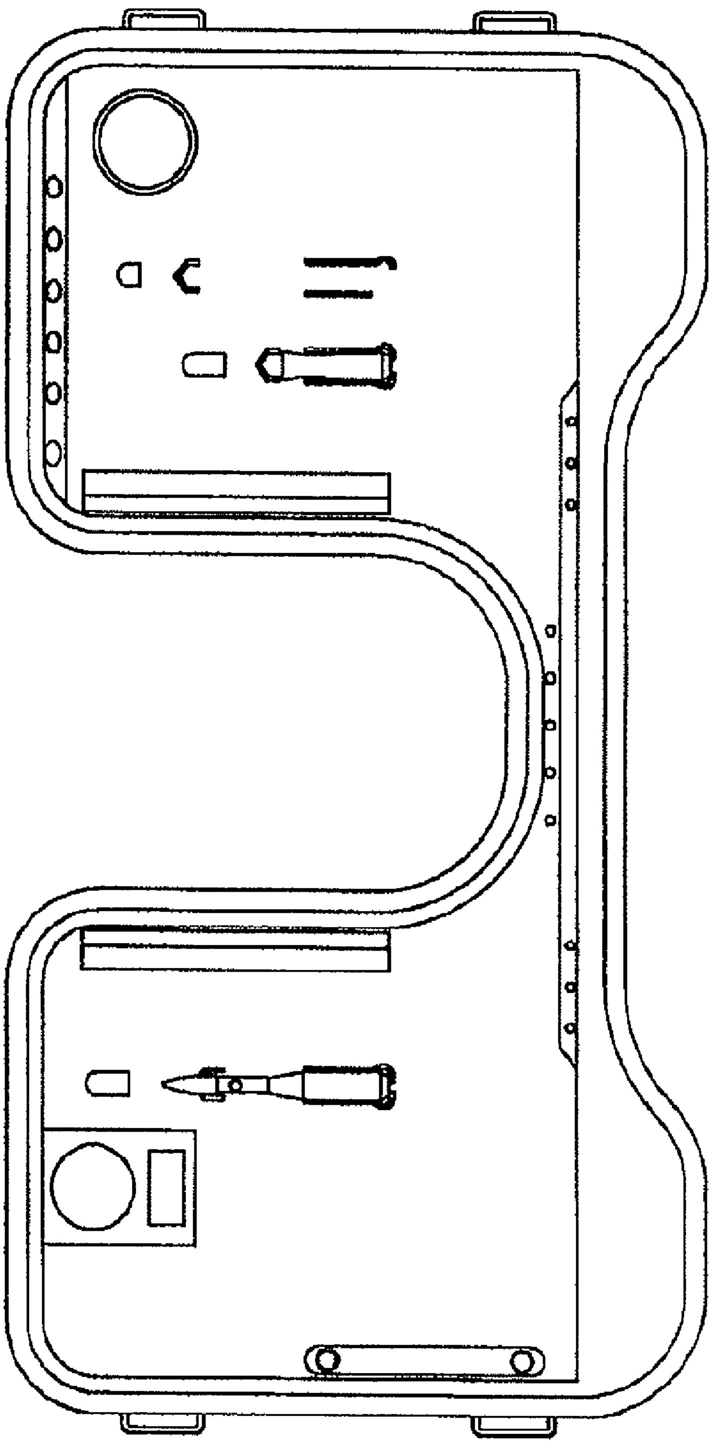
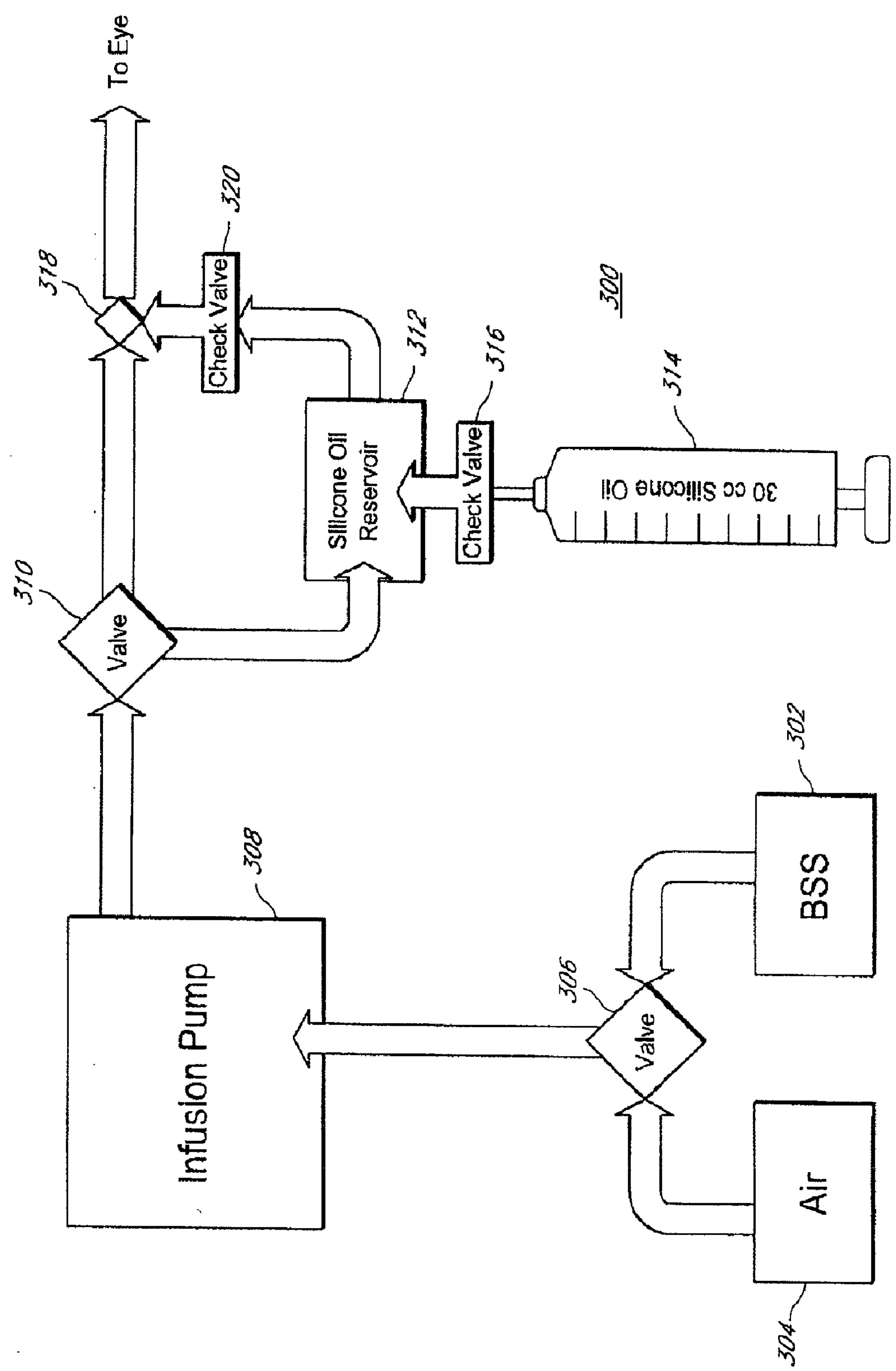


FIG. 12



To Eye
318
320
Check Valve
312
Silicone Oil
Reservoir
316
Check Valve
314
30 cc Silicone Oil
300
310
Valve
308
Infusion Pump
306
Valve
302
BSS
304
Air

FIG. 13

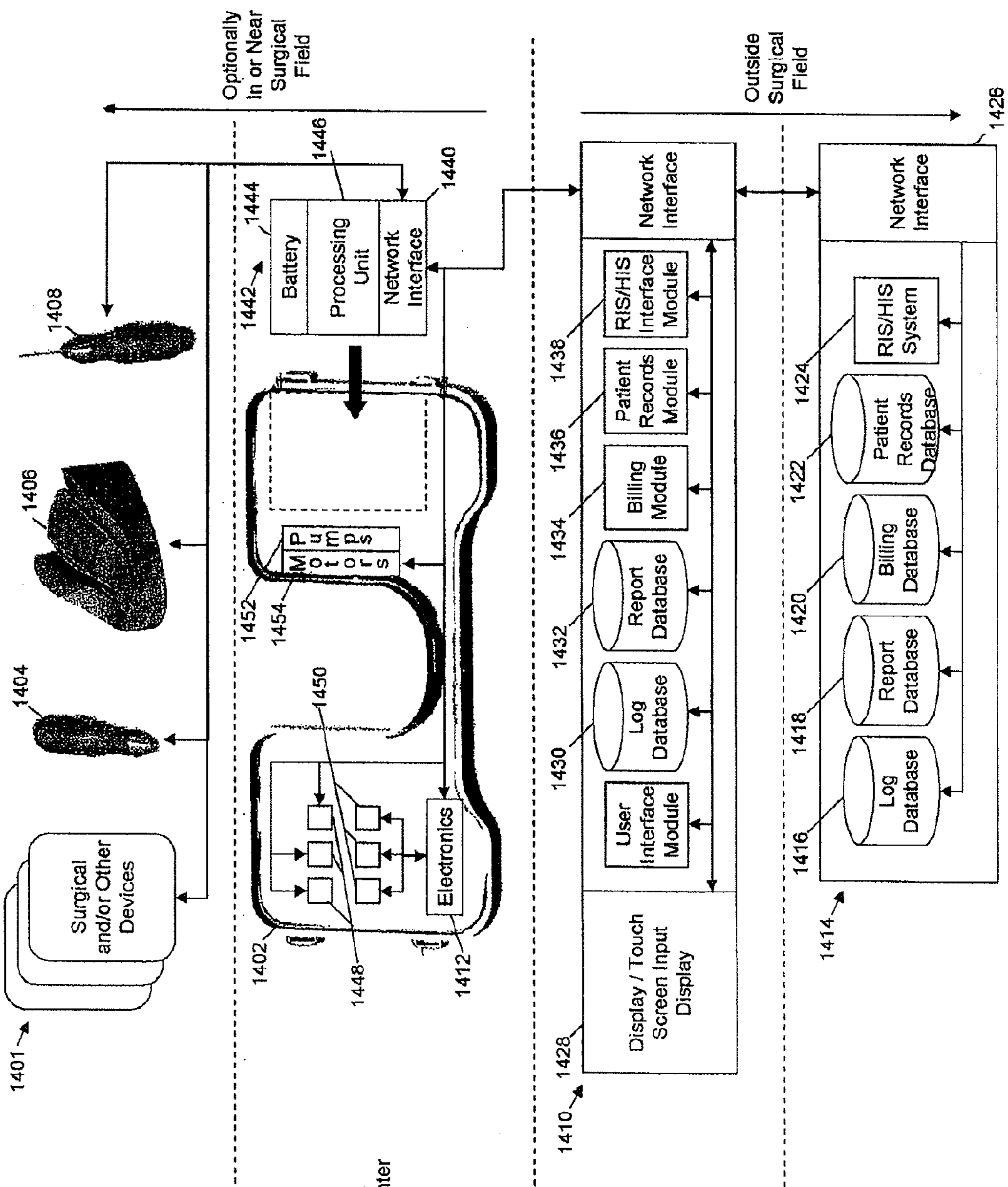

Surgical or Other Instruments
Independent Surgical Center
Personal Surgical Center
Hospital / Medical Office Systems
Optionally In or Near Surgical Field
Outside Surgical Field
1401
Surgical and/or Other Devices
1404
1406
1408
1402
1448
1450
1412
Electronics
1452
1454
Pumps
Motors
1442
1444
Battery
Processing Unit
Network Interface
1446
1440
1410
1428
Display / Touch Screen Input Display
User Interface Module
1430
Log Database
1432
Report Database
1434
Billing Module
1436
Patient Records Module
1438
RIS/HIS Interface Module
Network Interface
1414
1416
Log Database
1418
Report Database
1420
Billing Database
1422
Patient Records Database
1424
RIS/HIS System
Network Interface
1426

FIG. 14

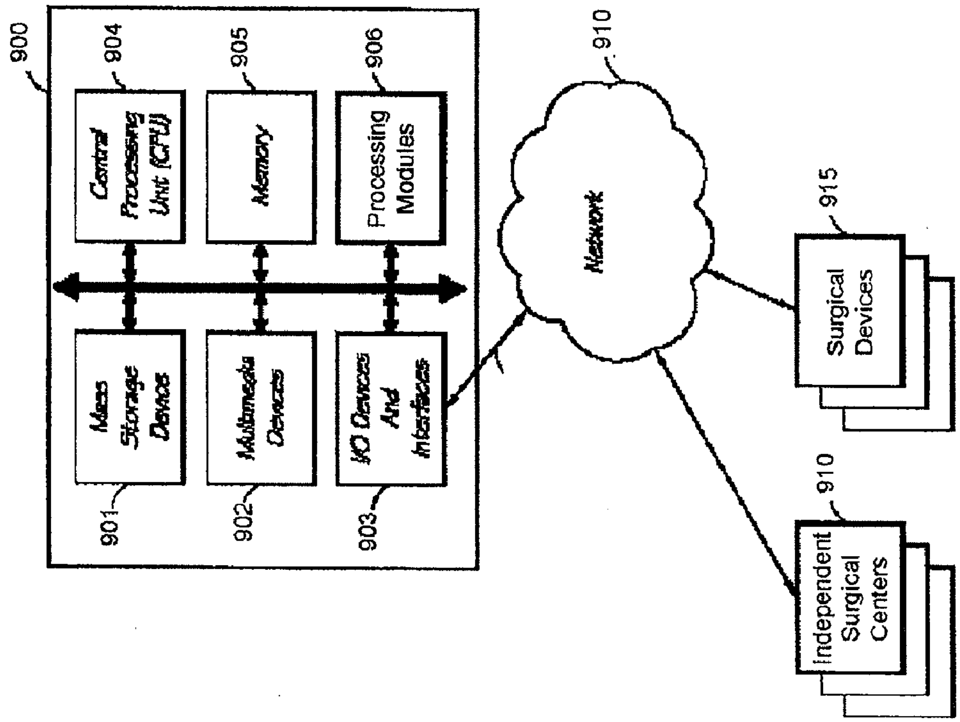

900
904
Central Processing Unit (CPU)
905
Memory
906
Processing Modules
901
Mass Storage Device
902
Multimedia Devices
903
I/O Devices And Interfaces
910
Network
915
Surgical Devices
910
Independent Surgical Centers

FIG. 14A

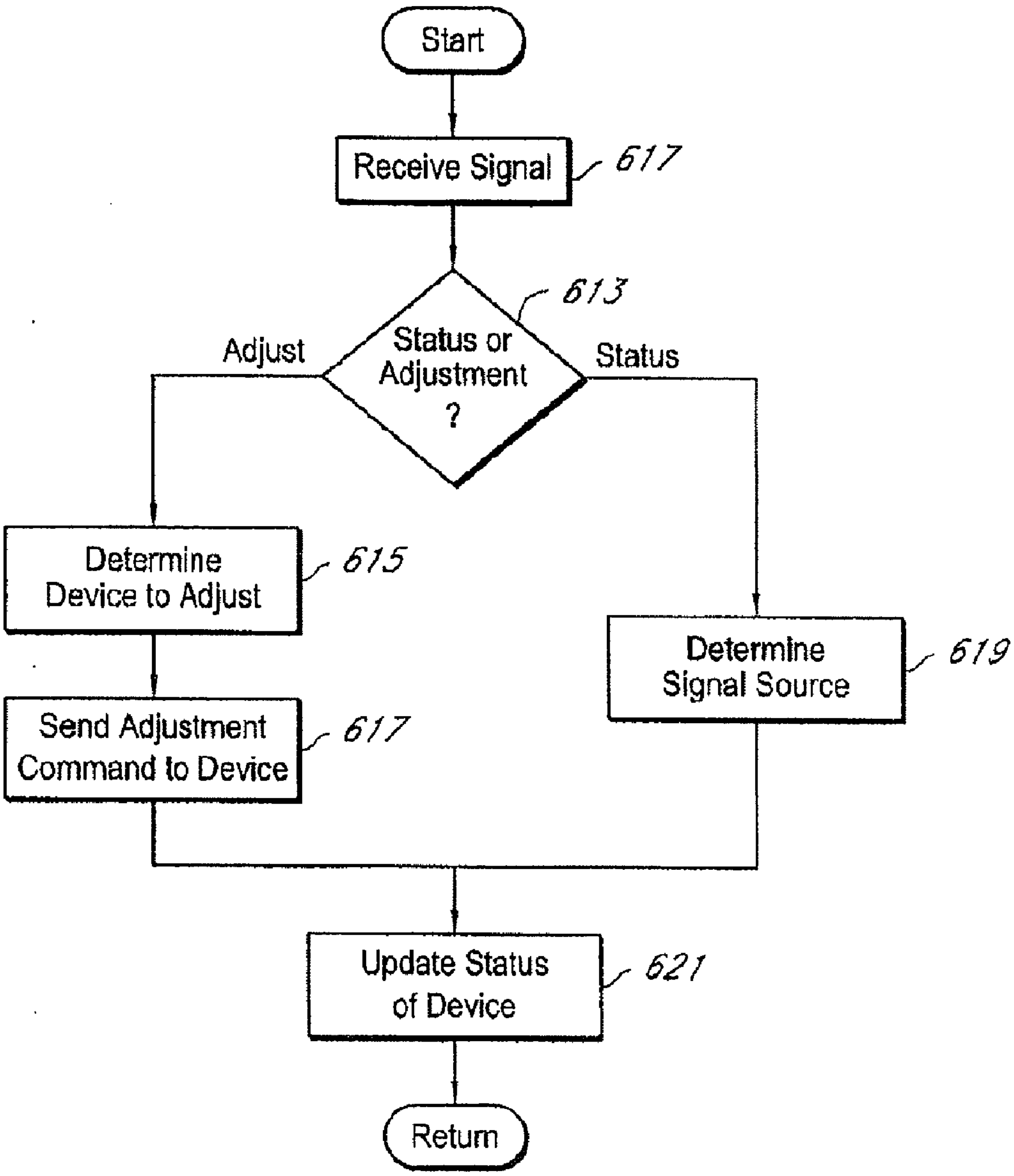
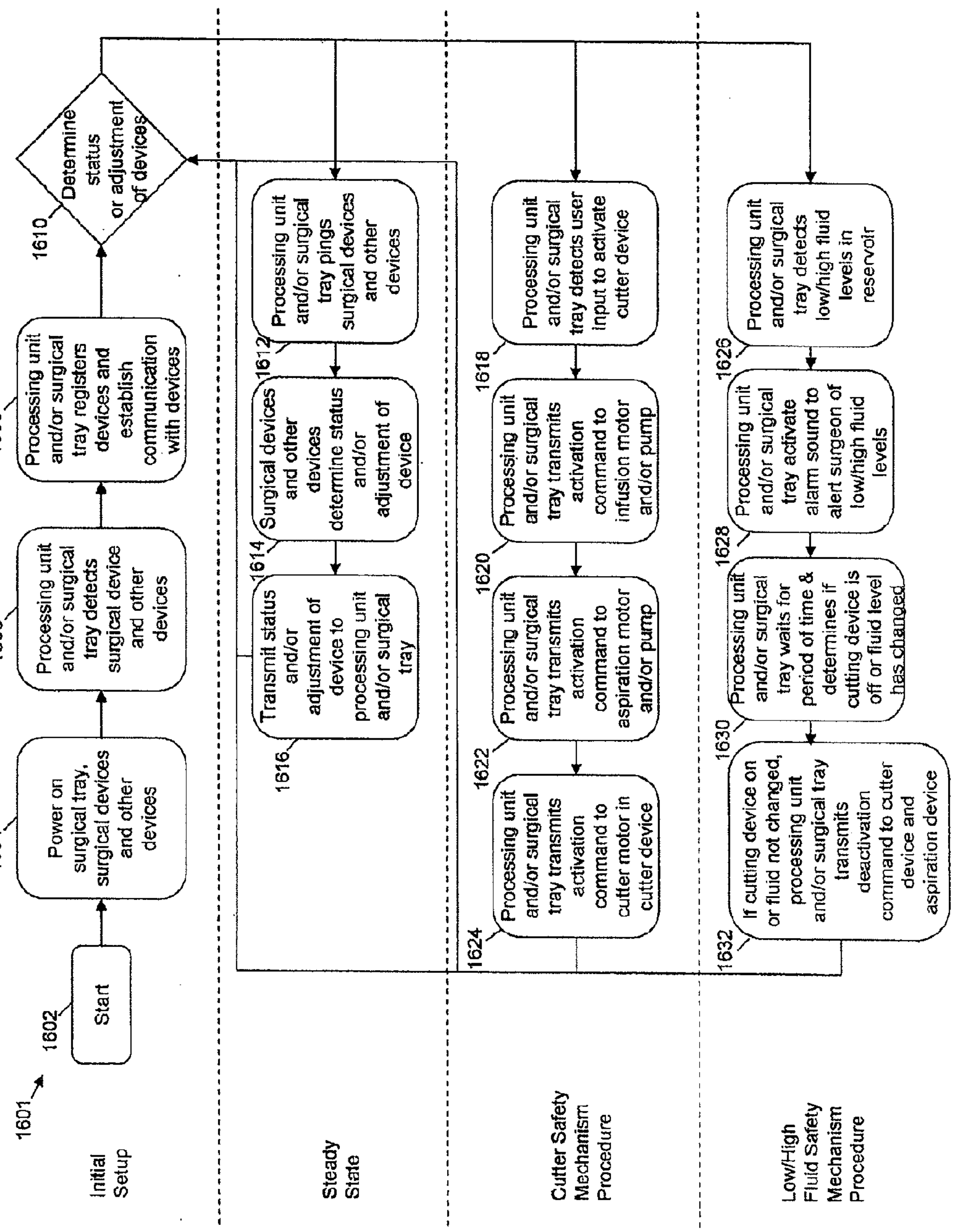

Start
Receive Signal
617
613
Status or Adjustment ?
Adjust
Status
Determine Device to Adjust
615
Send Adjustment Command to Device
617
Determine Signal Source
619
Update Status of Device
621
Return

FIG. 15

FIG. 16


1601
Initial Setup
Steady State
Cutter Safety Mechanism Procedure
Low/High Fluid Safety Mechanism Procedure
1602
Start
1604
Power on surgical tray, surgical devices and other devices
1606
Processing unit and/or surgical tray detects surgical device and other devices
1608
Processing unit and/or surgical tray registers devices and establish communication with devices
1610
Determine status or adjustment of devices
1612
Processing unit and/or surgical tray pings surgical devices and other devices
1614
Surgical devices and other devices determine status and/or adjustment of device
1616
Transmit status and/or adjustment of device to processing unit and/or surgical tray
1618
Processing unit and/or surgical tray detects user input to activate cutter device
1620
Processing unit and/or surgical tray transmits activation command to infusion motor and/or pump
1622
Processing unit and/or surgical tray transmits activation command to aspiration motor and/or pump
1624
Processing unit and/or surgical tray transmits activation command to cutter motor in cutter device
1626
Processing unit and/or surgical tray detects low/high fluid levels in reservoir
1628
Processing unit and/or surgical tray activate alarm sound to alert surgeon of low/high fluid levels
1630
Processing unit and/or surgical tray waits for period of time & determines if cutting device is off or fluid level has changed
1632
If cutting device on or fluid not changed, processing unit and/or surgical tray transmits deactivation command to cutter device and aspiration device

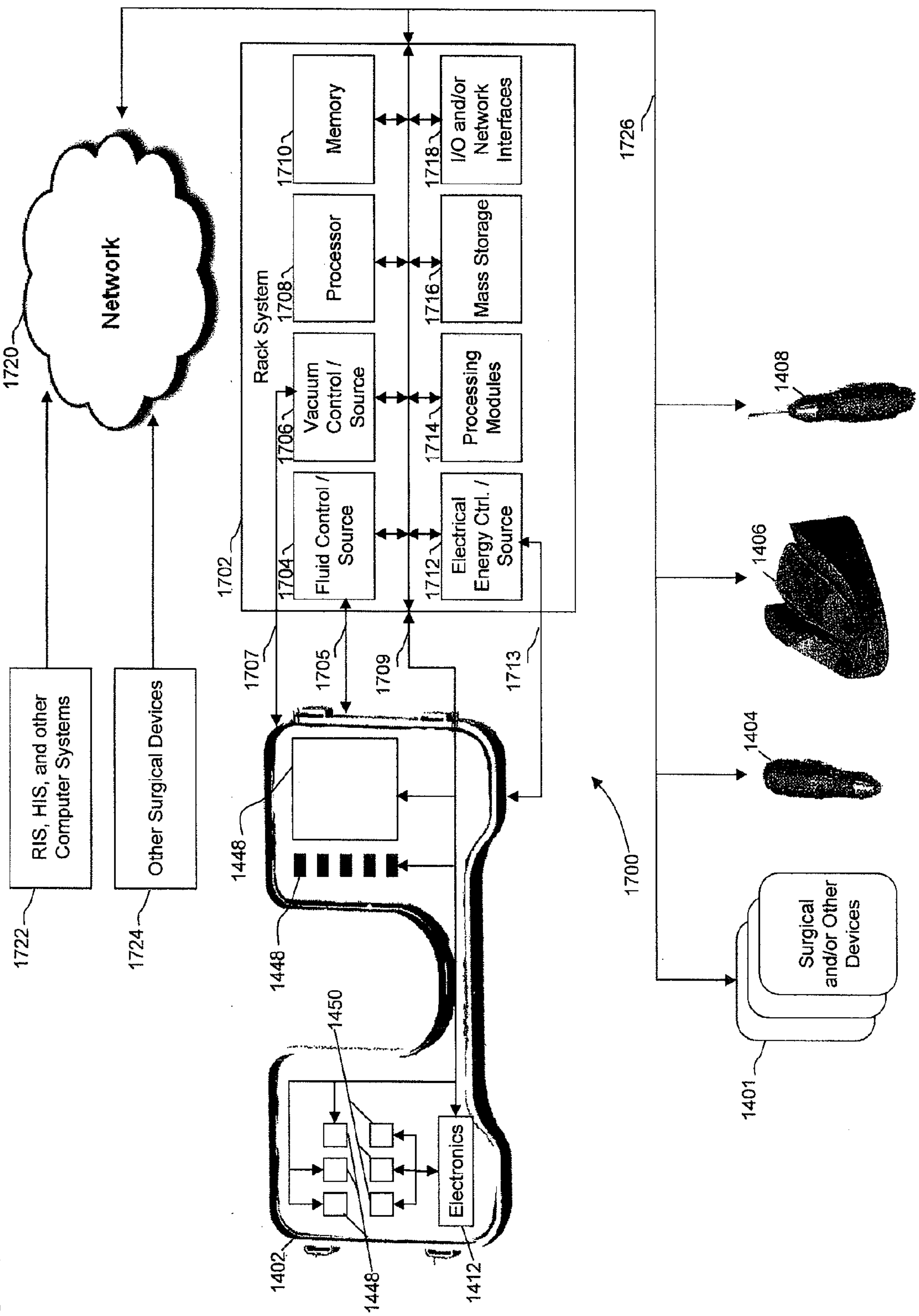
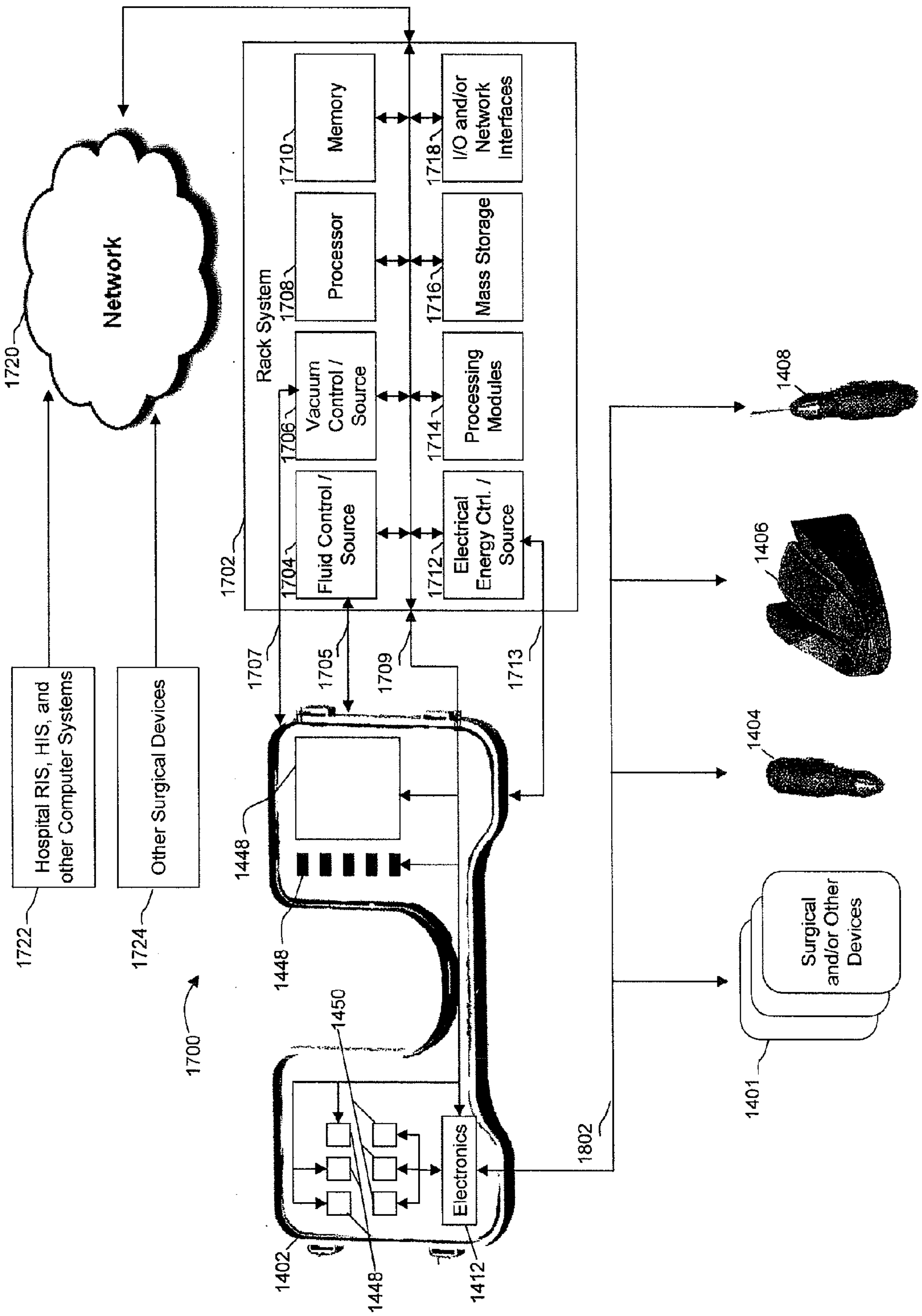

Network
1720
RIS, HIS, and other Computer Systems
1722
Other Surgical Devices
1724
Rack System
1702
Fluid Control / Source
1704
Vacuum Control / Source
1706
Processor
1708
Memory
1710
Electrical Energy Ctrl. / Source
1712
Processing Modules
1714
Mass Storage
1716
I/O and/or Network Interfaces
1718
1726
1707
1705
1709
1713
1448
1448
1450
Electronics
1402
1448
1412
1700
1404
1406
1408
Surgical and/or Other Devices
1401

FIG. 17

FIG. 18


Network
1720
Rack System
1702
Memory
1710
Processor
1708
Vacuum Control / Source
1706
Fluid Control / Source
1704
I/O and/or Network Interfaces
1718
Mass Storage
1716
Processing Modules
1714
Electrical Energy Ctrl. / Source
1712
Hospital RIS, HIS, and other Computer Systems
1722
Other Surgical Devices
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Surgical and/or Other Devices
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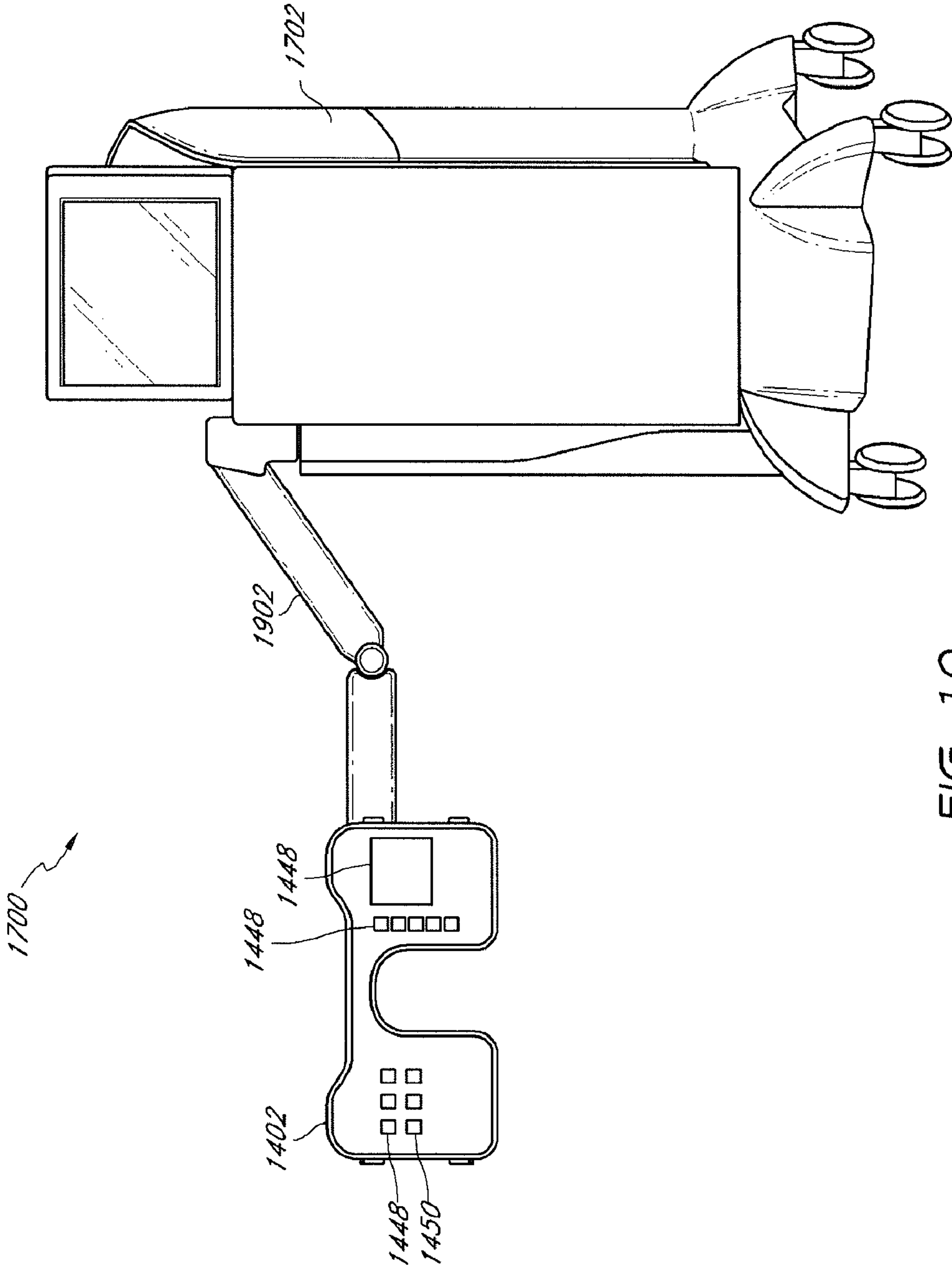

FIG. 19

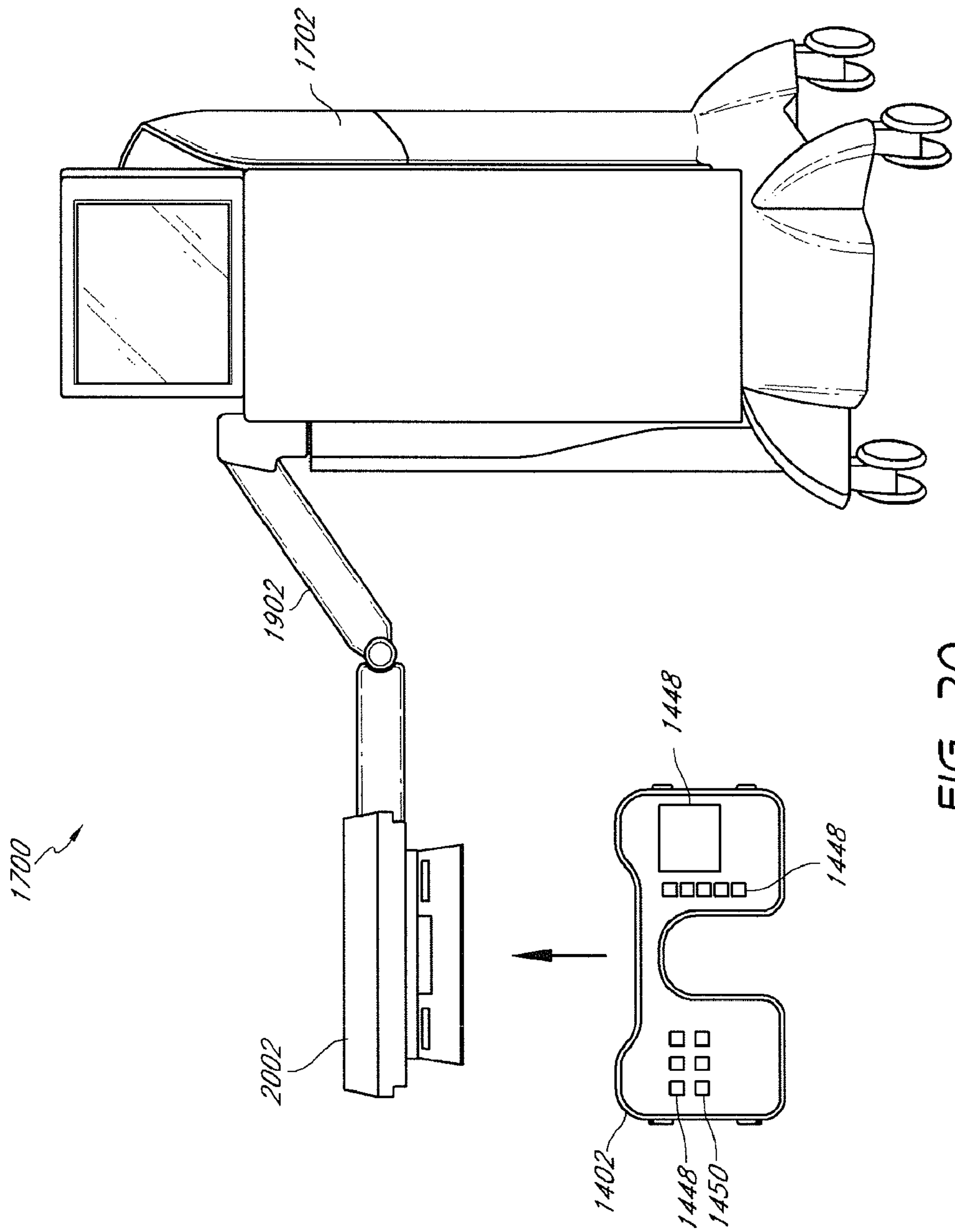

FIG. 20

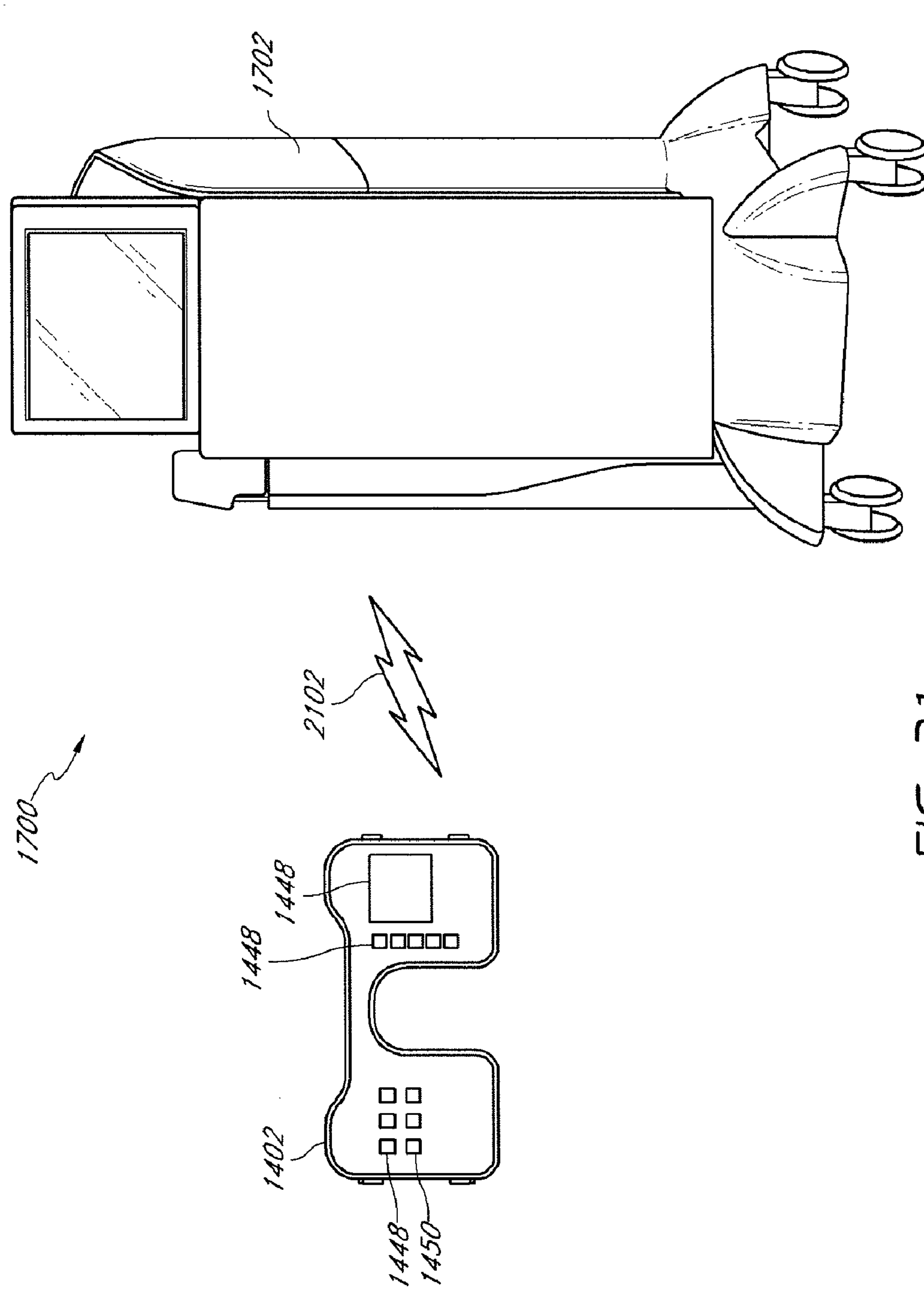

FIG. 21

STERILE SURGICAL TRAY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part application of U.S. application Ser. No. 12/256,420 filed Oct. 22, 2008, and titled STERILE SURGICAL TRAY, which is a continuation-in-part application of U.S. application Ser. No. 12/107,038 filed Apr. 21, 2008 and titled INDEPENDENT SURGICAL CENTER, which claims the benefit of U.S. Provisional Application No. 60/925,546 filed Apr. 20, 2007, and titled INDEPENDENT SURGICAL CENTER INCLUDING A PORTABLE VITRECTOMY HANDPIECE AND INFUSION/ASPIRATION CASSETTE. U.S. application Ser. No. 12/256,420 is also a continuation-in-part application of U.S. application Ser. No. 12/107,052 filed Apr. 21, 2008, and titled PERSONAL SURGICAL CENTER, which claims the benefit of U.S. Provisional Application No. 60/925,562 filed Apr. 20, 2007, and titled PERSONAL SURGICAL CENTER. U.S. application Ser. No. 12/256,420 is also a continuation-in-part application of U.S. application Ser. No. 12/106,962 filed Apr. 21, 2008, and titled SURGICAL PACK AND TRAY, which claims the benefit of U.S. Provisional Application No. 60/925,548 filed Apr. 20, 2007, and titled SURGICAL PACK AND TRAY.

[0002] This application is also a continuation-in-part application of U.S. application Ser. No. 12/107,038 filed Apr. 21, 2008, and titled INDEPENDENT SURGICAL CENTER, which claims the benefit of U.S. Provisional Application No. 60/925,546 filed Apr. 20, 2007, and titled INDEPENDENT SURGICAL CENTER INCLUDING A PORTABLE VITRECTOMY HANDPIECE AND INFUSION/ASPIRATION CASSETTE. This application is also a continuation-in-part application of U.S. application Ser. No. 12/107,052 filed Apr. 21, 2008, and titled PERSONAL SURGICAL CENTER, which claims the benefit of U.S. Provisional Application No. 60/925,562 filed Apr. 20, 2007, and titled PERSONAL SURGICAL CENTER. This application is also a continuation-in-part application of U.S. application Ser. No. 12/106,962 filed Apr. 21, 2008, and titled SURGICAL PACK AND TRAY, which claims the benefit of U.S. Provisional Application No. 60/925,548 filed Apr. 20, 2007, and titled SURGICAL PACK AND TRAY.

[0003] Each of the foregoing applications is hereby incorporated by reference in its entirety, specifically the systems, methods, and devices for relating to a surgical tray.

BACKGROUND

[0004] 1. Field

[0005] The invention is related to a surgical tray that technology, and in particular to a sterile surgical tray that allows a surgeon or other user to directly monitor from the surgical tray and/or directly control from the surgical tray other tools and instruments associated with the surgical tray. The surgical tray can also function as both a pack to transport surgical materials and devices to a surgery site and as a sterile tray for receiving a plurality of surgical instruments. The sterile surgical tray can also include a plurality of electrical input and output connectors attached to the tray.

[0006] 2. Description of the Related Art

[0007] It is well known to use, in surgery, a sterile pack shipped from a manufacturer to a surgery center, an example of which is ophthalmic surgery (vitreoretinal or cataract surgery, in particular). These packs typically contain several items that are typically used in surgery and include one-time use surgical instruments, fluid cassettes, tubing sets, drapes, needles, and other devices. The particular content of a pack depends on the type of surgery and perhaps the individual preference of the surgeon or surgery center.

[0008] When preparing for surgery, typically a sterile drape is placed over what is commonly referred to as a Mayo tray. The contents of the sterile pack and perhaps additional sterile instruments and materials are spread-out over the tray so that the materials and instruments necessary for the surgery are readily available to a nurse or surgeon.

[0009] It is also known to provide a sterile pack where many of the instruments and tubing sets are organized and placed in mating recesses of the pack so that the pack can act as a tray for at least some of the instruments in surgery.

[0010] Some of the surgical instruments are electrically or pneumatically powered by a surgical console or system that is outside of the sterile field defined by the surgical site and the sterile instruments and materials on the tray and used in the surgery. Some of the sterile materials are removed from the sterile field or a portion is removed from the sterile field prior to surgery. The materials removed include the pump cartridges and tubing sets which are connected to the non-sterile surgical console. The surgical console also typically includes a large display screen for displaying and inputting parameters that will control the devices used during surgery. This surgical set-up typically requires a surgeon and one or two support persons so that surgery can be performed efficiently while also adjusting the parameters on the console and switching to a different surgical instrument to perform a different procedure.

[0011] However, with the present trend of surgeries moving away from hospital and into ambulatory surgery centers (ASCs) and even into a doctor's own office, coupled with reduced reimbursements for surgical procedures, there is a need to allow surgeons to perform surgery with little or no assistance. In addition, because of personnel and cost restraints the assistant provided to the surgeon is typically not trained in the particular surgical procedure to be performed, so that the interaction between the surgeon and assistant may not be particularly efficient.

[0012] Therefore, a need exists for a surgical system and surgical products that allow a surgeon to perform safe, efficient, and cost-effective surgery with little or no assistance during surgery.

SUMMARY

[0013] In certain embodiments, a sterile surgical tray comprises a sterile tray, a pump within the sterile tray, and a motor within the sterile tray connected to the pump. Desirably, the tray includes structure for receiving a plurality of surgical instruments. It is also desirable that the tray contain at least one pump fluid reservoir and that the reservoir be operatively connected to the pump. In a distinct embodiment, a sterile surgical tray comprises a plurality of electrical input and output connectors attached to the tray.

[0014] In certain embodiments, an infusion fluid reservoir comprises a multiple chamber fluid reservoir for holding a different fluid in each chamber; a pressure pump connected to two or more chambers for pressurizing the chambers; and a multiple position valve connected to the multiple chambers for selectively opening one of the multiple chambers to allow a fluid contained in a selected chamber to flow out of the selected chamber.

[0015] In certain embodiments, a sterile surgical tray comprises a receiving area for holding a plurality of surgical instruments; a fluid reservoir disposed apart from the receiving area; a pump operatively connected to the fluid reservoir; a motor drivingly coupled to the pump; and a plurality of input and output connectors attached to the sterile tray, at least one of the input and output connectors being connected to the motor. A sterile surgical tray system can comprise in certain embodiments a tray with a top surface defining a sterile surface for holding a plurality of surgical instruments; at least one surgical instrument held on the top surface; a pump fluid reservoir for use with the at least one surgical instrument; a pump operatively connected to the at least one surgical instrument and to the pump fluid reservoir; a motor connected to the pump for driving the pump; and wherein at least the pump remains within a sterile field during surgery.

[0016] In certain embodiments, a sterile surgical tray comprises a top surface for holding a plurality of surgical instruments; a pump connected to the sterile tray and for connection to a fluid pump reservoir; and a motor connected to the pump for powering the pump. A sterile surgical tray can comprise in certain embodiments a tray having a sterile top surface for holding a plurality of surgical instruments; a pump fluid reservoir prepackaged and sterilized with the tray; a pump in the tray for operative connection to at least one surgical instrument and the pump fluid reservoir; and a motor connected to the pump for powering the pump.

[0017] In certain embodiments, an independent system for a surgical procedure comprises a control device including a processing unit; and a plurality of instruments associated with the surgical procedure and operably coupled to the control device, wherein the control device and the plurality of instruments are prepackaged together, and the processing unit is configured to control at least one of the prepackaged instruments. In certain embodiments, at least one of the plurality of electrical instruments comprises a processing unit. The processing unit can be configured to establish communication between each of the plurality of electrical instruments. In certain embodiments, the communication can be wireless communications. In certain embodiments, the processing unit can be configured to: receive status updates from the plurality of electrical instruments; and communicate with status updates to a user of the system.

[0018] In certain embodiments, a surgical system comprises a portable surgical tray including a processing unit; a plurality of instruments operably coupled to the processing unit; and a user input device providing a user input for controlling an operating parameter of one or more of the plurality of instruments, wherein the processing unit is configured to receive the user input and transmit an operating command to the one or more of the of the plurality of instruments. In certain embodiments, the processing unit is further configured to receive and/or monitor operating parameters from the plurality of instruments. In certain embodiments, the processing unit is further configured to transmit a shut down command to a handpiece in the event that at least one operating parameter meets a threshold, for example, as a safety mechanism.

[0019] In certain embodiments, a self-powered surgical system for a surgical procedure, comprises a surgical tray; a plurality of handheld instruments; a power source in at least one of the surgical tray and a handheld instrument; and a processing unit; wherein the processing unit is configured to execute program instructions, the program instructions including instructions for: detecting power from the at least one power source; directing power to the plurality of handheld instruments from the at least one power source; and establishing communication with each of the plurality of handheld instruments.

[0020] In certain embodiments, a portable biological cutting and aspiration device comprises a cutting tip; a fluid aspiration device; and an integrated control unit coupled to the cutting tip and fluid aspiration device, wherein the control unit is configured to control cutting and aspiration of the cutting tip and fluid aspiration device.

[0021] In certain embodiments, a surgical system comprises a portable surgical platform configured to perform at least one of cutting, resecting, illuminating, lasering, aspirating, infusing, cauterizing, cryopreserving biological tissue and fluids, and infusing and aspirating fluids in a human body during surgical procedures, wherein the surgical platform is at least in part disposable; and a monitoring center coupled to the surgical platform for monitoring one or more operating parameters during the surgical procedures.

[0022] In certain embodiments a personal surgical center comprising a portable computer unit in wireless communication with at least one of a plurality of handheld instruments, the portable computer unit including a processor and memory having program instructions stored therein, the processor being operable to execute the program instructions, the program instructions including: automatically identifying at least one of the plurality of handheld instruments; wirelessly receiving operation status of the identified handheld instruments; monitoring changes in the operation status of the identified handheld instruments; and displaying the operation status on a display.

[0023] In certain embodiments, a surgical system comprises a control system accessible by a surgeon for controlling operational parameters of a one or more medical instruments; a monitoring system including a general purpose computer in wireless communication with the control system, the general purpose computer including a processor and memory having program instructions stored therein, the processor being operable to execute the program instructions, the program instructions including: wirelessly identifying the medical instruments controlled by the control system; wirelessly receiving the operational parameters of the one or more medical instruments from the control system; monitoring changes in the operational parameters of the one or more medical instruments; and displaying the operational parameters of the one or more medical instruments on a display coupled to the general purpose computer.

[0024] In certain embodiments, a sterile surgical tray system comprises a sterile surgical tray for positioning in a surgical field, the sterile surgical tray further comprising at least one controller; and a rack system positioned apart from the sterile surgical tray and outside the surgical field, the rack system being in communication with the at least one controller of the sterile surgical tray.

[0025] In certain embodiments, a sterile surgical tray system comprises a sterile surgical tray for positioning in a surgical field, the sterile surgical tray further comprising at least one display; and a rack system positioned apart from the sterile surgical tray and outside the surgical field, the rack system being in communication with the at least one display of the sterile surgical tray.

[0026] In certain embodiments, a computer-implemented method for controlling a surgical system, the method comprises receiving user input at a controller coupled to a sterile surgical tray in a surgical field; transmitting the user input to a rack system positioned apart from the sterile surgical tray and outside the surgical field; processing, using a processor in the rack system, to process the user input; and controlling a surgical apparatus based on the processed user input. In certain embodiments, the sterile surgical tray comprises the controller. In certain embodiments, a surgical device comprises the controller, wherein the surgical device is coupled to the sterile surgical tray or to the rack system. In certain embodiments, the surgical device is a handheld device, for example, a cutter device. In certain embodiments, the transmitting is performed through a wireless or wired connection to the rack system. In certain embodiments, the transmitting is performed through a wireless or wired connection to the sterile surgical tray, which is in electronic communication with the rack system. The surgical apparatus can include without limitation a handheld surgical device (for example a cutter device), a vacuum control apparatus or vacuum source, a fluid control apparatus or fluid source, a light control apparatus or light source, an energy control apparatus or energy source (for example, electrical energy), or the like.

[0027] For purposes of this summary, certain aspects, advantages, and novel features of the invention are described herein. It is to be understood that not necessarily all such advantages may be achieved in accordance with any particular embodiment of the invention. Thus, for example, those skilled in the art will recognize that the invention may be embodied or carried out in a manner that achieves one advantage or group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The foregoing and other features, aspects and advantages of the present inventions are described in detail below with reference to the drawings of preferred embodiments, which are intended to illustrate and not to limit the invention. The drawings comprise several figures in which:

[0029] FIG. **1** is a top view of a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0030] FIG. **2** is a bottom view of the tray of FIG. **1**;

[0031] FIG. **3** is a view of an alternate shape of a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0032] FIG. **4** is a top view of an alternate embodiment of a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0033] FIG. **5** is a partial elevation view of FIG. **4**;

[0034] FIG. **6** is an alternate embodiment of a portion of a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0035] FIG. **7** is a partial view of another embodiment of a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0036] FIG. **8** is a perspective view of yet another embodiment of a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0037] FIG. **9** is a perspective view of a foot controller to be used with a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0038] FIG. **10** is a perspective view of an alternate embodiment of an infusion fluid reservoir in accordance with a preferred embodiment of the invention;

[0039] FIG. **11** is a top view of a sterile surgical tray for a specific surgery in accordance with a preferred embodiment of the invention;

[0040] FIG. **12** is a top view of a sterile surgical tray for another specific surgery in accordance with a preferred embodiment of the invention;

[0041] FIG. **13** is a functional block diagram of a fluid-air exchange system to be used with a sterile surgical tray in accordance with a preferred embodiment of the invention;

[0042] FIG. **14** is a block diagram illustrating an independent surgical center coupled to a personal surgical center, surgical or other instruments, and hospital and/or medical office systems in accordance with a preferred embodiment of the invention;

[0043] FIG. **14**A is a block diagram depicting one embodiment of a computer hardware system configured to run software for implementing one or more embodiments of the system described herein, for example, the personal surgical center;

[0044] FIG. **15** is a flow diagram of various processes executed by the processing unit and/or the surgical tray in accordance with a preferred embodiment of the invention; and

[0045] FIG. **16** is a flow diagram of a process executed by the processing unit of the independent surgical center in accordance with a preferred embodiment of the invention.

[0046] FIG. **17** is a schematic view of an embodiment of the sterile surgical tray in communication with a rack system.

[0047] FIG. **18** is a schematic view of an alternative embodiment of the sterile surgical tray in communication with a rack system.

[0048] FIG. **19** is a schematic view of an embodiment of the sterile surgical tray connected to the rack system.

[0049] FIG. **20** is a schematic view of an embodiment of the sterile surgical tray connecting to the rack system through a docking station.

[0050] FIG. **21** is a schematic view of an embodiment of the sterile surgical tray communicating wirelessly with the rack system.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENTS

[0051] The following description will be disclosed relative to ophthalmic surgery but this is only for illustrative purposes and those skilled in the art will appreciate that the embodiments as described herein and as claimed may equally apply to other types of surgery, for example but not limited to ortho surgery, neurosurgery, cardiovascular surgery, gastrointestinal surgery, plastic and dermatological surgery, general surgery, head and neck surgery, including without limitation to ear, nose, and throat, maxilofacial surgery, vascular surgery, thoracic surgery (lung), transplant surgery, or the like.

[0052] Enabling a surgeon to perform effective surgery with minimal assistance from another and to perform surgery in a surgery center or office setting without a large capital investment, requires control of the surgical instruments and devices to be in the sterile surgical field. The sterile field is typically defined by the area adjacent the surgical site that is covered by a sterile drape and the area where the surgical instruments and materials are placed for access by the surgeon during surgery. The area where the surgical instruments are placed for surgery is typically a non-sterile tray, commonly referred to as a Mayo tray, covered by a sterile drape.

[0053] The embodiments of the invention described herein provide the surgeon with sterile field control of the surgery by providing the surgeon with a sterile surgical tray that has been manufactured and assembled as a prepackaged sterile pack that functions as a tray during surgery. The term pack is meant to collectively identify the surgical instruments and other items contained in a sterile package that is shipped from the manufacturer to a customer (hospital, ASC, doctor's office) and is for use by a surgeon to perform surgery. The term tray refers to a structure that defines at least a portion of a surgical field and holds fluid handling devices, surgical instruments, and other miscellaneous items to be used during surgery.

[0054] In a preferred embodiment, the pack can be synonymous with the tray. As will be seen below, in a preferred embodiment the inventive surgical tray may be manufactured and assembled with the necessary equipment for surgery and then enclosed in a bag or other container and sterilized. Then when the bag is opened, the tray is removed from the bag, a lid or cover is potentially removed, revealing several if not all the instruments and other items needed for surgery. Of course, variations on the preferred embodiment may be made without departing from the scope and claims. For example, while it is contemplated that the preferred sterile tray can be packaged and sterilized with a pump reservoir, pump, and motor, it may be that the reservoir, pump, or motor can be packaged without being sterilized. For example if the motor were contained in a chamber that was sealed off from the tray the motor may not need to be sterilized. As used herein, the term "motor" means and includes without limitation a device that receives and modifies energy to drive at least the pump.

[0055] A sterile surgical tray **10** is shown in FIG. **1**. The tray **10** includes structure **12** for receiving a plurality of surgical instruments **14**. The structure **12** for receiving the instruments **14** may be a mating structure, such as shown, that generally conforms to the shape of a particular instrument. As used herein the term "mating" means without limitation a receptacle having a complementary shape for recessing part or all of an article. Alternatively, the structure **12** could be a recess (not shown) in the tray **10** having a shape that may hold a variety of instruments **14** or the structure **12** may be cavities (not shown) formed in tray **10** that retain instruments **14** in a generally vertical orientation relative to top surface **16**, or even some other suitable structure **12** may be used. The tray **10** should have sufficient area on top surface **16** to receive the surgical instruments **14** necessary for the surgery to be performed with sufficient space between the instruments **14** to allow the surgeon to easily and conveniently pick-up an instrument and return it to the tray **10**.

[0056] The sterile tray **10** may be molded of such materials as acrylonitrile butadiene styrene (ABS) or similar thermoplastic material. The tray **10** may take the place of the traditional Mayo tray and may be placed between the surgeon and the surgical site. Therefore, it is preferred that tray **10** be sturdy enough to withstand the weight of a surgeon's arms resting on the structure forming arm rests **18**. However, other accommodation may be made for a surgeon's arms and tray **10**, in which case, tray **10** need not be as robustly constructed.

[0057] Tray **10** also may include structure forming a priming fluid reservoir **20** for receiving one or more instruments **14** during priming of one or more instruments with a surgical fluid such as balanced-salt solution (BSS), as is well known. If a reservoir **20** is not provided the user may need to use a beaker or other container for priming (for example, filling) the surgical instruments and tubes with BSS.

[0058] Structure **22** for attaching a drape **24** to the tray **10** may also be provided. The drape **24** may be placed over a patient, such as a portion of a patient's head (not shown) during ophthalmic surgery. Structure **22** may be any suitable structure such as adhesive tape, hook and loop material, or other structure that will attach drape **24** to tray **10**. Using drape **24** allows for the use of at least one fluid retention trough **26** to collect fluid runoff from the drape **24** that occurs during surgery. FIG. **1** shows two troughs **26**, but a single trough (not shown) could also be formed that surrounds the entire center section **28** where a patient's head (not shown) will be placed during surgery.

[0059] The surgical instruments **14** may include a plurality of instruments, and in particular ophthalmic surgical instruments prepackaged and sterilized with the tray **10**. Also, at least one surgical instrument **14** may be connected at manufacture to a pump fluid reservoir **30** via tubing **32** and/or **34**, as shown in FIG. **1**. If the sterile surgical tray **10** is for ophthalmic surgery the plurality of surgical instruments **14** preferably includes at least a tissue isolation instrument, an aspiration instrument, and an infusion instrument. The tissue isolation instrument may be at least one of a vitreous cutter, a lens emulsification, fragmentation, or cutting device, a scissors, and a cautery knife, all of which are well known. The aspiration instrument may be incorporated into the tissue isolation instrument, such as is known in vitreous cutters and phacoemulsification (phaco) devices. The aspiration and infusion instruments may be a combined infusion and aspiration instrument, commonly referred to as an irrigation/aspiration (I/A) handpiece. If the surgical tray **10** is for vitreoretinal surgery the infusion instrument may be an infusion cannula and connected tubing.

[0060] Additional surgical instruments may include an illumination instrument, which is preferably self-illuminating. That is the illumination instrument preferably has a built-in light source and not the commonly known remote light source-fiber optic combination. In addition tray **10** may include additional items such as entry site alignment cannulas **36**, commonly used in sutureless vitreoretinal surgery.

[0061] Preferably tray **10** includes all or nearly all the instruments necessary to perform the desired surgery. For instance tray **10**, if the desired surgery is a vitrectomy of the eye, includes the instruments for a vitrectomy, which are a vitreous cutter, an irrigation instrument, an illumination instrument, an aspiration source, an infusion source, and passive surgical instruments (for example, not powered), and possibly an air/fluid exchange source. If the desired surgery is a cataract removal from the eye, the instruments included in tray **10** would be a cataract extraction instruments such as a phaco device, a phaco needle, a capsule polish tool, an aspiration source, an infusion source, and passive surgical instruments, and possibly an oil filled syringe. Tray **10** also preferably includes structure for receiving additional instruments beyond the plurality of instruments that are prepackaged and sterilized with the tray **10**; an example of which is the empty space, shown generally at **38** in FIG. **1**.

[0062] In certain embodiments, the sterile surgical tray **10**, as best seen in FIG. **2**, also includes a pump(s) **40** contained within the sterile tray **10** operatively connected to the pump fluid reservoir **30**. In certain embodiments, a motor(s) **42** is also contained within the sterile tray **10** and is connected to the pump **40**. In certain embodiments, the sterile surgical tray **10** can be configured to releasably receive a motor(s) and a pump(s), and/or be mechanically and/or electrically coupled to a motor(s) and a pump(s), which may or may not be partially or entirely sterile because in certain embodiments, the motor(s) and/or pump(s) may be reused with other sterile surgical trays. In the embodiment shown in FIG. **2**, which is a bottom view of tray **10**, reservoir **30** is not easily removable from tray **10**. Other embodiments (see for example FIG. **6** discussion below) may provide a reservoir, pump, motor assembly that is self-contained and placed in a pocket or cavity (not shown) of tray **10** so that the assembly can be removed from tray **10** easily before, during, or after surgery.

[0063] Reservoir **30** may be an aspiration pump fluid reservoir for collecting aspirated tissue and fluid during surgery or reservoir **30** may be infusion pump fluid reservoir for infusing fluid into a surgical site. Another embodiment of reservoir **30** is that shown in FIG. **2** where reservoir **30** is actually both an aspiration reservoir **44** and an infusion pump fluid reservoir **46**; such that infusion reservoir **46** and aspiration reservoir **44** form a single fluid reservoir **30** with separate chambers for infusion and aspiration and a pump operatively connected to each chamber. Therefore, in the configuration of FIG. **2** pump **40** is an infusion pump and pump **48** is an aspiration pump. Motors **42** and **50** are preferably electric motors and may be the same type motor or different motors depending on the performance needed to drive the pumps **40** and **48**. Aspiration pump **48** is preferably a suitable pump for aspirating a sufficient amount of tissue and fluid at an acceptable rate for the type of surgery to be performed. For ophthalmic surgery, pumps **40** and **48** may be one of a vacuum pump (for example, a rotary vein or diaphragm) or a positive displacement pump (for example, peristaltic or scroll). Tray **10** may also include a syringe pump (not shown) for injecting oil or other fluids into the eye.

[0064] In certain embodiments, the inclusion of a pump and reservoir in tray **10** provides particular fluidics advantages over traditional console based systems. For example, fluidics advantages can be achieved because the construction and functionality of tray **10** allow the pump fluid reservoir to be less than two feet from a surgical site, such as an eye. This close proximity can allow for infusion and aspiration tubing lengths of less than two feet and perhaps less than 18 inches to be used. By using such short tubing lengths compliance of the fluidics circuit defined by the path from the infusion reservoir **46** through infusion tubing and a surgical instrument into the eye followed by an aspiration out of the eye through aspiration tubing and into the aspiration reservoir **44**, can be greatly reduced compared to the conventional console based surgeries known today. Conventional console based surgeries use several feet (as much as 6-8 feet) of tubing for both the infusion path and the aspiration path. Furthermore, a reduced aspiration and infusion tubing length reduces fluid propagation delays and increases responsiveness of the aspiration and infusion functions. The 6-8 feet tubing length can negatively impact fluidic performance as compared to the much shorter tubing lengths possible in the preferred embodiments. The longer tubing lengths have longer delays in pressure and vacuum level changes introduced into the surgical instruments and an eye compared to the much shorter lengths of the preferred embodiments. These longer delays are the result of the increase tubing length and the compliance of the tubing. The effect of any tubing compliance will be amplified by longer tubing lengths. The shorter tubing lengths can also reduce the complexity of the surgical operation for the surgeon because with multiple lengthy tubes in the surgical room the surgeon generally must take care not to entangle the lengthy tubes or to pinch the lengthy tubes during the surgery.

[0065] Tray **10** may have a shape that conforms to a contour of a body portion adjacent a surgical site. As can be seen from FIGS. **1** and **2** tray **10** is curved so that the tray **10** may be placed around a patient's head (not shown) during ophthalmic surgery. Tray **10**, which can be said to be generally U-shaped, would be placed such that a top of the patient's head is placed nearest the wall **52** or, put another way, at the bottom of the U-shaped section **28**. The sterile surgical tray for ophthalmic surgery may also be semi-circular in shape, as shown at **54** in FIG. **3**. Fluid reservoir **30** is preferably located to a side of the patient's head during surgery, as shown in the embodiment of FIGS. **1** and **2**.

[0066] Fluid reservoir **30** may be a rigid housing formed of suitable material such as some form of plastic or resin. The Pump fluid reservoir may also be a bag **56**, shown in FIG. **4**. A sterile surgical tray **58** similar to tray **10**, in the embodiment of FIG. **4**, includes a remotely located infusion source **60**, such as a BSS bottle that may be hung from an IV pole (not shown). Infusion source **60** is connected to a surgical instrument **62** via tubing **64** (preferably included in tray **58** during manufacture). Instrument **62** is connected to a pump **66** via tubing **68**. Pump **66** is powered by a motor **70**, seen in FIG. **5**. FIG. **5** is a partial elevation view of the inside of tray **58** taken along line **5-5** of FIG. **4**. Pump **66** aspirates tissue and fluid from a surgical site into bag **56** via tubing **72**. Bag **56** may be hung from structure on tray **58** such as hooks **74**.

[0067] In reference to FIGS. **1** and **2**, fluid reservoir **30** preferably includes a filler port **76** for allowing a user to fill the fluid reservoir **46** with a surgical fluid to be infused into a surgical site. Fluid reservoir **44** preferably includes a discharge port for emptying aspirated fluid when the reservoir **44** becomes full during surgery.

[0068] FIG. **6** shows an aspiration and infusion reservoir **100**, including isolated aspiration reservoir **102** and infusion reservoir **104**. Reservoir **100** includes a separate pump and motor for each chamber **102** and **104**. An aspiration pump **106** and motor **108** will aspirate fluid and tissue from a surgical site through surgical instrument **110** via tubing **112**. Infusion fluid contained within infusion reservoir **104** is forced from reservoir **104** through tubing **114** to an infusion instrument (not shown) by infusion pump **116** and motor **118** pressurizing reservoir **104**. An example of an infusion instrument can be an infusion cannula that is inserted into the eye to allow infusion fluid to enter the eye and maintain internal eye pressure to prevent collapse of the eye. As can be seen pumps and motors **106**, **108**, **116**, and **118** are contained within a chamber **120** of reservoir **100**. It is possible that because of the isolation of the pumps and motors in chamber **120** that they may not need to be sterilized along with reservoir **100** and its associated tray and surgical instruments after packaging at a manufacturer. It is accepted protocol that any surface that comes in direct contact with the infused or aspirated fluids should be sterile. Though an associated tray is not shown with reservoir **100** it is easily understood that reservoir **100** could be retained in and prepackaged and sterilized with a tray in a similar fashion to that described above relative to tray **10**. In addition, it is possible that reservoir **100** may be removed from a tray and placed or hung by ledge **122** at a convenient location for surgery.

[0069] Tray **10** further includes a power connector **80** connected to motors **42** and **50** for connecting motors **42** and **50** to a power source **82** via lines **84**. Power source **82** is shown in FIG. **2** as a battery but the power source could be at least one of a direct current (DC) source, an alternating current (AC) source, a fuel cell, or a wireless power source, such as Witricity, or some other suitable power source. So power connector **80** can be at least one of an AC connector, a fuel cell connector or a wireless power connector instead of the battery connector shown. FIG. **2** shows one power source connection but it is to be understood that multiple power sources may be used. In addition, power source **82** may not be prepackaged and sterilized with tray **10** as shown, but rather, may be a power source that is connected to tray **10** after tray **10** is opened and is being prepared for surgery. Power connector or connectors **80** may be attached to a portion of tray **10**, such as in a side wall of tray **10**, as shown in FIG. **7**; where power connector **80** is for connection to a DC source, an AC source, or an AC cord (not shown) to be plugged into a wall socket (not shown). If wireless power transmission is used it is possible that lines **84** can be eliminated if the surgical instruments are able to incorporate the power transmission apparatus. Obviously not all surgical instruments need power and some instruments may be self-powered by battery or fuel cell.

[0070] In the case where a power source is connected after tray **10** is opened, it may not be necessary for the power source to be sterile. For instance, the lower portion of tray **10** may have an opening for accepting a battery pack or fuel cell. In this case a non-sterile battery pack or fuel cell could potentially be used because it is below the sterile field top surface **16** of tray **10**.

[0071] Power connector **80** may be connected directly to motors **42** and **50** and at least one surgical instrument **14** such that power source **82** powers the pumps and at least one surgical instrument **14**, as shown in FIG. **2**. At least one surgical instrument **14** is connected to power connector **80** through one of lines **84**, an input and output connector **86**, and line **88** (shown in FIG. **1**). Of course more than one surgical instrument **14** may also be connected to power connector **80** through other input and output connectors **86**, though these are not shown. The surgical instruments that can be connected include a vitreous cutter, a lens emulsification, fragmentation, or cutting device, an illumination device, and a scissors. In addition, the surgical instruments **14** may be prepackaged and sterilized with tray **10** and connected to pump reservoir **30** and input and output connectors **86**.

[0072] Though power connector **80** may be connected directly to motors and surgical instruments, a power distributor **90**, shown in FIG. **2**, may be desired for distributing power throughout the sterile tray **10** for powering a plurality of surgical instruments. Depending on the power source used and the instruments needed for surgery power distributor **90** may take on many forms, such as a voltage transformer, a DC-to-DC converter, and an AC-to-DC converter. In addition power distributor **90** may also include a processor for performing control functions to operate the surgical instruments, motors, and operator feedback or status indicators, in other words power distributor **90** may also be the central controller for the entire surgical operation to be performed.

[0073] Tray **10**, because of the desire to enable a surgeon to perform surgery with little or no assistance, preferably includes structure for connecting a sterile barrier to tray **10**, such as slots **92**. A sterile barrier **94** is attached to tray **10** in FIG. **8**. Sterile barrier **94** includes a pliable sheet **96** that has at least one pocket **95** formed in the sheet **96** for allowing a non-sterile user (not shown) outside a sterile field to manipulate items within the sterile field without compromising the sterile field. The sheet **96** is attached to supports **98** that are in turn held within slots **92** of tray **10**. Pocket **95** is shown as two pockets in FIG. **8** that form gloves for a user. It should be easily understood, that pocket **95** may take on other forms than gloves. For example, pocket **95** could simply be a cavity without any structure forming finger openings.

[0074] Tray **10**, in addition to having structure for receiving a plurality of surgical instruments, preferably includes a plurality of input and output connectors **86** attached to tray **10**, as seen in FIGS. **1** and **2**. So as best seen in FIG. **2**, sterile surgical tray **10** preferably includes pump fluid reservoir **30** contained within sterile tray **10**, a pump or pumps **40** and **48**, and a motor or motors **42** and **50** connected to the pumps and at least one of the input and output connectors **86** is connected to the motors **42** and **50** for connecting the motors **42** and **50** to a power source **82**, such as the battery shown.

[0075] Tray **10** further may include at least one status indicator **130** attached to at least one of the output connectors **86**. The status indicator may be a light emitting diode (LED) or an audible signal generator. In FIG. **1**, on the left side three status indicators **130** are shown adjacent a surgical instrument **14**. Depending on the type of instrument **14** the three status indicators **130** could provide different types of feedback to a user. For example, if reservoir **30** included a sensor the indicators **130** could be red, yellow, and green in color to indicate to the user that a vacuum level is unacceptable (red), a vacuum level is approaching an unacceptable level (yellow), or the vacuum level is acceptable (green). Another example is that the indicators **130** could indicate a speed or energy level of the instrument where all three indicators are on when the speed or energy level is high, two indicators are on when the speed or energy level is at an intermediate level, and one indicator is on when the speed or energy level is low.

[0076] Because tray **10** is used in an operating room that may be dark for certain surgeries, such as ophthalmic surgery, it is desirable that a plurality of LEDs **132** are connected to a plurality of output connectors **86** and at least one LED **132** is connected to tray **10** adjacent each of a plurality of surgical instrument retaining recesses **12** for illuminating a location of the surgical retaining recesses **12** on the tray **10**. Preferably, a plurality of surgical instruments **14** are retained in tray **10** and connected to a portion of the plurality of input and output connectors and prepackaged and sterilized with the tray.

[0077] Depending on the type of surgery for which tray **10** is intended it may be desirable for tray **10** to be sufficiently narrow at a location **134** that will be immediately between a patient and a surgeon to allow the surgeon unrestricted access to a surgical site. In the example of FIG. **1**, location **134** is in the center of tray **10** and forms the bottom of the U-shape of tray **10**. It also may be desirable where tray **10** includes a plurality of surgical instruments retained in tray **10** and connected to a portion of the plurality of input and output connectors **86**, that the input and output connectors **86** connected to the plurality of surgical instruments are attached to tray **10** at a generally central location **134**, so that the connected instruments may be placed on either side of the tray to accommodate either a left or right handed surgeon.

[0078] The status indicators **130**, in a similar fashion to the discussion above, may also be placed on tray **10** to indicate a power level of a battery or fuel cell, a fluid level of a pump fluid reservoir attached to the input and output connectors or an illumination level of an illuminator attached to the input and output connectors. An alternative or supplement to the status indicators and LEDs **130** may be a display **136** for displaying, via numbers, icons, bar graphs, and the like, the status of the instruments and/or other apparatus connected to tray **10**. As discussed above, tray **10** may also have a processor attached to the input and output connectors **86** for receiving inputs from a user and a plurality of surgical instruments **14** and devices attached to the input and output connectors **86** and for transmitting signals to a user and the plurality of surgical instruments **14** and devices. The processor may be part of power distributer **90** or it may be a separate device. The processor may also be prepackaged and sterilized with tray **10** or it may be connected to tray **10** after tray **10** is opened and is being prepared for surgery.

[0079] Tray **10** may also include a wireless transceiver **138** connected to the input and output connectors **86** for transmitting and receiving signals to and from remote devices and surgical instruments. Wireless transceiver **138** may be any acceptable type of wireless communication device such as an infrared or radio frequency transceiver. Known examples of radio transceivers include Bluetooth®, Zigbee®, Wifi or IEEE 802.11 transceivers, or other known wireless communication devices. The wireless transceiver **138** can be connected a processor connected to tray **10** and to a laptop computer (not shown) in the operating room or elsewhere for monitoring or controlling a surgical procedure through the information flowing throughout tray **10** and the input and output connectors **86**. For the sake of clarity and simplicity only some of the wires or lines **84** and some of the input and output connectors **86** have been shown in the drawings but it should be understood that potentially the processor could be remotely located from tray **10**, and the control, monitoring, feedback, and/or communication signals could flow wirelessly between the processor and tray **10** via wireless transceiver **138**.

[0080] In addition to the devices disclosed above some of the input and output connectors **86** may be connected to user input buttons, knobs **33**, or the like. Also, a foot control connector **140** may be attached to tray **10** for connecting a foot controller **142** shown in FIG. **9**. Of course, foot controller **142** may also be connected to tray **10** via wireless transceiver **138** as indicated by symbol **144** in FIG. **9**. It is also desirable that a portion of the input and output connectors **86** are for connection to additional instruments beyond the plurality of instruments prepackaged and sterilized in tray **10**. For example, a surgeon performing vitreoretinal surgery may require a fragmentation instrument that is not included in prepackaged and sterilized tray **10** but it can be connected to tray **10** using a mating input and output connector **86**.

[0081] Another example of an infusion fluid reservoir that may be used with a sterile surgical tray, is shown in FIG. **10**. Infusion reservoir **150** is a multiple chamber fluid reservoir for holding a different fluid in each chamber. A pressure pump **152** is connected to two or more chambers **154**, **156**, and **158** for pressurizing the chambers. A multiple position valve **160** is connected to the multiple chambers **154**, **156**, and **158**, via tubing **162**. Valve **160** allows a fluid contained in a selected chamber to flow out of the selected chamber and into an eye or other surgical site through tubing **164** and a surgical instrument (not shown). Valve **160** is shown as a well known three position stop cock but valve **160** could also be individual valves or mechanically or electrically actuated valves depending on the design. If valve **160** is electrically actuated it could be attached or contained within tray **10** and connected to a portion of the input and output connectors **86** to support other than manual selection of the position of valve **160**. The infusion fluid reservoir **150** shown has three chambers **154**, **156**, and **158**, each chamber holding one of BSS, silicone oil, and a gas, which are particularly useful in ophthalmic surgery; but other fluids could be held in the chambers depending on the requirements of the particular surgery to be performed. For example, one of the chambers could contain viscoelastic. Infusion reservoir **150** is also preferably transparent so that a user can easily see the fluid levels in chambers **154**, **156**, and **158**. It should also be appreciated that infusion fluid reservoir **150** has use beyond use with tray **10** and could be used with other surgical systems.

[0082] Infusion pump **152**, powered by motor **166** pressurizes multiple chambers **154**, **156**, and **158** for infusing multiple fluids into a surgical site. It should be understood that motor **166** is connected to input and output connectors **86** (not shown) for power and control. Chambers **154**, **156**, and **158** also preferably include access ports **168** for filling or refilling the chambers. Ports **168** can require caps or closure devices to prevent fluids from leaking and to allow the chambers to be adequately pressurized. The chamber **154** shows a bag **170** partially filled with a fluid **172**. Fluid **172** may be BSS or other liquid. Chamber **154** includes bag **170** at least partially filled with BSS such that pump **152** pressurizes the fluid reservoir chamber **154** during surgery to force BSS **172** from the fluid reservoir **150**. Chamber **156** may hold silicone oil **174** and chamber **158** may hold a gas **176**.

[0083] FIG. **11** shows an example of a sterile surgical tray **180** including a plurality of surgical instruments including the instruments to perform a vitrectomy of an eye. To perform a vitrectomy at least an illumination instrument, a tissue cutting instrument, an infusion instrument, an entry site alignment system, and a surgical knife would typically be included in a sterilized tray such as tray **180**.

[0084] FIG. **12** shows an example of a sterile surgical tray **182** including a plurality of surgical instruments including the instruments to perform a cataract removal from an eye. To perform a cataract removal at least a lens emulsification device, an infusion device, viscoelastic, a rhexis forceps, an intraocular lens insertion instrument, and a surgical knife would typically be included in a sterilized tray such as tray **182**.

[0085] FIG. **13** is a functional block diagram of a fluid-air exchange system **300** is an alternative to pump reservoir **150** that may be incorporated into a sterile surgical tray, such as tray **10**. System **300** preferably includes a BSS reservoir **302**, a reservoir **304** of air, connected to a selector valve **306** for selecting which fluid, BSS or air, will be allowed to flow into infusion pump **308**. Infusion pump **308** may be any suitable pump for infusing fluid into an eye or other body part. A bypass valve **310** connects a flow path from infusion pump **308** and an oil reservoir **312**. Oil reservoir **312** is connected to a source of oil **314** via a check valve **316**. Oil source **314** may be a syringe, as shown or may be another source that is connected to a pump (not shown) for automatically pumping oil into reservoir **312**. Oil reservoir is then connected to a three-way stopcock valve **318** via another check valve **320**. Depending on the positions of the valves **306**, **310**, and **318** air, BSS, or oil (typically silicone oil) will be infused into an eye. Bypass valve **310** allows infusion pump and air or BSS to push oil from reservoir **312** into an eye.

Independent Surgical Center and Personal Surgical Center

[0086] In certain embodiments, the independent surgical tray **1402** can include at least the sterile surgical tray as described herein as illustrated in FIG. **14**. The independent surgical center **1402** can be coupled to various surgical/medical or other devices **1401**, a personal surgical center **1410**, and/or a hospital/medical office system **1414**.

[0087] In reference to FIG. **14**, the independent surgical center can be operable without the use of an external surgical console, and can act as a standalone system. Alternatively, the independent surgical center can also be coupled to various surgical and/or other devices **1401** (also referred to herein as handpieces), for example but not limited to an illumination device **1407**, foot pedal input device **1406**, cutting device **1408** (also referred to as a biological tissue cutting device, as further described below), irrigation device, infusion device, viewing device, aspiration device, lasering device, cauterizing device, resecting device, lens emulsification device, fragmentation device, lens cutting device, scissor device, or any other like devices. In certain embodiments, the foregoing surgical and/or other devices can comprise a power source (internal or external, AC/DC), processing unit, network interface (wired or wireless), electronics, memory, audio mechanism, and the like. In certain embodiments, the independent surgical center **1402** communicates and/or is coupled/connected to the various surgical and/or other devices through a network interface **1440**. The network interface **1440** can operate on a wired connection and/or a wireless connection using Bluetooth®, Zigbee®, Wifi or IEEE 802.11, or any other wireless communication protocol.

[0088] As illustrated in FIG. **14**, the network interface **1440** can be coupled to a battery pack **1442**, which can be received in, coupled to, and/or removed from the independent surgical center **1402**. In certain embodiments, the battery pack **1442** comprises without limitation a battery or a plurality of batteries **1444**, and a processing unit **1446**. In certain embodiments, the processing unit can be in the independent surgical center **1402**, the personal surgical center, a separate console, and/or the surgical devices, as described herein. The battery pack **1442** can comprise electrical contact and/or connectors for allowing the battery **1444**, the processing unit **1446** (for example, Intel® 8085 microprocessor), and/or the network interface **1440** to be coupled and/or to connect to the circuitry and/or electronics **1412**. In certain embodiments, the processing unit **1446** is configured to execute programming instructions stored in memory within the electronics **1412** to control light emitting diodes (LEDs) **1448**, and/or receive user input through control knobs, buttons, or other input devices **1450**. For example, the processing unit can be configured to control the LEDs to indicate/show the cutting device's status, speed, or other like indicators. The processing unit **1446** can also be configured to communicate with the motors **1452** coupled to the pumps **1454**. The processing unit **1446** can also be configured to communicate and/or transmit commands to the surgical and/or other devices **1401** or to the personal surgical center **1410**.

[0089] In reference to FIG. **14**, the battery pack **1442** can be disposable or can be reused with other independent surgical centers **1402**. The battery pack **1442** can be sterile or non-sterile, in which case the battery pack cannot be within the surgical field. In a preferred embodiment, the battery pack **1442** is reused with other independent surgical centers **1402** because of the cost of the batteries **1444**, the processing unit **1446**, and/or the network interface **1440**, but in certain embodiments, the battery pack **1442** is disposable for purposes of sterility. The independent surgical center can also be coupled to a personal surgical center **1410**.

[0090] With reference to FIG. **14**, in certain embodiments, the personal surgical center **1410** can control the independent surgical center **1402**. The personal surgical center **1410** can also include without limitation a console, general purpose computer, laptop computer, networked device(s), or the like that can be configured to monitor and/or display the settings of the various medical instruments (for example, the handpieces and/or surgical devices) on display or a touch screen input display **1428**. Additional embodiments of the personal surgical center **1410** are described below. The personal surgical center **1410** can include without limitation a log database **1430** for storing real-time data and/or periodic data and status levels obtained and/or received from the independent surgical center. Based on the data, status levels, and/or patient information received from the independent surgical center and/or surgeon/technician, the personal surgical center **1410** can generate and/or store reports using the reports system and/or database **1432**. The personal surgical center **1410** can also initiate billing procedures using the billing module **1434** that can interface with a billing system and database **1420**. The personal surgical center **1410** can also store the data, status levels, and/or patient information in the patients records database **1422** using patient records module **1436**, or can store this data in the hospital information system (HIS) **1424** using the HIS interface module **1438**. In certain embodiments, the personal surgical center **1410** monitors and displays the settings and status of the various surgical and/or other devices while the independent surgical center controls the medical instruments via the circuitry and electronics **1412** in the independent surgical center, and the circuitry and controls in the various surgical and/or other devices. In certain embodiments, the personal surgical system **1410** can be coupled to other hospital/medical office systems **1414**.

[0091] FIG. **14** also illustrates one embodiment of a hospital/medical office system **1414**, which can include without limitations systems and databases **1416** for logging data from the personal surgical center **1410**, systems and databases **1418** for generating reports, systems and databases **1420** for producing invoices, bills, and/or insurance claims, systems and databases **1422** for storing patient records, systems **1424** for interfacing with hospital information systems (HIS).

[0092] In reference to FIG. **14**, in certain embodiments, the independent surgical center **1402** and surgical and/or other devices can be located within the sterile field in which a surgery is performed, while the personal surgical center, and the hospital/medical office systems can be located outside the sterile field.

Biological Tissue Cutting Device

[0093] With reference to FIGS. **6** and **14**, in certain embodiments, the biological tissue cutting and/or aspiration handpiece (for example, vitrectomy handpiece or other like handpieces) is portable, lightweight and can be powered by battery to power the cutter and/or aspiration. It can be used in the field, offices, surgery centers and operating rooms. The biological tissue cutting and/or aspiration handpiece may be used as a standalone instrument or in conjunction with the independent surgical center discussed above. The handpiece may be disposable and can be connected to the aspiration/infusion cassette, which provides aspiration pressure to the cutter. FIG. **6** illustrates on example of an aspiration/infusion cassette **100** with the infusion line **114** and the biological tissue cutting and aspiration handpiece **110**. The left side of the cassette functions to provide aspiration pressure to the biological tissue cutting and aspiration handpiece, while the right side provides infusion.

[0094] In certain embodiments, for example, the biological tissue cutting and/or aspiration handpiece is a disposable handpiece such as that described in co-pending U.S. Patent Publication No. 2008-0208233 A1 (U.S. patent application Ser. No. 11/963,749) titled Disposable Vitrectomy Handpiece, filed Dec. 21, 2007, the entire content of which is incorporated herein by reference. In addition, the biological tissue cutting and/or aspiration handpiece can incorporate battery power or other power supply, and a flow controller/pinch valve. The handpiece may wirelessly communicate (for example, Bluetooth or the like) with other surgical instruments, an internal or external monitor or speaker, or a control center in the aspiration/infusion cassette. Alternatively, the handpiece may wirelessly communicate with a personal surgical center and/or an independent surgical center. Surgical parameters (for example, cut speed, frequency, aspiration pressure/flow rate) may be controlled directly on the handpiece, or via a foot pedal wirelessly connected to the handpiece. Such parameters may control a cutting tip, aspiration pump, and the like. The drive circuitry may be incorporated directly in the handpiece, in the surgical tray, or aspiration/infusion cassette depending on how the handpiece is powered (for example, by battery or through the aspiration/infusion cassette).

[0095] As noted above, according to certain embodiments, the biological tissue cutting and/or aspiration handpiece can be a stand-alone instrument, not used with an external control center. In certain embodiments, the handpiece can be used in conjunction with other standalone instrumentation, such as an illumination device. The controls for the handpiece are located on the handpiece itself, eliminating the need for a surgical console. The handpiece itself or the surgical tray may have a display or speaker to inform the surgeon of current surgical settings and instrument faults. According to certain embodiments, the handpiece includes a control unit or processing unit which may be, for example, a microprocessor based unit, an ASIC, or the like, and other circuitry.

[0096] In certain embodiments, the biological tissue cutting and/or aspiration handpiece can be used in conjunction with an aspiration/infusion cassette that includes a control center or in conjunction with an external, laptop control center. Although it may be possible to plug the system into an outlet, battery power can enable better maneuverability of the handpiece. The battery may be placed inside the handpiece, surgical tray or at the aspiration/infusion cassette itself. When the battery is placed inside the handpiece, it adds weight and size to the unit, and can reduce maneuverability and ergonomics. The aspiration/infusion cassette can be larger and heavier because ergonomics on this instrument are not as critical. However, when the battery is placed at the aspiration/infusion cassette or surgical tray, an electrical line would need to be tethered to the handpiece along with the aspiration line.

[0097] The wireless control (for example, Bluetooth) may be mounted in the handpiece, the aspiration/infusion cassette, the surgical tray, or all of the above. If the handpiece uses battery power and includes no link to the aspiration cassette or surgical tray, wireless communication will generally be within the handpieces, surgical tray, and other devices. However, if there is a direct-wired link between the two, wireless communications may then be with certain devices, for example the surgical tray. In certain embodiments, the wireless communication will be within the aspiration/infusion cassette or surgical tray to reduce the weight of the handpiece. In certain embodiments, the battery/power source for the biological tissue cutting and/or aspiration handpiece, the network communication, and the aspiration originate from the surgical tray through a direct wire connection.

[0098] In certain embodiments, the handpiece may include a display and/or speaker for relaying information regarding instrument status, fault, cut speed, or the like. For example, the handpiece may include a LED and/or speaker on the handpiece itself. In certain embodiments, the instrument and operation information may also be shown on a display or speaker on the surgical tray or may be displayed on a personal surgical center or a laptop center to allow the surgeon to more easily review such information.

[0099] When used in conjunction with a personal surgical center or a laptop center, the biological tissue cutting and/or aspiration handpiece may communicate with the personal surgical center or the laptop directly or indirectly through the independent surgical tray or surgical tray. The personal surgical center or laptop center can indicate the instrument and operation information, such as current cut speed, battery life (if applicable), any faults, or any other indicator or status information. It may also receive additional information, such as the maximum cut speed permissible and other surgical parameters. Upon startup, the biological tissue cutting and/or aspiration handpiece can identify itself to the independent surgical center, and/or personal surgical center and/or laptop center, and indicate whether it has been used before. If flow sensing or flow control is used, the sensors and actuators may be placed close to or directly on the biological tissue cutting and/or aspiration handpiece.

Personal Surgical Center

[0100] With reference to FIG. **14**A, there is illustrated one embodiment of a computer system and/or device for the personal surgical center. FIG. **14**A illustrates a block diagram of one embodiment of a computing system (which can be a fixed system or mobile device) that is in communication with one or more independent surgical centers **910** and/or one or more surgical devices **915** via one or more networks **910**. The computing system **900** may be used to implement one or more of the systems and methods described herein. In addition, in one embodiment, the computing system **900** may be configured to process status data and/or information from surgical devices. While FIG. **14**A illustrates one embodiment of a computing system **900**, it is recognized that the functionality provided for in the components and modules of computing system **900** may be combined into fewer components and modules or further separated into additional components and modules.

[0101] In one embodiment, the system **900** comprises processing and analysis modules **906** that carry out the functions, methods, and/or processes described herein. The processing and analysis modules **906** may be executed on the computing system **900** by a central processing unit **904** discussed further below.

[0102] Computing System Components

[0103] In one embodiment, the processes, systems, and methods illustrated above may be embodied in part or in whole in software that is running on a computing device. The functionality provided for in the components and modules of the computing device may comprise one or more components and/or modules. For example, the computing device may comprise multiple central processing units (CPUs) and a mass storage device, such as may be implemented in an array of servers.

[0104] In one embodiment, the computing system **900** also comprises a laptop computer suitable for controlling and/or communicating with databases, performing processing, and generating reports from databases. The computing system **900** also comprises a central processing unit ("CPU") **904**, which may comprise a microprocessor. The computing system **900** further comprises a memory **905**, such as random access memory ("RAM") for temporary storage of information and/or a read only memory ("ROM") for permanent storage of information, and a mass storage device **901**, such as a hard drive, diskette, or optical media storage device. Typically, the modules of the computing system **900** are connected to the computer using a standards based bus system. In different embodiments, the standards based bus system could be Peripheral Component Interconnect (PCI), Microchannel, SCSI, Industrial Standard Architecture (ISA) and Extended ISA (EISA) architectures, for example.

[0105] The exemplary computing system **900** comprises one or more commonly available input/output (I/O) devices and interfaces **903**, such as a keyboard, mouse, touchpad, and printer. In one embodiment, the I/O devices and interfaces **903** comprise one or more display devices or touch screen display devices, such as a monitor, that allows the visual presentation of data to a user. More particularly, a display device provides for the presentation of GUIs, application software data, and multimedia presentations, for example. In the embodiment of FIG. **14**A, the I/O devices and interfaces **903** also provide a communications interface to various external devices. The computing system **900** may also comprise one or more multimedia devices **902**, such as speakers, video cards, graphics accelerators, and microphones, for example.

[0106] Computing System Device/Operating System

[0107] The computing system **900** may run on a variety of computing devices, such as, for example, a server, a Windows server, a Structure Query Language server, a Unix server, a personal computer, a mainframe computer, a laptop computer, a cell phone, a personal digital assistant, a kiosk, an audio player, and so forth. The computing system **900** is generally controlled and coordinated by operating system software, such as z/OS, Windows 95, Windows 98, Windows NT, Windows 2000, Windows XP, Windows Vista, Linux, BSD, SunOS, Solaris, or other compatible operating systems. In Macintosh systems, the operating system may be any available operating system, such as MAC OS X. In other embodiments, the computing system **900** may be controlled by a proprietary operating system. Conventional operating systems control and schedule computer processes for execution, perform memory management, provide file system, networking, and I/O services, and provide a user interface, such as a graphical user interface ("GUI"), among other things.

[0108] Network

[0109] In the embodiment of FIG. **14**A, the computing system **900** is coupled to a network **910**, such as a LAN, WAN, or the Internet, for example, via a wired, wireless, or combination of wired and wireless, communication link **915**. The network **910** communicates with various computing devices and/or other electronic devices via wired or wireless communication links. In the exemplary embodiment of FIG. **14**A, the network **910** is communicating with one or more independent surgical centers **910** and/or one or more surgical devices **915**.

[0110] Computing system may comprise a browser module or other output module that may be implemented as a combination of an all points addressable display such as a cathode-ray tube (CRT), a liquid crystal display (LCD), a plasma display, or other types and/or combinations of displays. In addition, the browser module or other output module may be implemented to communicate with input devices **903** and may also comprise software with the appropriate interfaces which allow a user to access data through the use of stylized screen elements such as, for example, menus, windows, dialog boxes, toolbars, and controls (for example, radio buttons, check boxes, sliding scales, and so forth). Furthermore, the browser module or other output module may communicate with a set of input and output devices to receive signals from the user.

[0111] The input device(s) may comprise a keyboard, roller ball, pen and stylus, mouse, trackball, voice recognition system, or pre-designated switches or buttons. The output device (s) may comprise a speaker, a display screen, a printer, or a voice synthesizer. In addition a touch screen may act as a hybrid input/output device. In another embodiment, a user may interact with the system more directly such as through a system terminal connected to the score generator without communications over the Internet, a WAN, or LAN, or similar network.

[0112] In some embodiments, the system **900** may comprise a physical or logical connection established between a remote microprocessor and a mainframe host computer for the express purpose of uploading, downloading, or viewing interactive data and databases on-line in real time or periodic basis. The remote microprocessor may be operated by an entity operating the computer system **900**, including the client server systems or the main server system, an/or may be operated by one or more of the surgical devices **915** and/or one or more of the independent surgical centers **910**.

[0113] Other Systems

[0114] In addition to the systems that are illustrated in FIG. **14**A, the network **910** may communicate with other data sources or other computing devices, for example billing systems or hospital information systems. The computing system **900** may also comprise one or more internal and/or external data sources. In some embodiments, one or more of the data repositories and the data sources may be implemented using a relational database, such as DB2, Sybase, Oracle, CodeBase and Microsoft® SQL Server as well as other types of databases such as, for example, a flat file database, an entity-relationship database, and object-oriented database, and/or a record-based database.

[0115] In some embodiments, the acts, methods, and processes described herein are implemented within, or using, software modules (programs) that are executed by one or more general purpose computers. The software modules may be stored on or within any suitable computer-readable medium. It should be understood that the various steps may alternatively be implemented in-whole or in-part within specially designed hardware. The skilled artisan will recognize that not all calculations, analyses and/or optimization require the use of computers, though any of the above-described methods, calculations or analyses can be facilitated through the use of computers.

Example Process Flow

[0116] FIG. **15** is a flow diagram of a process executed by the processing unit **1446** of an independent surgical center in accordance with an embodiment of the invention.

[0117] In some embodiments, the process of FIG. **15** represents the process which is performed by the processing unit housed or received in the sterile surgical tray as described herein. In some embodiments of the invention, the process may be performed in another instrument or component of the system, based on where the processing unit is located in the system. In some embodiments, the system may include multiple processing units, and the process of FIG. **15** may be performed by one or more of the multiple processing units.

[0118] In block **611**, the process receives a signal from an instrument in communication with the independent surgical center. In the embodiment, the tray may receive the signals from an instrument through a wired connection, for example, the handpiece, or may receive the signals from an instrument through a wireless connection, for example, from the illumination device.

[0119] In block **613**, the process determines whether the received signal is a status update signal or an adjustment request signal. In some embodiments, the processing unit may be used to adjust operation parameters of selected instruments, and may also be used to process and communicate to a user the status of the same or other instruments. If the processing unit determines that the signal is an adjustment request signal, the process proceeds to block **615**. If the processing unit determines that the signal is a status update signal, the process instead proceeds to block **619**.

[0120] In block **615**, the process determines the device for which the adjustment signal is directed. In some embodiments, the adjustment signal may be received by a user control directly connected to the processing unit. For example, the adjustment signal may originate from a user control controlling the infusion device located alongside the processing unit in the tray. In other embodiments, the adjustment signal may be received wirelessly from a user control located on a remote instrument, for example, a foot pedal associated with the tray. Some of the adjustment requests may be meant for the device or component from which the signal originated, while some other of the adjustment requests may be meant for a different device, whether it is a device on the tray or on a completely separate instrument in the surgical system. Regardless of the source of the adjustment signal, the processing unit determines the intended destination device or instrument.

[0121] In block **617**, the process sends an adjustment command to the destination device or instrument. Depending on the configuration of the system, the adjustment command may be an unaltered adjustment signal, where the processing unit acts as a switch or routing device for the system, or the adjustment command may be a wholly new command signal generated by the processing unit based on a received adjustment request signal, for example, a received signal as was described above with respect to block **611**. In most embodiments of the system, after an adjustment command is sent to a respective device or instrument, the operational settings or parameters of the device are adjusted in accordance with the adjustment command.

[0122] If the signal is a status update signal, the process, in block **619**, determines the source of the status update signal. In most embodiments, status update signals include status update information of the device from which the status update signal originated. The status update information may include various information about an originating device, for example, current settings, operating parameters, remaining power levels, instrument fault conditions, and other information. Status information for each specific instrument in the system is different depending on the functionality of the instrument. For example, a handpiece may provide status of cut speed of a cutter or aspiration levels, whereas an illumination device may provide illumination level status.

[0123] In block **621**, the process updates the status of a device or instrument. Whether the originally received signal was an adjustment signal or a status update signal, the processing unit of the system may update status information pertaining to the received signal. In cases where the signal was an adjustment signal, the processing unit may update the status information of the destination device to which the adjustment request was sent. In cases where the signal was a status update signal, the processor may directly update the status information of the device from which the status update signal originated, based on the contents of the status update signal. The processing unit may display the status updates on, for example, a monitor located on the instrument housing the processing unit. Alternatively, the status updates may be expressed visually through changes to, for example, LED indicators, or aurally through, for example, audio alerts outputted through available speakers. In some embodiments, visual or aural status indicators may be available on various other instruments of the system in addition to, or in lieu of, the instrument housing the processing unit. In these embodiments, the processing unit may send the status update information to an appropriate instrument for output or user feedback purposes. According to one embodiment of the invention, the update information is transmitted to the personal surgical center for logging in a log file generated for the surgical procedure. After the status updates have been applied to or recorded by the system, the process returns.

Safety Mechanism Procedures

[0124] As illustrated in FIG. **16**, in certain embodiments, the independent surgical center **1402** and/or the processing unit **1446** and/or the personal surgical center **1410** as described herein can be configured to receive status and/or adjustment data from, or determine the status of the various surgical and/or devices **1401**. In analyzing and/or monitoring the status of the various surgical and/or devices **1401**, the independent surgical center **1402**, and/or the processing unit **1446**, and/or personal surgical center **1410** can be configured to invoke various safety mechanism procedures, for example but not limited a cutter safety mechanism procedure and a low fluid safety mechanism procedure.

[0125] With reference to FIG. **16**, the illustrated process **1601** can be segmented into at least four different stages, initial setup, steady state, cutter safety mechanism procedure, and the low fluid safety mechanism procedure. Process **1601** starts at block **1602**. The user and/or surgeon powers on the independent surgical center, the surgical and/other devices at block **1604**. In powering on the independent surgical center, at block **1606** the processing unit and/or the electronics in the independent surgical center searches, detects, and/or locates available surgical and/or other devices to be employed during the surgery. At block **1608**, the processing unit and/or the independent surgical center registers the available surgical and/or other devices for the surgery. In registering, the surgical and/or devices can communicate and/or send to the processing unit and/or the independent surgical center parameter and/or identification information, including but not limited to surgical device identification number, lot number, part number, surgical device name and/or type, current status of device, available options on device (for example, on or off; low, medium, or high speed; or the like). After registering and/or establishing communication with all the surgical and/or other devices, the processing unit and/or the independent surgical center obtains and/or receives periodic information/data from the surgical and/other devices in order to determine at block **1610** the status or adjustments made in or to the surgical and/or other devices.

[0126] In reference to FIG. **16**, in one embodiment, processing unit and/or the independent surgical center enters a steady state, wherein the processing unit and/or independent surgical center pings, requests, or receives data and/or information from the surgical and/or other devices at block **1612**. At block **1614**, the surgical and/or other devices can be configured to gather, obtain, and/or analyze status and/or other data for sending or transmitting to the processing unit and/or independent surgical center. The surgical and/or other devices can be configured to send or transmit, on a real-time, substantially real-time, periodic basis, data and/or other information to the independent surgical center at block **1616**, wherein the data and/or other information can comprise without limitation device status information (for example, on or off, activated or deactivated, speed levels, temperature, battery levels, elapsed time, fluid levels, warning and/or error messages, or the like), user inputted adjustment data, device data, or the like. After sending or transmitting the data, the procedure returns to block **1610** to repeat the process.

[0127] With reference to FIG. **16**, in certain embodiments, the processing unit and/or independent surgical tray can detect when the user or surgeon has activated the cutter device by receiving a status message from the cutter device at block **1618**. In certain embodiments, the processing unit and/or the independent surgical center can initiate a cutter safety mechanism procedure before and/or while allowing the cutter device to be activated. In certain embodiments, before allowing the cutter device to be activated, or simultaneously with the activation of the cutter, the processing unit and/or the independent surgical center at block **1620** can be configured to transmit an activation command or signal to the infusion motor and/or pump to initiate delivery of infusion fluids to the surgical site. In certain embodiments, before allowing the cutter device to be activated, or simultaneously with the activation of the cutter, the processing unit and/or the independent surgical center at block **1622** can also be configured to transmit an activation command or signal to the aspiration motor and/or pump to generate a vacuum for removing excess fluid and/or tissue/debris from surgical site, and/or to prime the fluid in the cutter before cutting begins. In certain embodiments, the processing unit and/or the independent surgical center at block **1624** can be configured to transmit an activation command or signal to the cutter motor device. After sending or transmitting the activation commands or signals, the procedure returns to block **1610** to repeat the process.

[0128] The cutter safety mechanism procedure can prevent surgical errors and/or harm to the patient by ensuring that the necessary surgical and/or devices are activated before cutting is initiated. For example, in various eye surgeries, the infusion motor must be activated prior to cutting to prevent the collapse of the eye caused by reduced internal eye pressure due to aspirated or leaked vitreous. The foregoing procedure can reduce the complexity of the surgery for the surgeon by reducing the number of steps to activate the various necessary devices for the surgery.

[0129] In reference to FIG. **16**, in certain embodiments, the processing unit and/or independent surgical tray at block **1626** can detect when fluid levels are low and/or high in the various fluid reservoirs by receiving a status message from a fluid chamber device, for example, infusion reservoir **104**. In certain embodiments, the processing unit and/or the independent surgical center can initiate a low/high fluid safety mechanism procedure before and/or while the cutter device is activated. In certain embodiments, before allowing the cutter device to be activated, or while the cutter device is activated, the processing unit and/or the independent surgical center at block **1628** can initiate and/or activate an alarm sound circuitry within the independent surgical center and/or other surgical device, wherein an audible sound/alarm would be generated to alert the user/surgeon of the low and/or high fluid levels in the various reservoir chambers. The processing unit and/or the independent surgical center at block **1630** can also be configured to wait for a period of time (predetermined or user defined), for example, ten seconds, ten minutes, or the like, before receiving and/or obtaining status information from the cutting device. In other embodiments, the processing unit and/or the independent surgical center can also obtain data and/or information from other surgical devices, such as the fluid reservoir chambers to determine if the fluid levels have been changed. If the cutting device is on and/or the fluid levels have not changed and/or have become worse, then the processing unit and/or the independent surgical center at block **1632** can transmit and/or send a deactivation command to the cutter device and/or the aspiration device. In certain embodiments, the processing unit and/or the independent surgical center will continue to maintain infusion to prevent collapse of the eye. After sending or transmitting the deactivation commands or signals, the procedure returns to block **1610** to repeat the process.

[0130] The high/low safety mechanism procedure can prevent surgical errors and/or harm to the patient by ensuring that the necessary reservoir chambers have sufficient fluid levels during the surgery. For example, in various eye surgeries, the infusion of the eye should be continuous to prevent collapse of the eye due to leakage/remove of vitreous fluids, and therefore, low levels of infusion fluids in the infusion reservoir can pose a risk for eye collapse during surgery. The foregoing procedure can also reduce the complexity of the surgery for the surgeon by reducing the need for the surgeon and/or the assistant to constantly monitor the fluid levels of the reservoir chambers.

[0131] As with the other embodiments disclosed above, FIGS. **17-21** disclose a surgical tray system **1700** configured to allow a surgeon or other user to directly monitor and/or directly control tools and other instruments associated with the surgical tray system **1700** while not having to move away from and/or to look substantially away from the surgical field. A surgeon or other user using the surgical tray systems described herein would not need to or would not substantially need to rely on and/or provide verbal instructions to an assistant or scrub in order to make various system adjustments.

[0132] As illustrated in FIG. **17**, the surgical tray system **1700** can comprise at least one display to allow the surgeon or other users to directly monitor the tools and other instruments associated with the surgical tray system **1700**. With the at least one display within the surgical field and/or substantially within, near, adjacent, and/or proximal to the same visual plane, area, and/or field as the surgical site, the surgeon and/or user would not need to substantially look away from the surgical site. For example, in certain embodiments, the surgeon and/or other user would generally only need to look to the side of the surgical site, and would generally not need to look substantially up and/or away from the surgical site to view a monitor or other display. In certain embodiments, the surgical tray system **1700** comprises at least one controller (for example, button, knob, switch, user input interface, or the like) to receive user input and to allow the surgeon or other user to directly control surgical tools, or other instruments, including but not limited to a fluid source, a vacuum source, a light source, a electrical energy source, or the like. With the at least one controller within the surgical field and/or substantially within, near, adjacent, and/or proximal to the same visual plane, area, and/or field as the surgical site, the surgeon and/or user would neither need to substantially look away from the surgical site, nor rely on and/or provide verbal instructions to an assistant in order to make various adjustments to the system, tools, and/or other instruments. In certain embodiments, the at least one controller is positioned on, within, combined with, embedded in, coupled to a surgical device, for example but not limited to, the cutting device **1408** or other handheld devices. In certain embodiments, user input can be received at or from or on or through a controller on a surgical device or on a surgical tray. User input received at, or by, a controller on the surgical device can be transmitted (through a wired or wireless connection) directly to a rack system or to the rack system through the surgical tray.

[0133] With further reference to FIG. **17**, in certain embodiments, the sterile surgical tray **1042** comprises at least one controller **1450**. The at least one controller **1450** can be connected to, be in electrical communication with, and/or be coupled to a rack system **1702** via communications link **1709** (wired and/or wireless). Examples of wireless communication links include but are not limited to radio frequency (RF), infrared or other optical links, or the like. The at least one controller **1450** can include but is not limited to a switch, knob, button, or other mechanism for capturing user input. In certain embodiments, the sterile surgical tray **1042** comprises at least one display **1448**. The at least one display **1448** can be connected to, be in electrical communication with, and/or be coupled to a rack system **1702**. The at least one display **1448** can include but is not limited to a liquid crystal display (LCD), a light emitting diode (LED), a light, a meter, an indicator, or other mechanism for outputting data, information, status, and/or indication to the user.

[0134] The rack system **1702** can comprise, for example, but is not limited to, a general purpose computer, a specialized purpose computer, or other computer system connected to, in communication with, or coupled to other systems, apparatuses, devices, and/or hardware, including but not limited to a fluid control apparatus and/or fluid source **1704**, a vacuum control apparatus and/or vacuum source **1706**, a processor **1708**, memory **1710**, electrical energy control apparatus and/or source **1712**, processing modules **1714**, mass storage **1716**, and/or input/output (I/O) interfaces and/or network interfaces **1718**.

[0135] The rack system **1702** can also comprise a fluid control apparatus and/or a fluid source **1704**. The rack system **1702** can be connected to an external fluid source wherein the fluid control apparatus **1704** is configured to control the flow of fluid into the sterile surgical tray **1042** through tube **1705**. Alternatively, the rack system **1702** can comprise a fluid source **1704** wherein the rack system is configured to control the flow of fluid into the sterile surgical tray **1042** through tube **1705**. In certain embodiments, the surgeon and/or other user can control the fluid control apparatus and/or the fluid source **1704** by adjusting the at least one controller on the sterile surgical tray **1042** and/or by adjusting a controller on a surgical instrument, handheld device, handpiece, or the like that is near, adjacent, around, or proximal to the sterile surgical tray. The rack system **1702** can comprise vacuum control apparatus and/or a vacuum source **1706**. The rack system **1702** can be connected to an external vacuum source wherein the vacuum control apparatus **1706** is configured to control the amount or strength of vacuum applied or delivered to the sterile surgical tray **1042** through tube **1707**. Alternatively, the rack system **1702** can comprise a vacuum source **1706** wherein the rack system is configured to control the amount or strength of vacuum into the sterile surgical tray **1042** through tube **1707**. In certain embodiments, the surgeon and/or other user can control the vacuum control apparatus and/or the vacuum source **1706** by adjusting the at least one controller on the sterile surgical tray **1042**.

[0136] The rack system **1702** can comprise a processor **1708**. The processor **1708** can be configured to process user input received from the user through the at least one controller **1450**. The processor **1708** can be configured to process output data for displaying to the user through the at least one display. The processor **1708** can be configured to control and/or send instructions to tools, instruments, modules, components, and/or devices associated with the rack system **1702** and/or the surgical tray system **1700**. The rack system **1702** can comprise memory for storing data and/or instructions to be processed by the processor **1708**. The rack system **1702** can comprise an electrical energy control apparatus and/or an electrical energy source **1712**. The rack system **1702** can be connected to an external electrical energy source wherein the electrical energy control apparatus **1712** is configured to control the flow of electrical energy to and/or allow electrical energy to be directed into the sterile surgical tray **1042** through wires **1713**. Alternatively, the rack system **1702** can comprise an electrical energy source **1712** wherein the rack system is configured to control the flow of electrical energy into the sterile surgical tray **1042** through wires **1713**. In certain embodiments, the surgeon and/or other user can control the electrical energy control apparatus and/or the fluid source **1712** by adjusting the at least one controller **1450** on the sterile surgical tray **1042**.

[0137] The rack system **1702** can comprise processing modules **1714**. Processing modules **1714** can include but is not limited to a processing apparatus for controlling a light source, an electric motor, a pressure detection apparatus, and any other apparatus. The rack system **1702** can comprise a mass storage apparatus **1716** for storing software instructions, and/or data processed by the processor **1708**, and/or data received from the user and/or the tools and instruments associated with the surgical tray system **1700**. The rack system **1702** can comprise an input/output (I/O) and network interface apparatus for communicating, via a wired and/or wireless connection, with other computer systems through a network **1720**, and/or with other instruments **1401** associated with the surgical tray system **1700** through the communications link **1726**.

[0138] For example, a surgeon and/or other user can control a cutting device **1408** by providing input or instructions through the at least one controller **1450** on the sterile surgical tray **1042**, wherein the at least one controller **1450** transmits a signal to the rack system **1702** through the communications link **1709** (wired or wireless). Alternatively, a surgeon and/or other user can control a cutting device **1408** or other device by providing input or instructions through the at least one controller **1450** on the cutting device **1408** or other device, wherein the at least one controller **1450** transmits a signal to the rack system **1702** through the communications link **1709** (wired or wireless), wherein the signal can be transmitted directly to the rack system **1702** or to the rack system **1702** through the sterile surgical tray **1042**. The rack system **1702** can be configured to process the user input and to send a signal to the cutter device **1408** through communications link **1726** (wired or wireless). The cutter device **1408** can be configured to return status data to the rack system **1702** via the communications link **1726**, wherein the rack system **1702** is configured to process the status data. The rack system **1702** can be configured to display the processed status data to the surgeon and/or other user through the at least one display **1448**. In this configuration, the sterile surgical tray **1042** is configured to allow the surgeon and/or other user to control and/or adjust from within the sterile surgical field various instruments and components associated with the surgical tray system **1700**, while the processing of the instructions from the surgeon and/or the actual control of the various instruments and components is conducted or performed by the rack system **1702**. In this configuration, the surgeon and/or other user can review and/or monitor on the sterile surgical tray **1042** the status of various instruments and components associated with the surgical tray system **1700**, while the processing of the status data of the various instruments and components is conducted by the rack system **1702**.

[0139] In certain embodiments, the sterile surgical tray **1042** is an extension of the rack system **1702**. In certain embodiments, the sterile surgical tray **1042** is a "slave" of the rack system **1702**, as opposed to a smart and/or independently operating surgical tray, as disclosed in other embodiments described herein. The sterile surgical tray **1042** can be configured to allow the surgeon to control and/or adjust the rack system **1702**. The sterile surgical tray **1042** can be configured to display data processed and/or generated by the rack system **1702**. In certain embodiments, the sterile surgical tray **1042** comprises electronics **1412**, including but not limited to circuits, processors, memory, and other components for processing data received from the rack system via communications link **1709** (wired or wireless). The electronics **1412** can be configured to receive and/or process signals and/or input from the at least one controller **1450**. The electronics **1412** can be configured to transmit, send, and/or communicate the signals and/or input to the rack system **1702** for further processing.

[0140] In certain embodiments, the rack system **1702** can be configured to communicate with radiology information system (RIS), hospital information system (HIS), and/or other computer systems **1722** through a network **1720**. The rack system **1702** can be configured to store on or communicate to the RIS, HIS, and/or other computer systems **1722** data received from the sterile surgical tray **1402**. Such data can include but is not limited to a serial number associated with the tray, a tray activation code or signal, a billing code or signal, or the like. In receiving any of the foregoing data, codes and/or signals, the RIS, HIS, and/or other computer systems **1722** can be configured to process a billing invoice or other signal or code. The rack system **1702** can be configured to store on or communicate to the RIS, HIS, and/or other computer systems **1722** data received from the user through the at least one controller **1450** on the sterile surgical tray **1402**. The rack system **1702** can be configured to store on or communicate to the RIS, HIS, and/or other computer systems **1722** data displayed on the at least one display **1448**. The rack system **1702** can be configured to store on the RIS, HIS, and/or other computer systems **1722** data received from the surgical tools and/or other devices **1401**, **1404**, **1406**, **1408**.

[0141] With reference to FIG. **18**, there is illustrated another embodiment of the surgical tray system **1700** that is similar to the embodiment disclosed in FIG. **17**. In the illustrated embodiment, the surgical tools and other devices **1401** (for example, the cutting device **1408**) are connected to and/or are in direct communication with the sterile surgical tray **1402** through electronics **1412**. The surgical tools and other devices **1401** can be configured to receive fluid, light, electrical energy, and/or vacuum through the sterile surgical tray **1402**. Alternatively, the surgical tools and other devices **1401** can be configured to receive fluid, light, electrical energy, and/or vacuum from the rack system through connection tubes.

[0142] FIG. **19** illustrates another embodiment of the surgical tray system **1700** comprising a rack system **1702** connected and/or coupled to a sterile surgical tray **1402** via an arm **1902**. The arm **1902** can include without limitation communication link **1709** and/or tubes **1705**, **1707**, and/or wires **1713**, and any other connectors and/or conduits. As illustrated in FIG. **20**, the surgical tray system **1700** can comprise a docking station **2002** connected or coupled to the arm **1902**, which is connected or coupled to the rack system **1702**. In certain embodiments, the sterile surgical tray **1402** comprises a connector or other apparatus for allowing the sterile surgical tray **1402** to dock with the docking station **2002**. The docking station **2002** and/or the sterile surgical tray **1402** can comprise a locking mechanism for locking the sterile surgical tray **1402** to the docking station **2002**. The docking station **2002** can comprise wire connectors to enable delivery of electrical energy or to enable electronic communication between the sterile surgical tray **1402** and the rack system **1702**. The docking station **2002** can comprise tube connectors for allowing fluid and/or vacuum to be delivered to the sterile surgical tray **1402** from the rack system **1702**. The docking station **2002** can comprise fiber optic connectors for allowing light to be delivered to the sterile surgical tray **1402** from the rack system **1702**. With reference to FIG. **21**, the sterile surgical tray **1402** can communicate wirelessly with the rack system **1702** through a wireless link **2102**. In certain embodiments, the sterile surgical tray **1402** can be configured to receive data from the rack system **1702** through the wireless link **2102**, wherein the at least one display **1448** is configured to display the data. In certain embodiments, the sterile surgical tray **1402** can be configured to receive input data from the surgeon or other user through the at least one controller **1450**, wherein the sterile surgical tray **1402** can communicate or transmit the input data to the rack system **1702** through the wireless link **2102**. The rack system **1702** can be configured to process the input data into instructions for controlling various surgical tools and/or other instruments associated with the surgical tray system **1700**. The foregoing embodiments relating to the rack system **1702** can also be configured to communicate and/or combine and/or function with the smart surgical trays **10** disclosed herein.

[0143] In general, the term "module," as used herein, refers to logic embodied in hardware or firmware, or to a collection of software instructions, possibly having entry and exit points, written in a programming language, such as, for example, Java, C or C++, or the like. A software module may be compiled and linked into an executable program, installed in a dynamic link library, or may be written in an interpreted programming language such as, for example, BASIC, Perl, Lua, or Python. It will be appreciated that software modules may be callable from other modules or from themselves, and/or may be invoked in response to detected events or interrupts. Software instructions may be embedded in firmware, such as an EPROM. It will be further appreciated that hardware modules may be comprised of connected logic units, such as gates and flip-flops, and/or may be comprised of programmable units, such as programmable gate arrays or processors. The modules described herein are preferably implemented as software modules, but may be represented in hardware or firmware. Generally, the modules described herein refer to logical modules that may be combined with other modules or divided into sub-modules despite their physical organization or storage.

[0144] In some embodiments, the acts, methods, and processes described herein are implemented within, or using, software modules (programs) that are executed by one or more general purpose computers or other computer systems. The software modules may be stored on or within any suitable computer-readable medium. It should be understood that the various steps may alternatively be implemented in-whole or in-part within specially designed hardware. The skilled artisan will recognize that not all calculations, analyses and/or optimization require the use of computers, though any of the above-described methods, calculations or analyses can be facilitated through the use of computers.

[0145] Conditional language, such as, among others, "can," "could," "might," or "may," unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or steps. Thus, such conditional language is not generally intended to imply that features, elements and/or steps are in any way required for one or more embodiments or that one or more embodiments necessarily include logic for deciding, with or without user input or prompting, whether these features, elements and/or steps are included or are to be performed in any particular embodiment.

[0146] Although the inventions have been disclosed in the context of a certain preferred embodiments and examples and in the context of use with an endoilluminator, for example, an endoilluminator having an LED illumination light source, it will be understood by those skilled in the art that the present inventions extend beyond the specifically disclosed embodiments to other alternative embodiments and/or uses of the inventions and obvious modifications and equivalents thereof. In addition, while a number of variations of the inventions have been shown and described in detail, other modifications, which are within the scope of the inventions, will be readily apparent to those of skill in the art based upon this disclosure. It is also contemplated that various combinations or subcombinations of the specific features and aspects of the embodiments may be made and still fall within one or more of the inventions. Accordingly, it should be understood that various features and aspects of the disclosed embodiments can be combine with or substituted for one another in order to form varying modes of the disclosed inventions. Thus, it is intended that the scope of the present inventions herein disclosed should not be limited by the particular disclosed embodiments described above.

What is claimed is:

1. A sterile surgical tray system comprising:

a sterile surgical tray for positioning in a surgical field, the sterile surgical tray further comprising at least one controller; and

a rack system positioned apart from the sterile surgical tray and outside the surgical field, the rack system being in communication with the at least one controller of the sterile surgical tray.

2. The sterile surgical tray system of claim **1**, wherein the rack system comprises a processor for processing user input received at the sterile surgical tray through the at least one controller.

3. The sterile surgical tray system of claim **1**, wherein the sterile surgical tray comprises a processor for processing user input received at the sterile surgical tray through the at least one controller.

4. The sterile surgical tray system of claim **1**, wherein the at least one controller is an input mechanism.

5. The sterile surgical tray system of claim **1**, wherein the at least one controller is disposed on a handpiece communicatively coupled to the sterile surgical tray.

6. The sterile surgical tray system of claim **5**, wherein the handpiece is in communication with the rack system through the sterile surgical tray.

7. The sterile surgical tray system of claim **1**, wherein the rack system further comprises a pump configured to pump fluid into the sterile tray, and wherein the controller is configured to control the pump.

8. The sterile surgical tray system of claim **7**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the fluid.

9. The sterile surgical tray system of claim **1**, wherein the rack system further comprises a light source configured to be controlled by the controller of the sterile surgical tray.

10. The sterile surgical tray system of claim **9**, wherein the light source is configured to direct light into the sterile surgical tray.

11. The sterile surgical tray system of claim **10**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the light.

12. The sterile surgical tray system of claim **9**, wherein the light source is configured to direct light into a surgical instrument.

13. The sterile surgical tray system of claim **1**, wherein the rack system further comprises a pressurized gas source configured to be controlled by the controller of the sterile surgical tray.

14. The sterile surgical tray system of claim **13**, wherein the pressurized gas source is configured to direct pressurized gas into the sterile surgical tray.

15. The sterile surgical tray system of claim **14**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the pressurized gas to drive a pneumatic drive in the surgical instrument.

16. The sterile surgical tray system of claim **13**, wherein the pressurized gas source is configured to direct pressurized gas into a surgical instrument to drive a pneumatic drive in the surgical instrument.

17. The sterile surgical tray system of claim **1**, wherein the rack system further comprises an electrical energy source configured to be controlled by the controller in the sterile surgical tray.

18. The sterile surgical tray system of claim **17**, wherein the electrical energy source is configured to direct electrical energy to the sterile surgical tray.

19. The sterile surgical tray system of claim **18**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the electrical energy.

20. The sterile surgical tray system of claim **17**, wherein the electrical energy source is configured to direct electrical energy to a surgical instrument.

21. The sterile surgical tray system of claim **1**, wherein the rack system further comprises a vacuum source coupled to the rack system, wherein the vacuum is controlled by the controller in the sterile surgical tray.

22. The sterile surgical tray system of claim **21**, wherein the vacuum source is coupled to the sterile surgical tray.

23. The sterile surgical tray system of claim **22**, further comprising a surgical instrument coupled to the sterile surgical tray to communicate with the vacuum source.

24. The sterile surgical tray system of claim **1**, wherein the sterile surgical tray is disposable and the rack system is reusable.

25. The sterile surgical tray system of claim **1**, wherein the sterile surgical tray is packaged in a sterile kit.

26. The sterile surgical tray system of claim **1**, wherein the communication between the sterile surgical tray and the rack system is through a wired link.

27. The sterile surgical tray system of claim **1**, wherein the communication between the sterile surgical tray and the rack system is through a wireless link.

28. The sterile surgical tray system of claim **1**, wherein the sterile surgical tray is coupled to the rack system through an arm mechanism.

29. The sterile surgical tray system of claim **1**, wherein the sterile surgical tray comprises a geometric shape for positioning around a head of a patient during an ophthalmic surgery.

30. The sterile surgical tray system of claim **1**, further comprising a docking station configured to receive the sterile surgical tray.

31. The sterile surgical tray system of claim **30**, wherein the docking station is coupled to the rack system through an arm mechanism.

32. The sterile surgical tray system of claim **30**, wherein the docking station is configured to establish a connection between the sterile surgical tray and the rack system.

33. The sterile surgical tray system of claim **32**, wherein the connection is at least one of an electrical, fluid, or vacuum connection.

34. The sterile surgical tray system of claim **1**, wherein the sterile surgical tray is positioned in a surgical field, and the rack system is positioned outside the surgical field.

35. A sterile surgical tray system comprising:

a sterile surgical tray for positioning in a surgical field, the sterile surgical tray further comprising at least one display; and

a rack system positioned apart from the sterile surgical tray and outside the surgical field, the rack system being in communication with the at least one display of the sterile surgical tray.

36. The sterile surgical tray system of claim **35**, wherein the rack system comprises a processor for processing output data for displaying on the at least one display of the sterile surgical tray.

37. The sterile surgical tray system of claim **35**, wherein the rack system further comprises a pump configured to pump fluid into the sterile tray, and wherein the display is configured to display status data of the pump.

38. The sterile surgical tray system of claim **37**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the fluid.

39. The sterile surgical tray system of claim **35**, wherein the rack system further comprises a light source, wherein the display is configured to display status data of the light source.

40. The sterile surgical tray system of claim **39**, wherein the light source is configured to direct light into the sterile surgical tray.

41. The sterile surgical tray system of claim **40**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the light.

42. The sterile surgical tray system of claim **39**, wherein the light source is configured to direct light into a surgical instrument.

43. The sterile surgical tray system of claim **35**, wherein the rack system further comprises a pressurized gas source, wherein the display is configured to display status data of the pressurized gas source.

44. The sterile surgical tray system of claim **43**, wherein the pressurized gas source is configured to direct pressurized gas into the sterile surgical tray.

45. The sterile surgical tray system of claim **44**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the pressurized gas to drive a pneumatic drive in the surgical instrument.

46. The sterile surgical tray system of claim **43**, wherein the pressurized gas source is configured to direct pressurized gas into a surgical instrument to drive a pneumatic drive in the surgical instrument.

47. The sterile surgical tray system of claim **35**, wherein the rack system further comprises an electrical energy source, wherein the display is configured to display status data of the electrical energy source.

48. The sterile surgical tray system of claim **47**, wherein the electrical energy source is configured to direct electrical energy to the sterile surgical tray.

49. The sterile surgical tray system of claim **48**, further comprising a surgical instrument coupled to the sterile surgical tray to receive the electrical energy.

50. The sterile surgical tray system of claim **47**, wherein the electrical energy source is configured to direct electrical energy to a surgical instrument.

51. The sterile surgical tray system of claim **35**, wherein the rack system further comprises a vacuum source coupled to the rack system, wherein display is configured to display status data of the vacuum source.

52. The sterile surgical tray system of claim **51**, wherein the vacuum source is coupled to the sterile surgical tray.

53. The sterile surgical tray system of claim **52**, further comprising a surgical instrument coupled to the sterile surgical tray to communicate with the vacuum source.

54. The sterile surgical tray system of claim **35**, wherein the sterile surgical tray is disposable and the rack system is reusable.

55. The sterile surgical tray system of claim **35**, wherein the sterile surgical tray is packaged in a sterile kit.

56. The sterile surgical tray system of claim **35**, wherein the communication between the sterile surgical tray and the rack system is through a wired link.

57. The sterile surgical tray system of claim **35**, wherein the communication between the sterile surgical tray and the rack system is through a wireless link.

58. The sterile surgical tray system of claim **35**, wherein the sterile surgical tray is coupled to the rack system through an arm mechanism.

59. The sterile surgical tray system of claim **35**, wherein the sterile surgical tray comprises a geometric shape for positioning around a head of a patient during an ophthalmic surgery.

60. The sterile surgical tray system of claim **35**, further comprising a docking station configured to receive the sterile surgical tray.

61. The sterile surgical tray system of claim **60**, wherein the docking station is coupled to the rack system through an arm mechanism.

62. The sterile surgical tray system of claim **60**, wherein the docking station is configured to establish a connection between the sterile surgical tray and the rack system.

63. The sterile surgical tray system of claim **62**, wherein the connection is at least one of an electrical, fluid, or vacuum connection.

64. The sterile surgical tray system of claim **35**, wherein the sterile surgical tray is positioned in a surgical field, and the rack system is positioned outside the surgical field.

65. The sterile surgical tray system of claim **35**, wherein the at least one display is at least one light emitting diode.

66. The sterile surgical tray system of claim **35**, wherein the at least one display is a liquid crystal display.

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