US006361497B1

(12) **United States Patent**
Lathbury et al.

(10) **Patent No.: US 6,361,497 B1**
(45) **Date of Patent: *Mar. 26, 2002**

(54) **CONTROL PANEL FOR INTRAVASCULAR ULTRASONIC IMAGING SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **09/611,374**

(22) Filed: **Jul. 7, 2000**

Related U.S. Application Data

(63) Continuation of application No. 09/167,055, filed on Oct. 6, 1998, now Pat. No. 6,142,940.

(51) **Int. Cl.**[7] **A61B 8/00**
(52) **U.S. Cl.** **600/437**
(58) **Field of Search** 600/437, 443, 600/447, 459; D24/158, 100, 186

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,161,535	A	11/1992	Short et al.	128/660.01
D334,062	S	3/1993	Davis et al.	D24/160
D334,981	S	4/1993	Davis et al.	D24/160
5,255,682	A	10/1993	Pawluskiewicz et al.	128/662.03
5,315,999	A	5/1994	Knicki et al.	128/660.07
5,379,771	A	1/1995	Kawasaki et al.	128/661.1
D360,690	S	7/1995	Murakami	D24/160
D365,148	S	12/1995	Murakami et al.	D24/160
D368,521	S	4/1996	Asai et al.	D24/160
D379,231	S	5/1997	Ungari	D24/160
5,722,412	A	3/1998	Pflugrath et al.	128/660.07
D398,059	S	9/1998	Kwak	D24/160
5,817,024	A	* 10/1998	Ogle et al.	600/447
5,941,824	A	8/1999	Hwang	600/437
6,084,576	A	* 7/2000	Leu et al.	345/168
6,142,940	A	* 11/2000	Lathbury et al.	600/137

FOREIGN PATENT DOCUMENTS

EP	0 501 819 A2	9/1992	A61B/8/12

* cited by examiner

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(57) **ABSTRACT**

A control panel for an ultrasonic imaging system. A pointing device such as a track ball is centrally located on the control panel and a plurality of buttons and control knobs are arranged around the pointing device in a manner that is ergonomically improved and enhances intuitive system operation. For example, a plurality of image mode selection buttons may be arranged in a substantially linear fashion and located above the pointing device on the control panel. The imaging mode selection buttons preferably are arranged from left to right in order of anticipated use or in order of anticipated frequency of use.

15 Claims, 2 Drawing Sheets

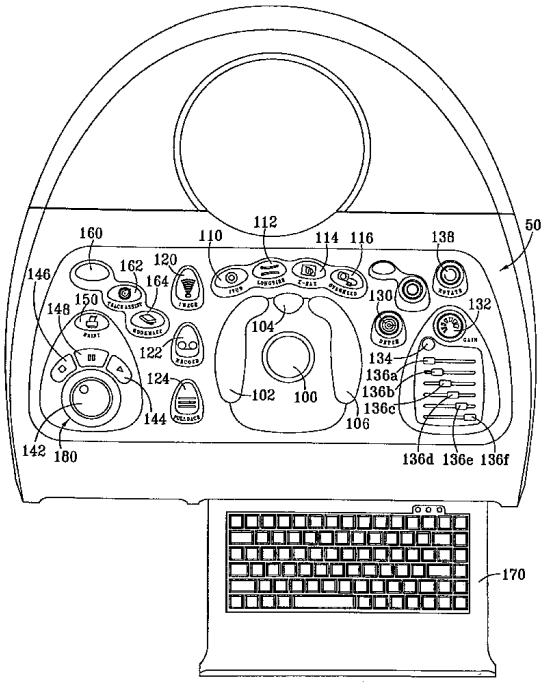
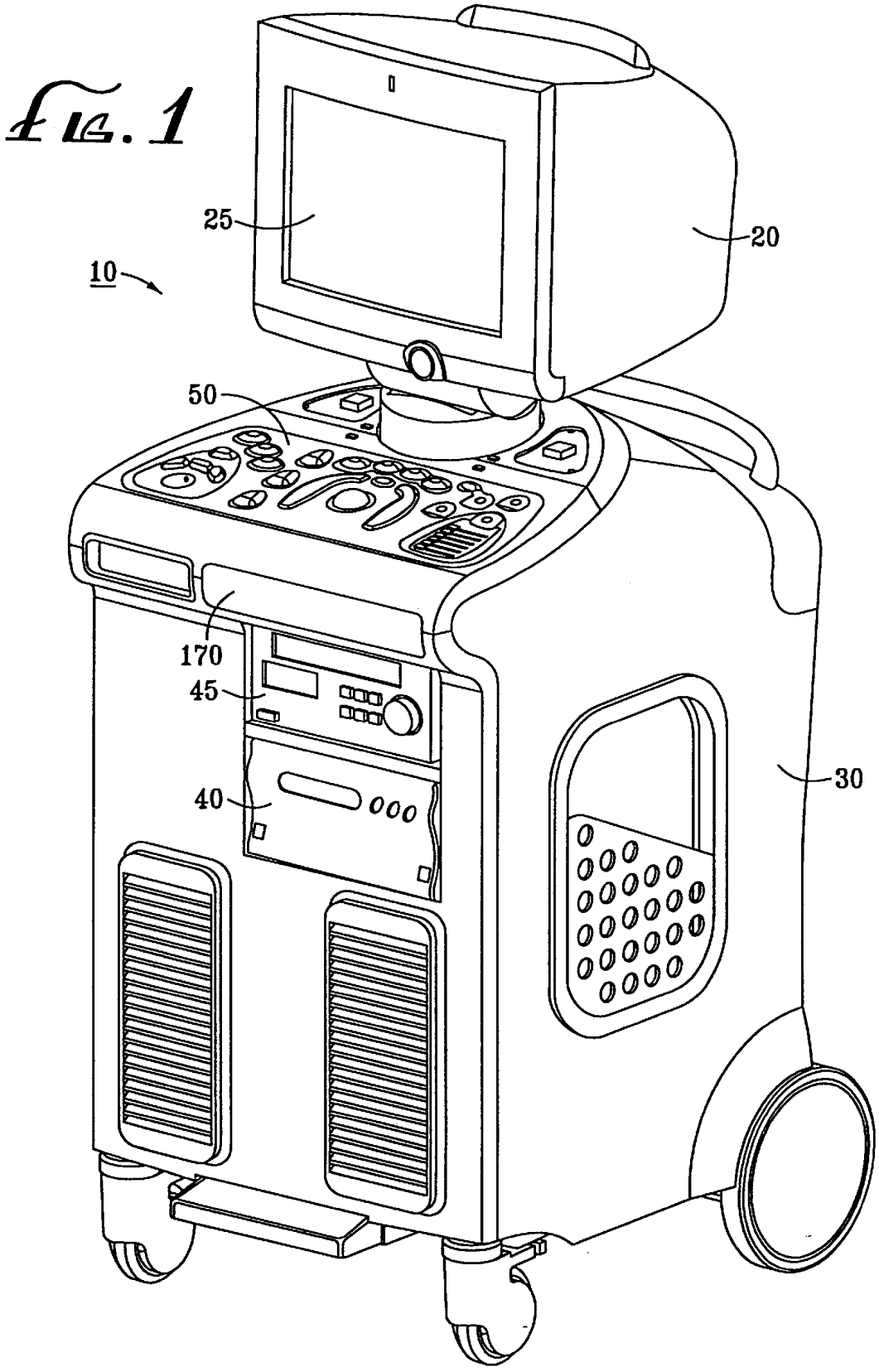
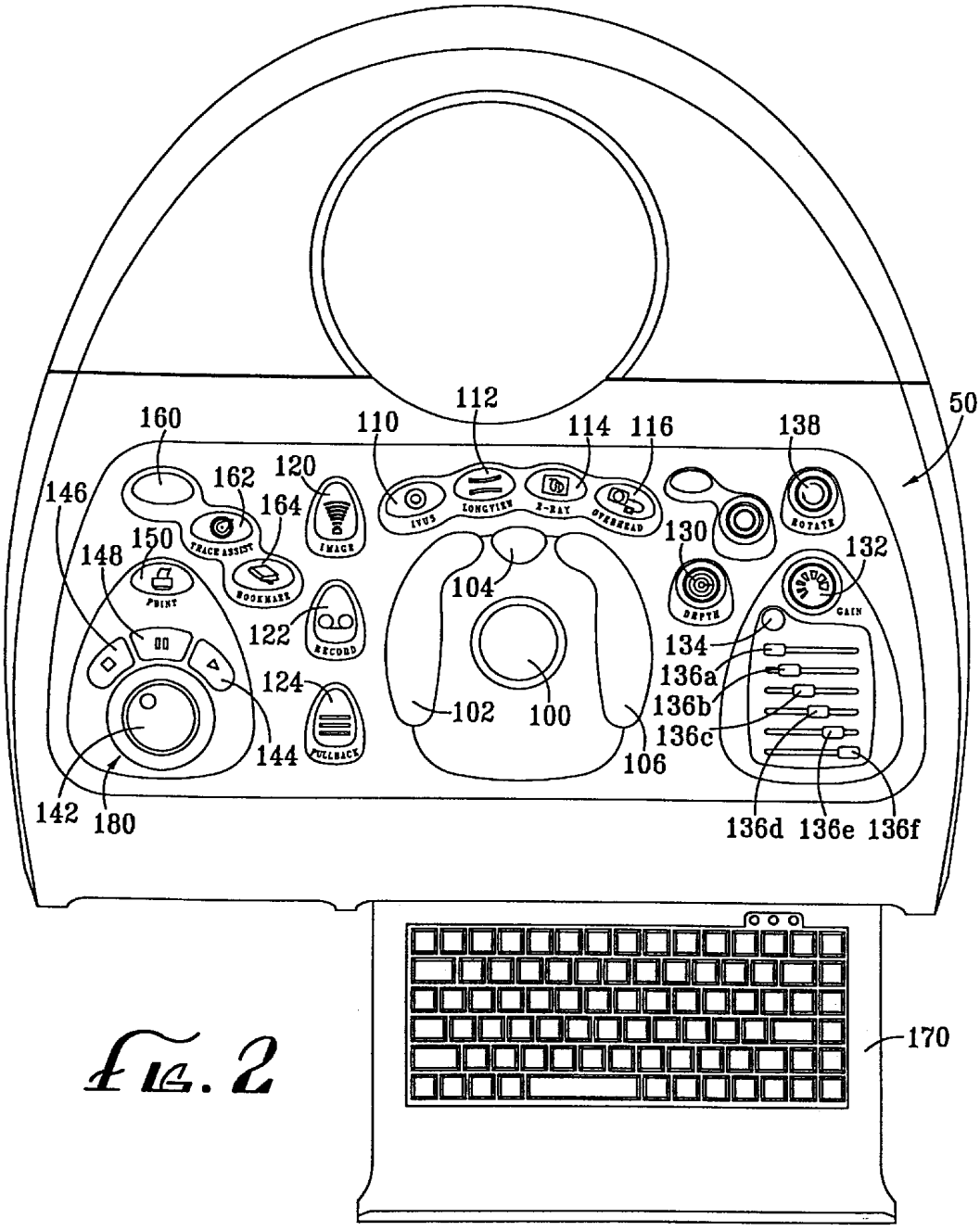


FIG. 1

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136a
136b
136c
124
102
100
106
144
142
180
136d
136e
136f
170
IVUS
LONGVIEW
X-RAY
OVERHEAD
ROTATE
TRACE ASSIST
IMAGE
POINT
BOOKMARK
DEPTH
GAIN
RECORD
PULLBACK

FIG. 2

CONTROL PANEL FOR INTRAVASCULAR ULTRASONIC IMAGING SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. application Ser. No. 09/167,055, filed on Oct. 6, 1998 and now U.S. Pat. No. 6,142,940. The priority of the prior application is expressly claimed and its disclosure is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

For the past several years, substantial attention has been directed to the field of intravascular ultrasonic imaging systems. Such systems generally include an imaging catheter assembly, a motor drive unit and an imaging subsystem. The imaging catheter assembly is coupled to the motor drive unit, and the motor drive unit is coupled to the imaging subsystem. An imaging transducer is provided within a distal extremity of the catheter assembly and is electronically coupled to the imaging subsystem via the motor drive unit. Conventional imaging subsystems generally include a computer-based image processing system and a display. Thus, when the distal extremity of the catheter assembly is inserted, for example, into a body lumen such as a coronary vessel, an image of an interior surface and/or the structures comprising a wall of the lumen may be depicted on the display. This enables physicians to gain valuable information regarding, for example, occlusions that may exist within, for example, coronary vessels due to the build-up of atherosclerotic plague.

While intravascular ultrasonic imaging systems are very valuable tools to physicians, the use of such systems is often quite complicated and non-intuitive. One reason for this is that the control panels of such systems are not laid out in an intuitive manner. Indeed, conventional control panels are often cluttered with buttons, potentiometers, track balls, and other devices that are not well organized and, as a result, substantial training is often required to educate imaging personnel with regard to even basic imaging functions that are performed by such systems.

Accordingly, it is believed that those skilled in the art would find an innovative control panel with improved ergonomic features and/or an intuitive control group layout to be quite useful.

SUMMARY OF THE INVENTION

In one innovative aspect, the present invention is directed to an innovative control panel for an intravascular ultrasonic imaging system. The control panel preferably has a centrally located track ball, or other pointing device, and a plurality of subsystem control groups that are arranged around the pointing device in an intuitive manner.

For example, in one preferred embodiment, a plurality of imaging mode selection buttons are provided within a region of the control panel just forward of the pointing device and within a region of the control panel that is generally below a display screen of the imaging system. The imaging mode selection buttons preferably are arranged from left to right in order of anticipated use and/or in order of anticipated frequency of use.

Similarly, in another preferred embodiment, an imaging initiation button, record button and pullback button are arranged in a linear fashion adjacent one side of the pointing device. For example, in a presently preferred embodiment, the image initiation, record and pullback buttons are located directly to the left of the pointing device and are arranged in anticipated order of use from a forward region of the control panel to a rearward region of the control panel. It will be appreciated that the term "forward," as used herein, refers to a location generally further away from a user of the system, whereas the term "rearward" is meant to denote a location closer to a user of the system. Thus, when initiating an imaging sequence, a user of a system in accordance with the present invention may reach out to depress the image initiation button and, upon withdrawing his or her hand or arm, easily depress the record button and, if desired, the pullback button.

In still other innovative embodiments, the pointing device is located in a region between an image processing control group and an image analysis control group. The image processing control group may comprise, for example, a depth of field or "zoom" control knob and a plurality of gain control devices including a master gain control knob, a plurality of time gain control potentiometers and a time gain control (TGC) on/off switch. The image analysis control group may comprise, for example, a trace assist button, a bookmark button, a print button and a jog shuttle control assembly including a jog shuttle knob, play button, stop button and pause button.

In a further innovative aspect, the control console may include a pop-out keyboard. Thus, a control panel in accordance with the present invention may take advantage of a relatively large keyboard without limiting to any significant degree the functionality of the control panel.

In view of the foregoing, it is an object of the present invention to provide an improved control panel for use with ultrasonic imaging systems.

It also is an object of the present invention to provide a control panel having improved ergonomic characteristics and an intuitive control group layout such that minimal training is required to operate the controls of the control panel.

Other objects and features of the present invention will become apparent from consideration of the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of an intravascular ultrasonic imaging system in accordance with a preferred form of the present invention.

FIG. **2** is a top view of a control panel of the intravascular ultrasonic imaging system shown in FIG. **1**.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Turning now to the drawings, as shown in FIG. **1**, an intravascular ultrasonic imaging system **10** in accordance with the present invention preferably includes a monitor **20** having a display screen **25** for displaying various images (i.e., "tissue ball" ultrasound images, "longview" or vessel cross-sectional images and various X-ray images), and a main chassis assembly **30** for housing a computer-based image processing system (not shown), printer **40** and video recording apparatus **45**. As explained above, the image processing unit may be coupled to a motor drive unit (not shown) and the motor drive unit may be coupled to an imaging catheter assembly (not shown) having an imaging transducer (not shown) located within a distal end thereof.

Turning now to FIG. **2**, an innovative control panel **50** is located on an upper surface of the main chassis **30** and directly below the monitor **20**. In one particularly preferred embodiment, the control panel **50** includes a centrally located trackball **100** and related "mouse" type control buttons **102**, **104** and **106**. Those skilled in the art will appreciate that the trackball assembly **100–106** could be replaced by a touch pad mouse (not shown) or by some other pointing device, and that the use of such pointing devices would be equivalent to using the trackball assembly **100–106** illustrated in FIGS. **1** and **2**. While the trackball assembly **100–106** need not be located precisely at the center of the control panel **50**, it is preferred that the trackball assembly **100–106** be located generally in the center of the control panel **50** to facilitate both right handed and left handed operation of the control panel **50**.

A plurality of imaging mode selection buttons **110**, **112**, **114** and **116** preferably is located within a region of the control panel **50** directly above or forward of the trackball assembly **100**. The imaging mode selection buttons preferably include an IVUS image selection button **110**, a longview image selection button **112**, an x-ray image selection button **114** and an overhead image selection button **116**. It will be appreciated that the imaging mode selection buttons **110**, **112**, **114** and **116** are located on the control panel **50** within a region generally below the display screen **25** of the monitor **20**. The image selection control buttons **110**, **112**, **114** and **116** also preferably are arranged from left to right by order of anticipated use and/or by order of anticipated frequency of use. Finally, the image selection control buttons **110–116** preferably have icons provided on their surfaces for providing an indication of the type of image that will be displayed as the respective buttons **110–116** are depressed. For example, the IVUS image selection button **110** has a "tissue ball" icon provided upon its surface, the longview image selection button **112** has a "vessel cross-section" icon provided upon its surface, and the X-ray image selection button **114** has a heart-vessel image icon provided upon its surface.

The IVUS image selection button **110** preferably functions as an image toggle button that causes an IVUS image or "tissue ball" to be displayed or removed from the main system display **25**. This is useful because the system display **25** preferably can depict several images (i.e., tissue ball, longview, x-ray, or saved images). It may be appreciated that in a preferred form the intravascular ultrasonic imaging system **10** shall default to activation of the IVUS image display. That is, following power-up, a full screen IVUS image or tissue ball is displayed on the main system display **25** or monitor **20**. During an imaging procedure, a user of the system **10** may add other images to the display **25**. When this happens, the system preferably will resize the IVUS image in order to make room on the display **25** for one or more additional images. At this point, pressing the IVUS display button **110** preferably will cause the IVUS image to be removed from the display **25** and will cause any remaining images to be resized to take maximum advantage of available display pixels. Pressing the IVUS display button **110** again preferably redisplays the IVUS image. The IVUS image selection button **110** preferably functions in both live (or active imaging) and digital replay modes.

The longview image selection button **112** functions as a toggle that acts to enable/disable a longview or vessel cross-section display. The default of the system preferably is set to not display a longview image. Thus, pressing the longview image selection button **112** preferably causes any existing image displays to be resized and located in an upper portion of the main display **25** and causes a longview image to be shown horizontally on a lower portion of the display **25**.

The x-ray image selection button **114** functions as a toggle that acts to add a x-ray video image onto the system display **20**. The x-ray video image may comprise a "roadmap" image or fluoroscopic image. If the IVUS image video is enabled and in the IVUS only mode, then depressing the x-ray button **114** preferably resizes the IVUS display into the upper left corner of the display **25** and places the x-ray image in the upper right corner. Toggling the x-ray image selection button **114** again preferably removes the x-ray video image from the display **25** and resizes the IVUS video image to full screen. It will be appreciated that the x-ray video image may comprise either a "roadmap" or fluoroscopic image, depending upon which type of image is made available from an associated catheter lab x-ray system. However, in some alternative embodiments it may be desirable to allow a user to toggle, for example, between a roadmap and a fluoroscopic image using the x-ray image button **114**.

The overhead image selection button **116** enables the imaging system **10** to provide an output of the main display video in a format compatible with that utilized, for example, by x-ray video monitors located within a catheter lab. Thus, through the use of the overhead image selection button **116**, it is possible to switch the presentation on the catheter lab x-ray monitor from x-ray images to the main display **25** of the IVUS system **10**.

An image on/off button **120**, record button **122** and pullback button **124** preferably are arranged in a linear fashion and are located slightly to one side of the track ball assembly **100–106**. The image on/off button **120**, record button **122** and pullback button **124** preferably are arranged by order of anticipated use with the image on/off button **120** being located within an upper or forward region of the control panel **50**, and the pullback button **124** being located within a lower or rearward region of the control panel **50**. Thus, those skilled in the art will appreciate that the use of the image on/off button **120**, record button **122** and pullback button **124** proceeds in an intuitive manner. First, image depiction is initiated via the image on/off button **120**. Then, recording of obtained images is initiated via the record button **122**, and a pullback function may be initiated via the pullback button **124**.

A plurality of image processing control devices **130–138** preferably are provided within a region of the control panel **50** that is to one side of and adjacent the track ball assembly **100–106**. The image processing control devices include a depth control knob **130**, gain control knob **132**, time gain control on/off switch **134**, time gain control potentiometers **136** and image rotation knob **138**. The depth control knob **130** enables a user to view more or less of the vessel depth, effectively varying the depth of field of the IVUS image depicted on the display **25**. The gain control knob **132** allows a user to raise or lower the overall image gain. This, in effect, acts to raise or lower an entire time gain control curve that may comprise a default setting or a setting defined by the potentiometers **136***a*–**136***f*. Moreover, the gain control knob **132** allows a user to effect a gain change across an entire time gain control range.

The time gain control on/off switch **134** enables and disables the function of the potentiometers **136***a*–**136***f*. Thus, the time gain control on/off switch **134** provides a means for preventing alteration of a set time gain control curve and/or alteration of a displayed image in the event that the potentiometers **136** are moved unintentionally.

A video jog shuttle assembly **140** preferably is provided on the control panel **50** within a region opposite the image processing control devices **130–138**. The jog shuttle assembly **140** preferably includes a jog shuttle control knob **142**, a play button **144**, a stop button **146**, a pause button **148** and a print button **150**. The jog shuttle assembly **140** allows a user to play, fast/slow forward, and fast/slow reverse through recorded images while simultaneously displaying those images. This feature is implemented via a standard VCR-type jog shuttle control for viewing digital cine loop images. It will be appreciated of course that the print button **150** may be used to print any image that is displayed on the monitor **20**.

Preferably, a plurality of image analysis buttons **160**, **162** and **164** are positioned within a location slightly above the jog shuttle assembly **140** on the control panel **50**. The image analysis buttons **160**, **162** and **164** preferably include a speckle reduction button **160**, trace assist button **162** and bookmark button **164**. By depressing the speckle reduction button **160**, the user may initiate a speckle reduction subroutine within the image processing system and enable artifact from blood speckle to be removed from a displayed image. Similarly, by depressing the trace assist button **162**, the user may initiate a trace assist algorithm that may be used to define an internal and external wall of a vessel displayed on the display **25** of the monitor **20**. More specifically, depression of the trace assist button **162** results in enablement of a trace assist function and in the provision of a computer generated graphical representation of a vessel cross-sectional area, the lumen cross-sectional area, the minimum and maximum vessel diameter, and the minimum and maximum lumen diameter. Depressing the trace assist button **162** again preferably disables the trace assist function. Alternatively, depressing the trace assist button **162** could either clear the computer generated graphics, or provide a recalculation if a new set of data has been stored in the display buffer. This latter function would likely occur when the user has forwarded or reversed the digital cine loop paused image.

The bookmark button **164** provides a means for marking a displayed IVUS frame in the digital cine loop to facilitate quick reference to the "marked" frame.

Finally, in one preferred embodiment of the present invention, a pop-out keyboard **170** is provided on the control panel **50**. It will be appreciated that when the keyboard is not being used, it may be stored within the control panel **50**. Thus, a control panel **50** in accordance with the present invention may take advantage of a relatively large keyboard without limiting to any significant degree the functionality of the control panel **50**. Further, by using a pop-out keyboard **170**, it is possible to enhance the overall ergonomics of the control panel **50** because the location of the various controls and control groups on the control panel **50** is not dictated by keyboard location.

While the invention is susceptible to various modifications and alternative forms, specific examples thereof have been shown in the drawings and are herein described in detail. It should be understood, however, that the invention is not to be limited to the particular forms or methods disclosed, but to the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the appended claims.

What is claimed is:

1. A control panel for an ultrasonic imaging system comprising:

a pointing device located within a central region of the control panel to facilitate both right handed and left handed operation of the pointing device;

a plurality of imaging mode selection controls located within a region of the control panel forward of the pointing device and generally below a screen of a monitor of the imaging system; and

the plurality of imaging mode selection controls being arranged by anticipated order of use; and

wherein the imaging mode selection controls comprise an ultrasound image selection button and an x-ray image button.

2. The control panel of claim **1**, further comprising a plurality of image record controls, the image record controls including an image activation button, a record button and a pullback button, the image activation button and the record button and the pullback button being arranged substantially in a line and disposed to one side of the pointing device, and the record button being disposed between the image activation button and the pullback button.

3. The control panel of claim **1**, wherein the image activation button is located forward of the record button on the control panel.

4. The control panel of claim **1** further comprising a plurality of image processing controls, the image processing controls being located generally to one side of the pointing device on the control panel, and the image processing controls including a master gain adjustment knob, a plurality of time gain control potentiometers, and a time gain control on/off switch.

5. The control panel of claim **1** further comprising a plurality of image playback controls, the plurality of image playback controls being located generally to one side of the pointing device and including a play button, pause button, stop button and jog shuttle control knob.

6. The control panel of claim **5** further comprising a plurality of image analysis controls located generally forward of the image playback controls on the control panel and comprising a trace assist button and a bookmark button.

7. The control panel of claim **6** wherein the plurality of image analysis controls further comprise a speckle reduction button, the plurality of image analysis controls are arranged in a generally linear fashion, and the trace assist button is located between the speckle reduction and bookmark buttons.

8. The control panel of claim **1**, wherein the pointing device comprises a track ball or touch pad.

9. A control panel for an ultrasonic imaging system comprising:

a pointing device located within a central region of the control panel; and

a plurality of image record controls including an image activation button, record button and pullback initiation button, the image activation button and the record button and the pullback initiation button being located to one side of the pointing device, the image activation button and the record button and the pullback button being arranged in a line by anticipated order of use with the record button being located generally between the image activation and pullback buttons.

10. The control panel of claim **9** further comprising a pop-out key board.

11. The control panel of claim **9** further comprising a plurality of image processing controls, a plurality of imaging mode selection controls and a plurality of image playback controls, the image processing controls being located to one side of the pointing device, the image playback controls being located to another side of the pointing device, and the imaging mode selection controls being located forward of the pointing device within an area of the control board that

is located generally between the image processing controls and the image playback controls.

12. The control panel of claim **11** further comprising a plurality of image analysis controls located generally forward of the image playback controls and located generally between the image playback controls and the imaging mode selection controls.

13. The control panel of claim **12**, wherein

the image processing controls comprise a master gain control knob, a depth of field control knob, and a plurality of time gain control potentiometers;

the imaging mode selection controls comprise an ultrasonic imaging select button, a longview image select button, an X-ray image select button and an overhead display select button;

the image analysis controls comprise a trace assist button and a bookmark button; and

the image playback controls comprises a jog shuttle control knob, a play button, a pause button and a stop button.

14. The control panel of claim **13**, wherein the image analysis controls further comprise a speckle reduction button, the image playback controls further comprise a print button, and the image processing controls further comprise an image rotation knob.

15. The control panel of claim **9**, wherein the pointing device comprises a track ball or touch pad.

* * * * *

专利名称(译)	用于血管内超声成像系统的控制面板		
公开(公告)号	US6361497	公开(公告)日	2002-03-26
申请号	US09/611374	申请日	2000-07-07
申请(专利权)人(译)	SCIMED LIFE SYSTEMS INC.		
当前申请(专利权)人(译)	SCIMED LIFE SYSTEMS INC.		
[标]发明人	LATHBURY GEORGI BEYHAN NIYAZI MOORE THOMAS C LIBERTY SHARON		
发明人	LATHBURY, GEORGI BEYHAN, NIYAZI MOORE, THOMAS C. LIBERTY, SHARON		
IPC分类号	A61B8/12 A61B8/00		
CPC分类号	A61B8/12 A61B8/467 A61B8/4405 A61B8/461		
外部链接	Espacenet USPTO		

摘要(译)

用于超声成像系统的控制面板。诸如跟踪球的指示设备位于控制面板的中央，并且多个按钮和控制旋钮以符合人体工程学的方式围绕指示设备布置并且增强了直观的系统操作。例如，多个图像模式选择按钮可以以基本上线性的方式布置并且位于控制面板上的指示设备上方。成像模式选择按钮优选地按照预期使用的顺序从左到右排列或按预期使用频率的顺序排列。