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(54) MULTIPURPOSE ENDOSCOPY SUITE

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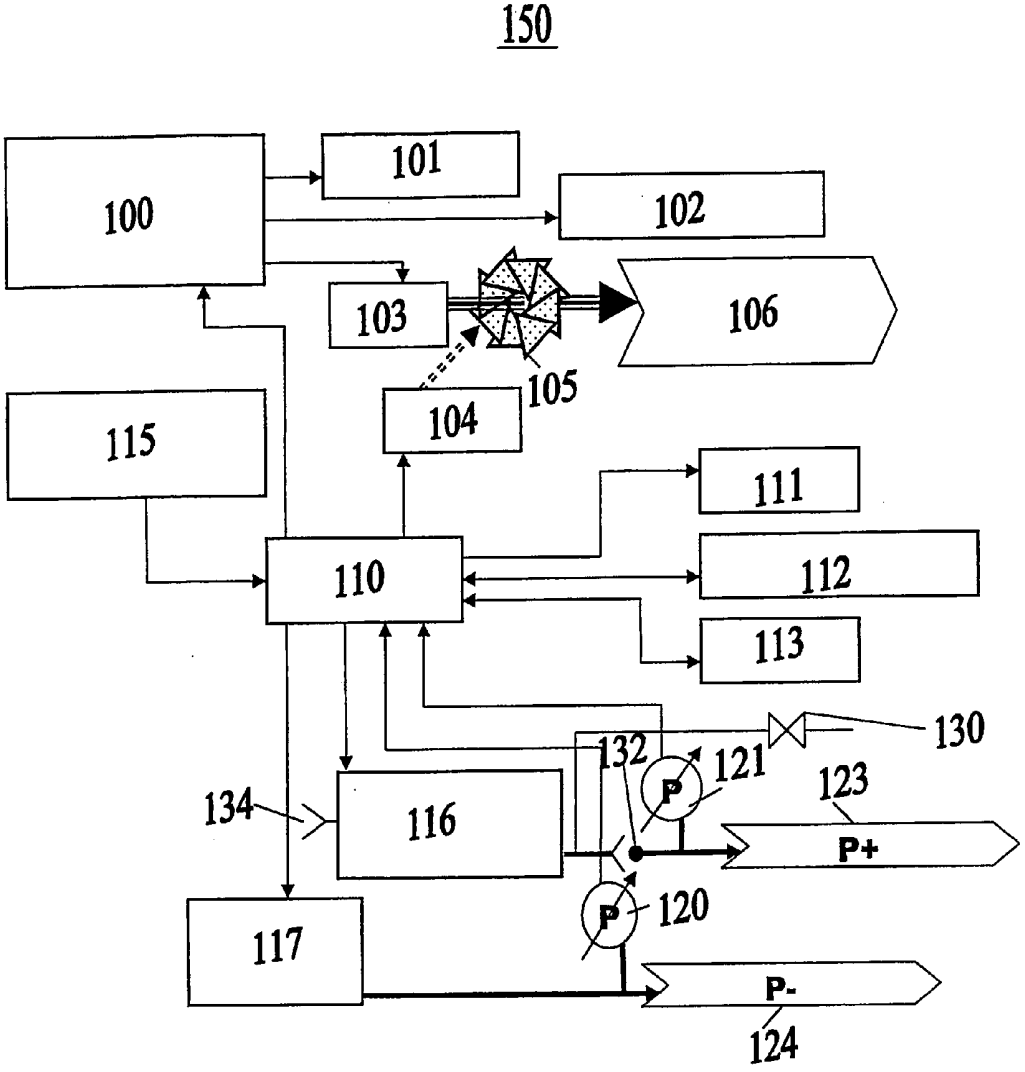
(57) **ABSTRACT**

An endoscopy suite is adaptable for carrying out a plurality of endoscopy procedures and/or for supporting several endoscopes being used simultaneously in a given procedure. The endoscopy suite comprises a memory unit in which are stored a plurality of predetermined sets of parameters. Each of these sets comprises a unique set of parameters for each of a plurality of endoscopic procedures. Once a specific endoscopic procedure has been selected by the operator of the endoscopy suite and one or more endoscopes appropriate for carrying out the specific endoscopic procedure has been connected to the endoscopy suite, then the set of parameters appropriate to the specific procedure are transferred automatically to a controller, which controls the operation of the components of the endoscopy suite to provide the predetermined lighting, suction, and insufflation pressure levels for the selected endoscopy procedure.



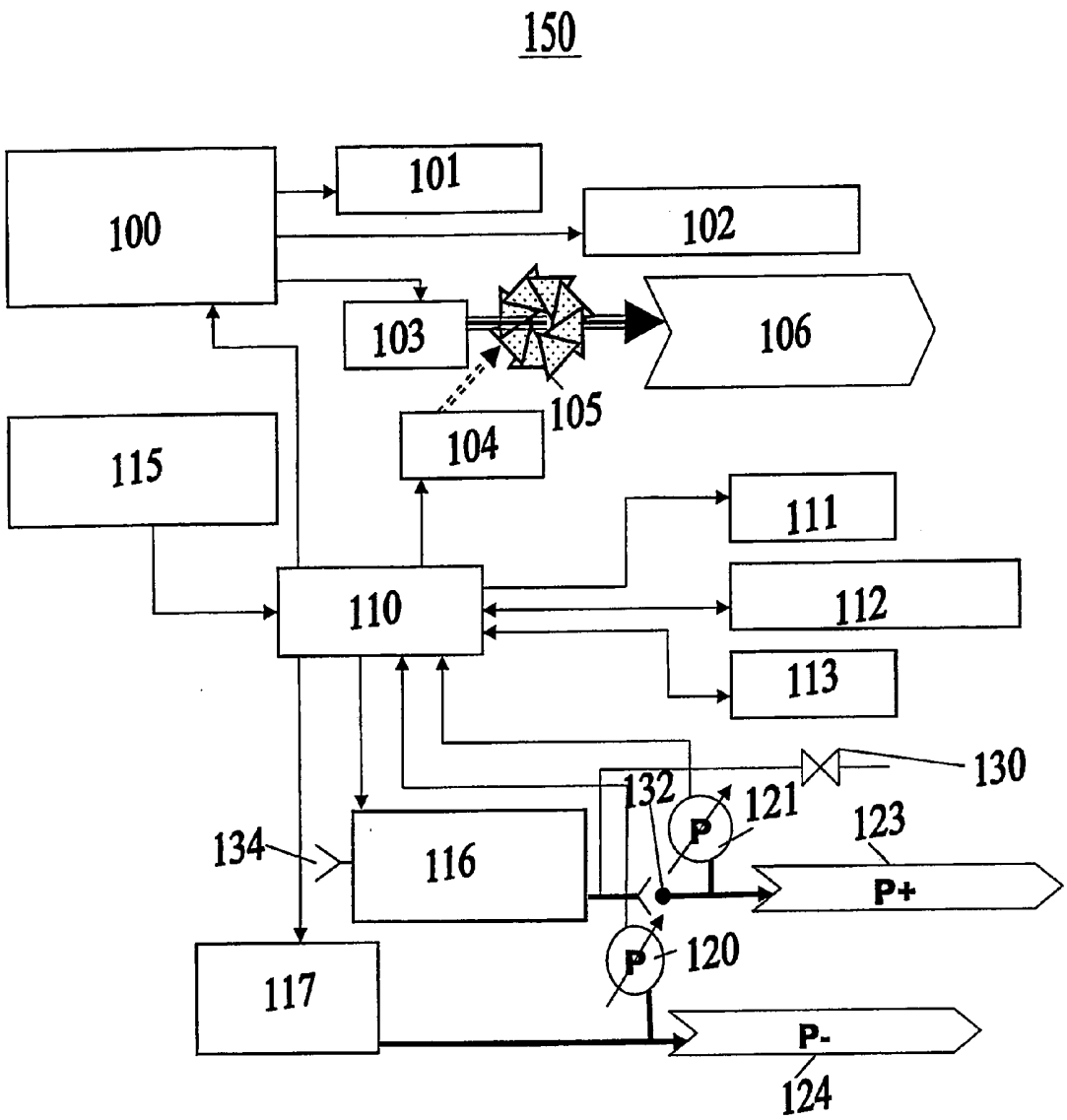

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Fig. 1

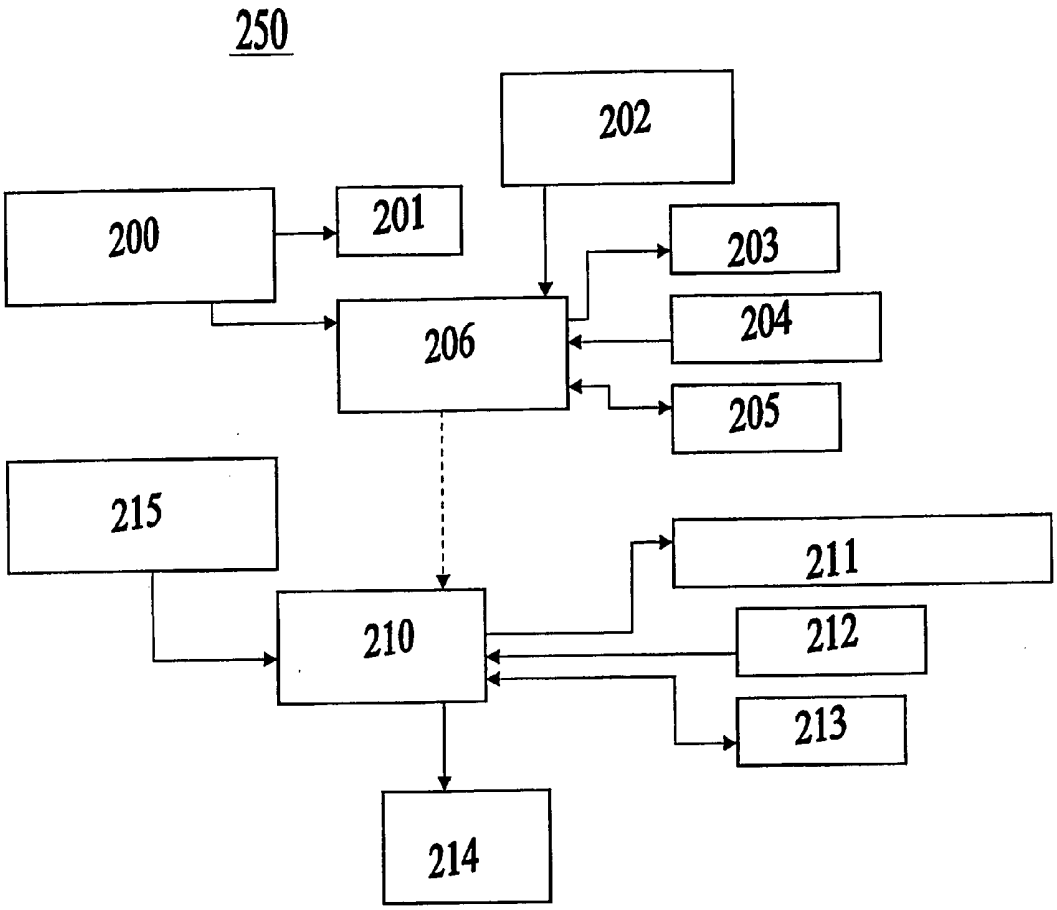

Fig. 2

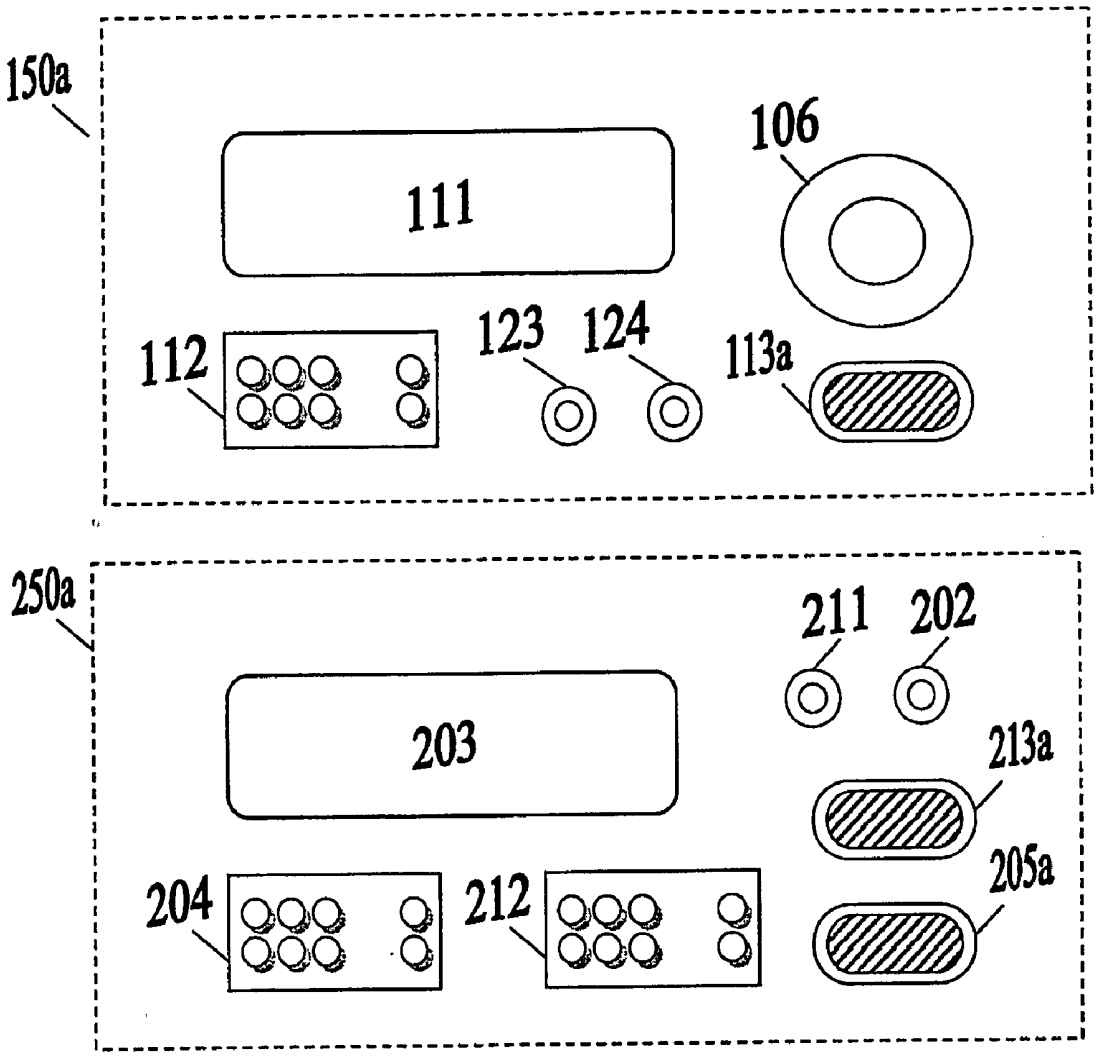
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Fig. 3

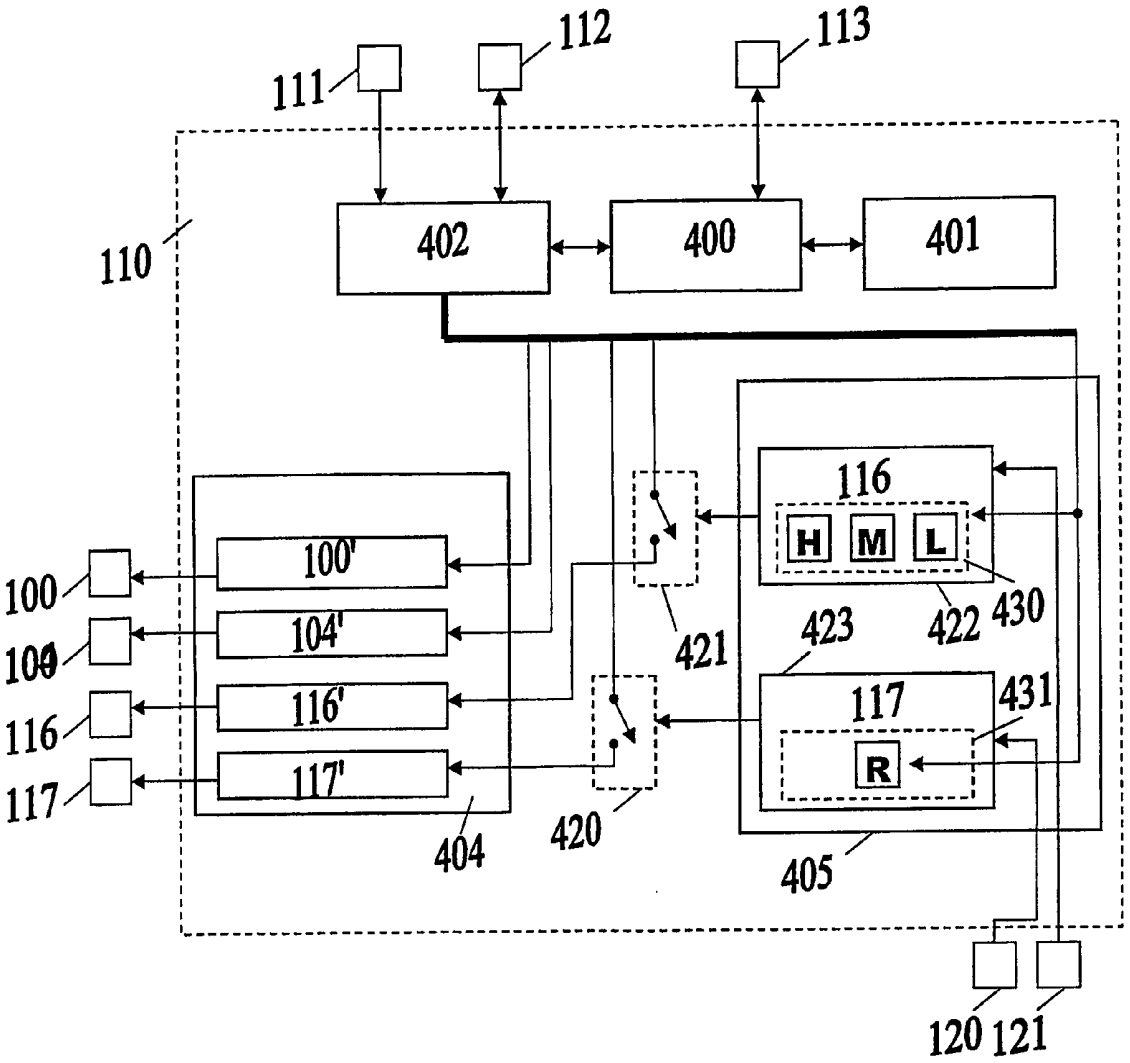
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Fig. 4

MULTIPURPOSE ENDOSCOPY SUITE

FIELD OF THE INVENTION

[0001] The invention relates to the field of endoscopy suites. More particularly, the invention relates to a multipurpose endoscopy suite to which different types of endoscopes may be connected for carrying out various types of endoscopy procedures.

BACKGROUND OF THE INVENTION

[0002] Endoscopes are in general rigid, semiflexible, or flexible instruments that are used to examine interior organs and to carry out various medical procedures inside a patient's body without the necessity of performing an open major surgery. A flexible endoscope usually consists of a control handle and an insertion tube having a manoeuvrable tip. On the tip are located various elements such as a lens for an imaging system, an ultrasound transducer, irrigation nozzle, a miniature camera, stapler, etc. Channels extend through the interior of the endoscope from the distal tip to the proximal end. Typically these channels are of two types: (1) working channels to allow the surgeon to employ medical instruments relevant to carrying out specific tasks during the procedure, e.g., biopsy forceps, other small diameter endoscopes, tools such as scissors, small diameter staplers or suture device, (2) tubes that are necessary for delivering air and irrigation, cables that carry the imaging system signals (e.g., CCD or CMOS signals), cables that carry the ultrasound signals, fibers that carry the illumination toward the distal tip from a proximal light source, and often suction and insufflation channels. Special controls that are normally connected to cables that also pass through the interior channels allow the operator to maneuver the tip of the endoscope through interior passages of the body and perform complex procedures.

[0003] Endoscopy has advanced in recent years to the stage where many different procedures which are related to a specific body system or organ have become commonplace and are carried out in large numbers. Examples of some of these procedures are: Colonoscopy to examine the lining of the colon; Gastroscopy (EGD), carried out through the esophagus to view the stomach and upper gastroenterological tract; ERCP (Endoscopic Retrograde Cholangiopancreatography) for examining and treating the liver, gallbladder, bile ducts and pancreas; Bronchoscopy for viewing the breathing passages; and Transgastric or Extragastric procedures in the abdomen. In Transgastric procedures a mother scope including two or more small diameter baby scopes is advanced into the stomach and is used to view the stomach. The stomach tissue is pierced with a tool that is extended from the working channel of the mother scope and then the distal tip of the motherscope is advanced through the incision into the abdomen where a procedure is performed using the babyscopes. If necessary the abdomen is inflated with air or Co2 gas. Transgastric procedures may include procedures such as Appendectomy, Cholecystectomy, Liver biopsy and excision, Gastric banding for morbid obesity, and implanting of medical devices, for example a device for tubal ligation or devices to be anchored on internal organs. Hence the endoscopy suite will need to support more than one endoscope, several pumps, various types of gas, and various types of optical, imaging, measurement, and control systems.

[0004] Each procedure has different requirements that are dictated by factors such as the diameter, curvature and complexity, of the passageways of the body through which the endoscope must be inserted. For example, the endoscope used in Gastroscopy procedures is typically designed for diameters of about 8-14 mm, while endoscopes used for carrying out bronchoscopy procedures are designed for passageways which are less than 6 mm in diameter. Another example is Transgastric procedures. The endoscope used in a procedure for tubal ligation or Cholecystectomy is typically designed with a diameter of about 14-16 mm and with three or more working channels. Two of the working channels contain small diameter endoscopes (baby scopes), each having a diameter of 3.9 mm. Each baby scope contains a working channel of 1.2 mm. In another option the endoscope comprises two 2.5 mm diameter baby scopes that use an imager of "1/15". A stapling or suturing device is contained in a third channel or as a part of the mother scope. As can be understood from the above, the differing requirements of different procedures have resulted in the development of a large variety of specialized endoscopes.

[0005] The peripheral equipment and resources referred to hereinabove, e.g. illumination, irrigation, etc. required for operating the various types of procedure oriented endoscopes is essentially the same, however considerations such as the amount of illumination that must be supplied or the maximum amount of suction/insufflation/irrigation that can be safely applied vary from procedure to procedure. The peripheral equipment is packaged in units known as endoscopy suites and historically there has arisen a situation wherein each type of endoscope and/or endoscopic procedure comes together with a dedicated endoscopy suite.

[0006] The main advantage in the provision of endoscopy suites specifically suitable for carrying out a certain procedure is in the simplicity of its operation and in its safety. This is because the operator does not have to be concerned with the settings of the different procedure-related parameters (e.g., light intensity, insufflation and suction pressures, etc) since these are determined in advance, set during the production stage of the endoscopy suite, and cannot be easily changed. The major disadvantage is that hospitals and clinics at which many different types of endoscopic procedures are routinely carried out must maintain a supply of endoscopy suites, often several in a single operating theater. In addition, the cost of a procedure oriented endoscopy suite is often linked to the particular medical procedure with which it is associated and not entirely to the actual manufacturing costs, thus the present practice of supplying a dedicated endoscopy suite for every type of procedure and endoscope leads to inefficient use of resources and ultimately to inflated cost of the medical procedure.

[0007] In view of the fact that most endoscopy procedures require more or less the same peripheral equipment and resources, and the main differences between different endoscopic procedures is the range of parameters within which the equipment must work, it would be advantageous to supply a single endoscopy suite that is capable of being used with many, if not all, types of endoscopes.

[0008] It is an object of the present invention to provide a multipurpose endoscope suite that can be adapted for carrying out a plurality of endoscopy procedures.

[0009] It is another object of the present invention to provide a multipurpose endoscope suite for which the opera-

tor can select and or adjust the values of the operating parameters making them suitable for a particular endoscopy procedure.

[0010] It is still another object of the present invention to provide an endoscope suite that can be easily calibrated utilizing programmable means through it's input keypad.

[0011] It is still another object of the present invention to provide endoscopes suite that can simultaneously support more than two different types of endoscopes used during a single procedure.

[0012] Other objects and advantages of the invention will become apparent as the description proceeds.

SUMMARY OF THE INVENTION

[0013] The present invention provides an endoscopy suite that is adaptable for carrying out a plurality of endoscopy procedures and/or for supporting several endoscopes being used simultaneously in a given procedure.

[0014] The endoscopy suite of the invention comprises one or more of each of the following items:

[0015] an insufflation pump and a sensor for sensing the pressure and/or flow rate created by the pump;

[0016] means for creating a vacuum comprising either an internal or an external vacuum pump and a sensor for sensing the pressure created by the pump;

[0017] a memory and an input device;

[0018] circuitry linked to the memory for controlling the operation of the insufflation and vacuum pumps; and

[0019] a power source for supplying power to internal components of the endoscopy suite and for external needs.

[0020] The endoscopy suite of the invention is characterized in that the memory comprises a plurality of predetermined sets of parameters. Each of the sets comprises a unique set of parameters for each of a plurality of endoscopic procedures. Once a specific endoscopic procedure and the corresponding set of parameters has been selected, by means of an input received from the input device, and one or more endoscopes appropriate for carrying out the specific procedure has been connected to the endoscopy suite, then the selected set of parameters and the pressure and/or flow rates sensed by the sensors controls the operation of the circuitry to provide the predetermined suction and insufflation pressure levels for the selected endoscopy procedure.

[0021] The endoscopy suite of the invention may comprise one or more lamps adapted for providing light (generally white light) that can be conducted to the distal end of the endoscope/s. It can also comprise one or more fans for cooling the lamp/s, additional power sources, which may include ballast means, for operating the lamp/s. The lamp/s may be selected from the group comprising: xenon lamps, halogen lamps, and metal halide lamps. One or more beam splitters can be provided to allow the light from one lamp to be used to supply light to two or more illumination channels. Other means of light can be used to illuminate the region in which the procedure is to be carried out. For example, light-emitting diodes (LEDs) can be placed on the distal tip of the endoscope in which case the endoscopy suite will comprise a power source that will be connected to the LEDs by means of electrical cables. In another option the light from LEDs can be transmitted by fibers up to the distal tip of the endoscope. The endoscopy suite of the invention may comprise means linked to the memory for adjusting the amount of light delivered from the lamp according to a predetermined value selected from one or more predetermined values stored in the memory and selected by an input received from the input device. The means for controlling the amount of light delivered from the lamp may comprise an iris attached to a motor adapted to respond to signals for adjusting the opening of the iris. The motor can be a step motor. An optical sensor may be provided to sense the home position of the stepping motor.

[0022] The endoscopy suite of the invention may comprise an ultrasound module for generating ultrasound signals to be emitted by an ultrasound transducer on the endoscope, detecting and processing ultrasound signals received by the transducer, and outputting the processed signals to a display device. The endoscopy suite may comprise an input device linked to the ultrasound module for modifying the operation and settings of the module. The ultrasound signals can be used to measure distances, position, or tissue thickness within the body.

[0023] The endoscopy suite of the invention may comprise a video module for acquiring video signals from one or more cameras on the endoscope/s, processing the signals, and outputting the processed signals to a display device. The video module may be able to receive signals from several camera heads on the same or on several different endoscopes and display the signals received properly on one or several display devices. The endoscopy suite may comprise an input device linked to the video module for modifying the operation and settings of the module. The video module can be adapted to receive output signals form the ultrasound module and to store them in a memory, to transmit them to the network, to display them along with the output video signals on a display, and/or to transmit them to a printer.

[0024] The video and ultrasound modules can be housed in a unit having its own power source and the remainder of the components of the endoscopy suite can be housed in another unit. Each of the units may comprise one or more fans for cooling the components housed within it. The fans and other electrical components are controlled by a central unit so in case of fan failure it is possible to advise the operator to stop the procedure.

[0025] The endoscopy suite of the invention may comprise a processor capable of managing the data stored in the memory, receiving inputs from the input device, and outputting signals to a display device and to the circuitry controlling the operation of the pumps. The endoscopy suite may comprise a communication interface linked to the processor and/or a communication interface linked to the ultrasound module and/or a communication interface linked to the video module and/or a communication interface linked to a video printer.

[0026] The circuitry controlling the pumps of the endoscopy suite of the invention may comprise cut off circuitries and programmable resistors adapted to receive predetermined values from the memory. The predetermined parameters for each pump may include a value of low pressure at

which the pump is activated and a value of high pressure at which the pump is deactivated.

[0027] The preferred embodiment of the endoscopy suite of the invention comprises means for controlling and monitoring the status of surgical tools, e.g. a surgical stapler used to perform endoscopic procedures.

[0028] The endoscopy suite of the invention can be used to perform an endoscopy procedure selected from the group comprising: a Gastroscopy procedure; an ERCP procedure using a mother scope and a baby scope; a Colonoscopy procedure; a Gynecology procedure; a Bronchoscopy procedure; an ENT procedure; an Endoluminal anti Reflux procedure; a Transgastric or Extragastric procedure using a mother scope and one or more baby scopes; and an Anti Reflux procedure. The Transgastric or Extragastric procedure can be selected from the group comprising: Appendectomy; Cholecystectomy; liver biopsy and excision; gastric banding for morbid obesity; and implantation of medical devices.

[0029] All the above and other characteristics and advantages of the invention will be further understood through the following illustrative and non-limitative description of preferred embodiments thereof, with reference to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] In the drawings:

[0031] FIG. **1** is a block diagram illustrating a preferred embodiment of a unit for suction, insufflations, and light (ISL) intensity control according to the invention;

[0032] FIG. **2** is a block diagram illustrating a preferred ultrasound and video control unit according to a preferred embodiment of the invention;

[0033] FIG. **3** illustrates an embodiment of a user interface for the endoscopy suite of the invention; and

[0034] FIG. **4** is a block diagram illustrating the ISL board in a preferred embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0035] The present invention is directed to a multipurpose endoscopy suite that can be used for carrying out different endoscopy or transgastric procedures. The endoscopy suite of the invention is designed to comprise reconfigurable equipment and resources that can be used for carrying out different procedures at different times according to user defined or, preferably, predetermined sets of parameters that are particularly suitable for the specific procedure.

[0036] FIG. **1** is a block diagram showing a ISL system for providing insufflation, suction, and light intensity (ISL) control. As has been discussed hereinabove, various procedures that are carried out require the simultaneous use of two or more endoscopes. Preferred embodiments of the endoscopy suite of the invention are designed to provide the requirements of several endoscopes simultaneously. In order to simplify the description of the invention, the system shown in the figures and described hereinbelow relates to an ISL system for attachment to a single endoscope only. The description provided herein along with the general knowledge possessed by skilled persons will suffice to allow the design of similar systems capable of being used with multiple endoscopes.

[0037] The ISL system is preferably enclosed in an independent unit (Console) **150**. The unit **150** preferably comprises two independent power sources: a light source power supply **100** for supplying power to lamp **103**, lamp fans **101**, and general fan **102** (used to cool the interior of unit **150**); and an ISL board power supply **115**, which provides power to the ISL board **110**.

[0038] The ISL board **110** preferably comprises a controller, memory, and interface circuitries (not shown in FIG. **1**), for controlling the operation of the suction pump **117**, the insufflation pump **116**, activation/deactivation of the lamp **103**, the iris motor **104**, for reading the pressure sensed by the pressure sensors **120** and **121**, and for inputting and outputting data from/to display **111**, the keypad and light emitting diodes (LEDs) **112**, and the communication interface **113**. A block diagram of a preferred embodiment of the ISL board is shown in FIG. **4** and described hereinbelow.

[0039] Insufflation pump **116** is provided with a gas input manifold **134** to allow the provision of air or other gases, such as CO_2 under pressure at the distal tip of the endoscope. A pressure relief valve **130** and a relief ("one-way") valve **132** are provided in the insufflation line since most of the DC pumps that are used to generate the positive pressure for irrigation/insulation are not able to start working against pressure. The sequence of events is as follows: the pump **116** builds up the pressure in the insufflation channel until the sensor **121** supplies a signal to the controller that will shut down the operation of the pump **116**; now the pressure is reduced e.g., by user demand and than the sensor **121** signals that the pump **116** should be activated; the check valve **132** maintains the pressure in the distal part of the channel while the relief valve **130** is opened for a brief period, e.g. 10 msec, to reduce the pressure in the section of the line between the pump **116** and the check valve **132** to zero; now, the pump can start to work against zero pressure and the relief valve is closed either before the pump is activated or immediately thereafter; allowing the pressure in the insufflation channel to rise.

[0040] The Lamp **103** is a white light source such as a halogen, metal halide, LED or xenon lamp, and the light source power supply should include means for operating the lamp **103**. Such means are, for example, a ballast in the case of a xenon lamp, where the term "ballast" includes all the electrical components necessary to operate the lamp. Also preferably included in the power supply circuit is a case interlock to protect the eyes of the operator from the UV radiation emitted by the lamp when the console is open. The light intensity that is required depends not only the amount of light needed for a bright image at the distal tip, but also on factors such as the diameter, absorption coefficient, quality, etc of the optical fibers that are in the endoscope that is connected to the system. Additionally, the output of the lamps must be controlled to optimize the light intensity at the distal tip of the endoscope. In the preferred embodiment of the invention, the output intensity of the lamp is controlled by adjusting the opening of iris **105** to allow passage of the amount of light required for the procedure being carried out. The opening of iris **105** is adjusted by signals provided by the ISL board **110** to motor **104**, which is

preferably a step motor. An optical sensor may be provided to sense the home position of the motor that controls the iris. The light passing through iris **105** opening is delivered to the endoscope multi-connector **106** on the front panel of unit **150**. When the connector at the proximal end of the endoscope is inserted into multi-connector **106** the light enters a light guide or optical fibers and travels through one of the endoscope's channels to the distal tip. The lamp is preferably mounted on a mechanical adjustable bracket that enables optimization of the coupling of the output of the lamp into the fiber, thereby increasing the amount of light that is gathered by the fiber and increasing the illumination at the distal end of the endoscope. Skilled persons will be aware of other arrangements to control the light intensity that can replace the iris and the motor in the ISL system. If several endoscopes are attached to the endoscopy suite, each through its own multiconnector **106**, then multiple lamps, **103**, ballasts, etc. may be provided in console **150**. Alternatively an optical arrangement comprising one or more beam splitters can be provided to allow the light from one lamp to be used to supply light to two or more illumination channels. In either case, separate irises **105**, each controlled by its own motor **104** are preferably provided to allow optimal adjustment of the light intensity for each endoscope. Other sources of light can be used illuminate the region in which the procedure is to be carried out. For example, LEDs can be placed on the distal tip of the endoscope in which case the endoscopy suite will comprise a power source connected to the LEDs by means of electrical cables.

[**0041**] The pressurized air supplied by insufflation pump **116** is delivered to the respective endoscope channel via the P+ connector **123** and suction created by vacuum pump **117** via the P− connector **124** on the front panel of the unit **150**. In the preferred embodiment the vacuum pump is part of the endoscopy suite, however this is optional since most hospitals have a central vacuum system. The pressure supplied by the insufflation pump can also be used for supplying water to the endoscope tip via a separate irrigation channel in the endoscope. This is accomplished by connecting a "Y" connector at the outlet from the P+ connector **123**. One branch of the "Y" being directly connected to the proximal end of the endoscope insufflation channel and the other branch connected to the inlet of a sealed water-filled container whose outlet is connected to the proximal end of the endoscope irrigation channel. In an alternative implementation, the "Y" connector may be connected to the insufflation pump from within the console **150**, where one output of the "Y" is connected to the P+ connector **123** in order to generate the irrigation and the other output of the "Y" will be connected to the insufflation channel of the endoscope through the Multi-Connector **106**.

[**0042**] The ISL Board **110** controls the operation of insufflation pump **116** and vacuum pump **117** in accordance with the pressure sensed by the respective pressure sensors **120** and **121**. In a preferred embodiment of the invention, the suction and insufflation pressures are maintained within the required ranges by activating the respective pump **116** or **117** whenever the pressure sensed by the respective sensor **120** or **121** deviates beyond the lower limit of proscribed conditions, and by stopping the operation of the respective pump whenever the pressure sensed by the respective sensor is above the upper limits of the proscribed conditions. For example for a Gastroscopy procedure performed with a specific endoscope, the lower limit for suction pressure is preferably limited to −0.4 bar, the upper limit for suction pressure is preferably limited to −0.6 bar, the low limit for insufflation pressure is preferably limited to 1.0 bar, and the upper limit for insufflation pressure is preferably limited to 1.5 bar.

[**0043**] The keypad and LEDs **112** allow the operator to manually activate/deactivate various components of unit **150** or to select the predetermined set of parameters required for the respective procedure, and also indicate the operator's selection via the LEDs. The keypad **112** includes keys for activating and deactivating the light source and the suction and insufflation control loops. In a preferred embodiment of the invention, the operator may use keypad **112** to select a desired insufflation pressure from a set of alternatives designated e.g., low, medium, or high; wherein the exact value of pressure that corresponds to each of these alternatives has been preset according to the endoscopic procedure that will be carried out.

[**0044**] The ISL Board can display via the display **111** information including, but not limited to: alerts, the predetermined values of the parameters currently selected, the sensed pressures, and other information associated with the specific endoscopy procedure being carried out. The suction and insufflation pressure are preferably controlled by utilizing analog circuitries to avoid any possible software faults from interfering with the operation of pumps **116** and **117**. In the preferred embodiment of the invention analog cut off circuits based on non-volatile programmable resistors (not shown) are utilized for this purpose. Implementation of such pressure control circuitries can be carried out in various ways that are well known to persons skilled in the art.

[**0045**] When the operator selects a specific endoscopic procedure via the keypad **112**, a predetermined set of parameters appropriate to that procedure are read from the memory of the ISL board **110** and written to the respective programmable resistors. The parameters of the set preferably are values of the upper and lower recommended pressure limits for suction and insufflation. Thus, the pressure control circuitries can provide analog control means for monitoring and adjusting the insufflation and suction pressures according to the predetermined high and low bounds and establish a hysteresis loop for controlling operation of pumps **116** and **117**.

[**0046**] The communication interface **113** is used for modifying the currently stored parameter set, i.e. calibrating the device, or for inserting new parameter sets, as may be required. However, only skilled and authorized technicians should preferably carry out these operations in order to prevent introducing unwanted and even unsafe changes in the sets of parameters stored in memory of the ISL board of unit **150**.

[**0047**] The operation of other equipment, for which specific predetermined operating parameters are not required, is preferably controlled via an independent unit (Console) **250**, as exemplified in FIG. **2**. In this exemplary embodiment, unit **250** comprise devices used for controlling the operation of video camera and ultrasound transducers located on the distal tip of the endoscope and connected to unit **250** via camera connector **211** and ultrasound connector **202**, respectively. Unit **250** preferably comprises two power supplies **200** and **215**.

[**0048**] The Ultrasound Power Supply **200** is used to power the ultrasound module **206** and one or more fans **201** in unit **250**. Ultrasound module **206** comprises a signal generator, processing means, memory, and interfacing circuitries **205**

required for emitting and acquiring ultrasound signals from the ultrasound transducer via the ultrasound connector **202**. A keypad **204** is linked to the ultrasound module **206** and used by the operator to adjust various ultrasound settings (for example for calibration). The processing means provides the digital signal processing (DSP) capabilities required for processing and analyzing the acquired ultrasound signals. The results of the signal analysis are displayed on display **203**, which is linked to ultrasound module **206**. The ultrasound signals can be used for measuring position, distance, and tissue thickness within the body.

[**0049**] The video board power supply **215** powers the video module **210**, the keypad **212**, the keyboard **212** and the communication interface **213**. The video module **210** provides the required electrical supply and control for operating the camera, which is connected to it via the camera connector **211**. The image data received form the camera is processed by the video module **210** and displayed on the video display **214**. To enable it to display the images, the video module **210** should include means for acquiring the image signals from the camera and processing means capable of carrying out the DSP tasks involved in processing the acquired image data. The operator can change various image properties (e.g., color intensity, brightness, zoom, etc) by means of keypad **212**. The communication interface **213** can be used to connect units **150** and **250** or to connect the ultrasound module **206** to the video module **210** thus allowing data inputs to be provided from one unit to the other. In addition to displaying the images and other information acquired by the system, they can be stored in memory, transmitted to a communication network, e.g. the internet, or sent to a printer.

[**0050**] It should be noted that the display **203** of unit **250** is not necessarily required if the ultrasound module **206** and video module **210** are linked (broken line in FIG. **2**). In that case modules **206** and **210** can be adapted to provide the information output produced by the ultrasound module **206** on the video display **214**, which is directly linked to the video module **210**.

[**0051**] FIG. **3** schematically illustrates one embodiment of the front panels, which fulfill the function of the user interface with units **150** and **250**, which together comprise the endoscopy suite. Panel **150***a* comprises keypad and LEDs **112**, which are used to operate the ISL of unit **150**, and display **111**. Panel **150***a* also includes the multi-connector socket **106**, the P+ Connector **123**, the P− Connector **124**, and a communication connector **113***a*, which provides the external electrical connection of communication interface **113** to communication interface **213** (see FIG. **2**).

[**0052**] Panel **250***a* comprises display **203**, keypads **204** and **212**, used to operate the video and ultrasound modules **206** and **210** of unit **250**, as well as the camera connector **211**, the ultrasound connector **202**, and the communication connectors **213***a* and **205***a* which provides the required external electrical connections to the communication interfaces **213** and **205** respectively.

[**0053**] In one embodiment, the communication connectors **113***a*, **213***a*, and **205***a*, are located on the front panels **150***a* and **250***a* of the respective units, as shown in FIG. **3**. In other embodiments they can be located on the back panels of the units. In other embodiments a keyboard can be provided in addition to or instead of keypads **112**, **204**, and **212**. As mentioned, the endoscopy suite can be designed for simultaneous use with more than one endoscope, in which case multiple connectors and display units will be present. In preferred embodiments LEDs will be provided on the front panel to indicate operation of various subsystems of the endoscopy suite, e.g. that the illumination system is operating.

[**0054**] FIG. **4** is a block diagram illustrating a preferred embodiment of the ISL board **110**. The instrumentation circuitries and the operation of the drivers **404** is controlled by the CPU **400** via the interface logic circuits of block **402**. The CPU **400** is linked to memory **401** in which is stored the predetermined sets of parameters, the operation code, and other information. The ISL board is connected to the communication interface **113**, which may simply be a suitable communication connector (e.g., RS232, IEEE 1394, USB or similar). The logic circuits in **402** provide the necessary signals for activating/deactivating the lamp, motor, insufflation pump, and vacuum pump, via the respective drivers **100'**, **104'**, **116'**, and **117'** respectively (collectively indicated by numeral **404**), in response to signals received from the CPU **400**. The logic circuits in **402** are also linked to the keypad and LEDs **112** and the display **111**.

[**0055**] The components in block **405** comprise circuitries **422** and **423** for controlling the activation/deactivation of the insufflation and vacuum pumps, **116** and **117** in response to the pressure sensed by pressure sensors **120** and **121**. The cut off circuits **430** and **431** respond to the signals for activating/deactivating the pumps by activating switching devices **421** and **420**. The signals from the logic circuits in **402** are connected by the switches to the respective drivers in, **404** whenever an activation signal is provided by the cut off circuits **430** and **431**, to the switching devices **421** and **420** respectively. In this way the activation signals provided by the logic circuits in **402** to the drivers of the insufflation and suction drivers are conditional on the signals provided by the cut off circuitries **430** and **431**.

[**0056**] The predetermined sets of parameters stored in the memory **401** are used by the logic circuits in **402** to set the values of the non-volatile programmable resistors in the cut off circuits. The insufflation cut off circuit **430** preferably comprise six programmable resistors "H", "M", "L", for providing high, medium, and low insufflation pressure values wherein one resistor is used for the upper deactivation limit and the other is used for the lower activation limit. The suction cut off circuitry preferably comprises two programmable resistors "R", for presetting the suction pressure. This is the presently preferred embodiment however the invention can be implemented by providing more or less programmable resistors.

[**0057**] Although the memory **401** is shown in this example as connected only to the CPU **400**, it should be noted that the logic circuits in **402** may be directly linked to memory **401** or, alternatively, to an additional memory (not shown) for providing direct access to the predetermined sets of parameters.

[**0058**] The endoscopy suite of the invention can be used to perform any endoscopy procedure including those selected from the group comprising: a Gastroscopy procedure; an ERCP procedure using a mother scope and a baby scope; a Colonoscopy procedure; a Gynecology procedure; a Bronchoscopy procedure; an ENT procedure; an Endoluminal anti Reflux procedure; a Transgastric or Extragastric procedure using a mother scope and one or more baby scopes; and an Anti Reflux procedure. The Transgastric or Extragastric procedure can be selected from the group comprising: Appendectomy; Cholecystectomy; liver biopsy and excision; gastric banding for morbid obesity; and implantation of medical devices.

[0059] In order to enable the surgeon to completely control the operation with relative ease, preferred embodiments of the endoscopy suite of the invention comprise all of the control and display means necessary manipulate a number of endoscopes and also the surgical tools that must be used to perform the procedure. Thus, for example, the operation of the surgical stapler employed e.g. to close the hole in the stomach lining after a transgastric procedure can be operated and the status of the stapling procedure monitored from a single location.

[0060] The above examples and description have been provided only for the purpose of illustration, and are not intended to limit the invention in any way. As will be appreciated by the skilled person, the invention can be carried out in a great variety of ways, employing techniques different from those described above, all without exceeding the scope of the invention.

1. An endoscopy suite that is adaptable for carrying out a plurality of different endoscopy procedures, said endoscopy suite comprising:

one or more insufflation pumps;

one or more sensors for sensing the pressure and/or flow rate created by said insufflation pump/s;

means for creating a vacuum selected from the group comprising:

an internal vacuum pump; and

an external vacuum pump;

one or more sensors for sensing the pressure created by said means for creating a vacuum;

optionally one or more pressure relief valves and one or more check valves;

a memory device;

an input device;

circuitry linked to said memory for controlling the operation of said insufflation pump/s and said means for creating a vacuum; and

one or more power sources for supplying power to internal components of the endoscopy suite and for external needs;

characterized in that said memory comprises a plurality of predetermined sets of parameters, wherein each of said sets comprises a unique set of parameters for each of a plurality of endoscopic procedures and wherein once a specific endoscopic procedure and the corresponding set of parameters has been selected, by means of an input received from said input device, and one or more endoscopes appropriate for carrying out said specific endoscopic procedure has been connected to said endoscopy suite, then said selected set of parameters and the pressure and/or flow rates sensed by said sensors controls the operation of said circuitry to provide the predetermined suction and insufflation pressure levels for said selected endoscopy procedure.

2. An endoscopy suite according to claim 1, comprising one or more lamps adapted for providing white light that can be conducted to the distal end of the endoscope/s.

3. An endoscopy suite according to claim 2, comprising one or more controlled fans for cooling the lamp/s and internal power supplies.

4. An endoscopy suite according to claim 2, comprising one or more additional power sources for operating the lamp/s.

5. An endoscopy suite according to claim 4, wherein the additional power source/s includes ballast means.

6. An endoscopy suite according to claim 2, wherein the lamp/s is selected from the group comprising: xenon lamps, (light emitting diodes) LED, halogen lamps, and metal halide lamps.

7. An endoscopy suite according to claim 2, comprising an optical arrangement comprising one or more beam splitters, thereby allowing the light from one lamp to be used to supply light to two or more illumination channels.

8. An endoscopy suite according to claim 1, comprising one or more power supplies connected by means of electrical cables to LEDs located at the distal tip of the endoscope/s.

9. An endoscopy suite according to claim 2, comprising means linked to the memory for adjusting the amount of light delivered from the lamp/s according to a predetermined value selected from one or more predetermined values stored in said memory and selected by an input received from the input device.

10. An endoscopy suite according to claim 9, wherein the means for controlling the amount of light delivered from the lamp comprise an iris attached to a motor adapted to respond to signals for adjusting the opening of said iris.

11. An endoscopy suite according to claim 10, wherein the motor is a step motor.

12. An endoscopy suite according to claim 10, comprising an optical sensor to sense the home position of the motor that controls the iris.

13. An endoscopy suite according to claim 1, comprising an ultrasound module for generating ultrasound signals to be emitted and received by one or more ultrasound transducers on the endoscope/s, detecting and processing ultrasound signals received by said transducer/s, and outputting said processed signals to a display device.

14. An endoscopy suite according to claim 13, wherein the processed signals are used to measure one or more of the following:

position;

distance; and

tissue thickness.

15. An endoscopy suite according to claim 13, comprising an input device linked to the ultrasound module for modifying the operation and settings of said module.

16. An endoscopy suite according to claim 1, comprising a video module for acquiring video signals from one or more cameras on the one or more endoscopes, processing said signals, and outputting said processed signals to one or more display devices, storage, network, and/or printers.

17. An endoscopy suite according to claim 17, comprising an input device linked to the video module for modifying the operation and settings of said module.

18. An endoscopy suite according to claim 1, comprising an ultrasound module for generating ultrasound signals to be emitted and received by one or more ultrasound transducers on the endoscope, detecting and processing ultrasound signals received by said transducer/s, and outputting said

processed signals to a display device and a video module for acquiring video signals from one or more cameras on the one or more endoscopes, processing said signals, and outputting said processed signals to one or more display devices, storage, network, and/or printers.

19. An endoscopy suite according to claim 18, wherein the video module is adapted to receive output signals form the ultrasound module and to display them along with the output video signals on a display.

20. An endoscopy suite according to claim 18, wherein the video and ultrasound modules are housed in a unit having its own power source and the remainder of the components of said endoscopy suite are housed in another unit.

21. An endoscopy suite according to claim 19, wherein each of the units comprise one or more controlled fans for cooling the components housed within it.

22. An endoscopy suite according to claim 1, comprising a processor capable of managing the data stored in the memory, receiving inputs from the input device, and outputting signals to a display device and to the circuitry controlling the operation of the pumps.

23. An endoscopy suite according to claim 22, comprising a communication interface linked to the processor.

24. An endoscopy suite according to claim 13, comprising a communication interface linked to the ultrasound module.

25. An endoscopy suite according to claim 16, comprising a communication interface linked to the video module.

26. An endoscopy suite according to claim 1, wherein the circuitry controlling the pumps comprise cut off circuitries and non-volatile programmable resistors adapted to receive predetermined values from the memory.

27. An endoscopy suite according to claim 26, wherein the predetermined values for each pump include a value of low pressure at which said pump is activated and a value of high pressure at which said pump is deactivated.

28. An endoscopy suite according to claim 1, comprising means for controlling and monitoring the status of surgical tools used to perform endoscopic procedures.

29. An endoscopy suite according to claim 28, wherein the surgical tool is a surgical stapler.

30. An endoscopy suite according to claim 1, wherein the endoscopy procedure is selected from the group comprising:

a Gastroscopy procedure;

an ERCP procedure using a mother scope and a baby scope;

a Colonoscopy procedure;

a Gynecology procedure;

a Bronchoscopy procedure;

an ENT procedure;

a Transgastric or Extragastric procedure using a mother scope and one or more baby scopes; and

an Anti Reflux procedure.

31. An endoscopy suite according to claim 30, wherein the Transgastric or Extragastric procedure is selected from the group comprising:

Appendectomy;

Cholecystectomy;

liver biopsy and excision;

Gastric banding for morbid obesity; and

Implantation of medical devices.

32. An endoscopy suite for supporting one or more endoscopic devices in order to carry out an endoscopy procedure selected from a plurality of different endoscopy procedures, said endoscopy suite comprising:

A. an ultrasound and video control unit comprising:

a) ultrasound components comprising one or more of the following:

(i) an ultrasound power supply;

(ii) an ultrasound module comprising an ultrasound signal generator, processing means, and interfacing circuitries;

(iii) input device;

(iv) an ultrasound display;

(v) an ultrasound connector;

(vi) a communication interface;

b) video components comprising one or more of the following:

(i) a video board power supply;

(ii) a video module;

(iii) a video display;

(iv) input means;

(v) a camera connector;

(vi) a communication interface;

B. a suction, insufflations, and light intensity (ISL) control unit comprising one or more of the following:

(i) a light source power supply;

(ii) a light source;

(iii) means to control the output of said light source;

(iv) cooling fans;

(v) an endoscope multiconnector;

(vi) an ISL board comprising controller and memory means and interfacing circuitries;

(vii) a power supply for said ISL board;

(viii) an insufflation pump;

(ix) suction means;

(x) pressure sensors;

(xi) valves;

(xii) a display;

(xiii) input means; and

(xiv) a communication interface;

characterized in that, when the operator of said endoscopy suite selects a specific endoscopic procedure via said input means of said ISL unit, a predetermined set of procedure-related parameters appropriate to said procedure and comprising maximum and minimum output values of selected devices in said

ISL unit are read from a plurality of different sets of procedure-related parameters appropriate to each of said plurality of different endoscopy procedures that are stored in a memory of said ISL board and the values of said appropriate set of parameters are written to non-volatile memory components of analog cut off circuits, which control the operation of said devices, thereby assuring maximum safety when performing said selected endoscopic procedure.

33. An endoscopy suite according to claim 32, wherein the analog cut off circuits, which control the selected devices, comprise non-volatile programmable resistors that receive the predetermined set of parameters read from the memory.

34. An endoscopy suite according to claim 32, wherein the selected devices are chosen from suction pumps, insufflation pumps, and means to control output of light source.

35. An endoscopy suite according to claim 34, wherein the predetermined set of procedure-related parameters include a value of low pressure at which the pump is activated and a value of high pressure at which said pump is deactivated.

36. An endoscopy suite according to claim 32, wherein the light source comprises one or more lamps that provide white light that can be conducted to the distal end of the endoscope/s.

37. An endoscopy suite according to claim 32, wherein the light source power supply includes ballast means.

38. An endoscopy suite according to claim 32, wherein the light source is selected from the group comprising: xenon lamps, light emitting diodes (LEDs), halogen lamps, and metal halide lamps.

39. An endoscopy suite according to claim 32, wherein the light source comprises an optical arrangement comprising one or more beam splitters, thereby allowing the light from one lamp to be used to supply light to two or more illumination channels.

40. An endoscopy suite according to claim 32, wherein the light source power supply is connected by means of electrical cables to one or more LEDs located at the distal tip of the endoscope/s.

41. An endoscopy suite according to claim 32, wherein the means to control the output of the light source comprises an iris attached to a motor adapted to respond to signals for adjusting the opening of said iris.

42. An endoscopy suite according to claim 41, wherein the motor is a step motor.

43. An endoscopy suite according to claim 41, comprising an optical sensor to sense the home position of the iris.

44. An endoscopy suite according to claim 32, wherein the ultrasound module generates ultrasound signals, which are emitted and received by one or more ultrasound transducers on the endoscope/s; detects and processes ultrasound signals received by said transducer/s; and outputs said processed signals to the ultrasound display.

45. An endoscopy suite according to claim 44, wherein the processed signals are used to measure one or more of the following:

position;

distance; and

tissue thickness.

46. An endoscopy suite according to claim 32, wherein the input device is linked to the ultrasound module to allow modifying the operation and settings of said module.

47. An endoscopy suite according to claim 32, wherein the video module acquires video signals from one or more cameras on the one or more endoscopes, processes said signals, and outputs said processed signals to one or more display devices, to storage devices, to a communication network, and/or to printers.

48. An endoscopy suite according to claim 32, wherein the input means are linked to the video module for modifying the operation and settings of said module.

49. An endoscopy suite according to claim 32, wherein the video module receives output signals from the ultrasound module and displays said output ultrasonic signals along with the output video signals on the video display.

50. An endoscopy suite according to claim 32, wherein the controller of the ISL board manages the data stored in the memory, receives inputs from the input device, and outputs signals to the display device and to the circuitry controlling the operation of the selected devices.

51. An endoscopy suite according to claim 32, comprising means for controlling and monitoring the status of surgical tools used to perform endoscopic procedures.

52. An endoscopy suite according to claim 51, wherein the surgical tool is a surgical stapler.

53. An endoscopy suite according to claim 32, wherein the endoscopy procedure is selected from the group comprising:

a Gastroscopy procedure;

an ERCP procedure using a mother scope and a baby scope;

a Colonoscopy procedure;

a Gynecology procedure;

a Bronchoscopy procedure;

an ENT procedure;

a Transgastric or Extragastric procedure;

a Transgastric or Extragastric procedure using a mother scope and one or more baby scopes; and

an Anti Reflux procedure.

54. An endoscopy suite according to claim 53, wherein the Transgastric or Extragastric procedure is selected from the group comprising:

Appendectomy;

Cholecystectomy;

liver biopsy and excision;

Gastric banding for morbid obesity; and

Implantation of medical devices.

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专利名称(译)	多功能内窥镜套件		
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发明人	SONNENSCHEIN, ELAZAR ELOVICI, YUVAL SONNENSCHEIN, MINELU		
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摘要(译)

内窥镜检查套件适于执行多个内窥镜检查程序和/或用于支持在给定程序中同时使用的多个内窥镜。内窥镜检查套件包括存储器单元，其中存储有多组预定参数。这些组中的每一组包括用于多个内窥镜过程中的每一个的唯一参数集。一旦内窥镜检查套件的操作者选择了特定的内窥镜程序并且已经将适合于执行特定内窥镜程序的一个或多个内窥镜连接到内窥镜检查套件，则适合于特定程序的一组参数被自动传送到控制器，其控制内窥镜检查套件的部件的操作，以为所选择的内窥镜检查过程提供预定的照明，抽吸和吹气压力水平。