(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 804 669 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
26.08.2015 Bulletin 2015/35

(21) Application number: **05754944.6**

(22) Date of filing: **27.06.2005**

(51) Int Cl.:
A61B 8/00 *(2006.01)* ***B06B 1/02*** *(2006.01)*
G10K 11/34 *(2006.01)* ***G01N 29/22*** *(2006.01)*
G01S 7/524 *(2006.01)*

(86) International application number:
PCT/IB2005/052126

(87) International publication number:
WO 2006/003605 (12.01.2006 Gazette 2006/02)

(54) **SYSTEM FOR AMPLIFYING TRANSMIT WAVEFORMS GENERATED BY AN ULTRASONIC SYSTEM**

SYSTEM ZUR VERSTÄRKUNG VON ÜBERTRAGUNGSWELLENFORMEN, DIE VON EINEM ULTRASCHALLSYSTEM ERZEUGT WERDEN

SYSTEME PERMETTANT D'AMPLIFIER DES FORMES D'ONDES D'EMISSION GENEREES PAR UN SYSTEME ULTRASONORE

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR

(30) Priority: **28.06.2004 US 583490 P**

(43) Date of publication of application:
11.07.2007 Bulletin 2007/28

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Description

[0001] The present invention relates generally to ultrasonic imaging systems. More particularly, it relates to a system for amplifying low-voltage arbitrary shape transmit waveforms beam-formed by a micro-beam-former of a ultrasonic imaging system to improve harmonic imaging.

[0002] Ultrasonic transducers are used in many medical applications and, in particular, for the non-invasive acquisition of images of organs and conditions within a patient, typical examples being the ultrasonic imaging of fetuses and the heart. The ultrasonic transducers used in such applications are generally hand held, and must meet stringent dimensional constraints in order to acquire the desired images. It is frequently necessary that the transducer be able to obtain high resolution images of particular portions of a patient's body when using endoscopic ultrasonic imaging equipment.

[0003] Typically, conventional ultrasonic imaging equipment use one-dimensional and two-dimensional arrays for acquiring the ultrasonic images of particular tissues or organs within the patient's body. Generally, these arrays include a plurality of acoustic elements arranged in a planar configuration. Beam steering and beam tractor-treading are used in such systems to control the propagation of the output ultrasonic beam such that the output beam may be steered along a horizontal axis and/or along a vertical axis. Employing these methods allows ultrasonic systems to receive transmit waveforms which are processed using harmonic imaging to acquire images of the particular region of the patient's body.

[0004] Existing matrix probe waveforms are generally limited to simple square "bangbang" transmit waveforms. Such waveforms, however, have poor performance when used for harmonic imaging due to their strong transmitted harmonic energy. Therefore, a need exists for an improved ultrasonic imaging system capable of improving poor harmonic performance.

[0005] US 5,997,479 A discloses a so-called phased array ultrasound imaging system with intra-group processors. The imaging system disclosed therein includes a transducer array with a larger number of transducer elements than beam former channels. Further similar ultrasound imaging systems are known from US 2001/0043090 A1 and US 2004/030227 A1.

[0006] It is an object of the present invention to provide an ultrasonic system having an ultrasonic probe which improves poor harmonic performance of existing transmit circuits through the use of a linear high-voltage transmit amplifier on each sub-channel.

[0007] This object is solved with an ultrasound imaging system according to independent claim 1.

[0008] An ultrasonic imaging system having an ultrasonic probe which improves poor harmonic performance of existing transmit circuits through the use of a linear high-voltage transmit amplifier on each sub-channel to amplify low-voltage arbitrary shape transmit waveforms generated by the ultrasonic system is hereinafter disclosed. In particular, the linear high-voltage amplifier of the ultrasonic probe amplifies low-voltage arbitrary shape transmit waveforms beam-formed by a micro-beam-former of the ultrasonic system.

[0009] Specifically, system transmit waveforms are either transmitted at a low-voltage or voltage divided down in order to be handled by a low-voltage analog delay ASIC. This signal is delayed a programmable amount in order to provide transmit beam formation, and then sent to the linear high-voltage transmit amplifier. The analog delay can be the same one that is used to beam-form receive signals. To share between transmit and receive, one can use analog T/R switches to control the direction of signals through the delay line.

[0010] The foregoing objects and advantages of the present invention may be more readily understood by one skilled in the art with reference being had to the following detailed description of preferred embodiments thereof, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a block diagram of an ultrasonic imaging system having a linear high-voltage amplifier for amplifying low-voltage arbitrary shape transmit waveforms beam-formed by a micro-beam-former of the ultrasonic imaging system in accordance with the present invention; and

FIG. 2 is a perspective view of the ultrasonic probe and several linear high-voltage amplifiers of the ultrasonic imaging system shown by FIG. 1.

[0011] An ultrasonic imaging system according to the present invention is shown by FIG. 1, and further described with specificity hereinafter. The ultrasonic imaging system 100 includes an ultrasonic probe 110 having a housing 112, an ultrasonic transducer assembly 114, a selector switch 116 (FIG. 2), and associated circuitry 118 which includes a micro-beam-former 119. The ultrasonic probe 110 is preferably a Matrix TEE probe.

[0012] The ultrasonic transducer assembly 114 includes a plurality of acoustic elements arranged in a number of columns and rows for generating at least one acoustic beam 102 and/or receiving at least one echo signal 104. The ultrasonic transducer assembly 114 is configured and adapted to fit within the housing 112. The acoustic elements are preferably configured and arranged in a generally planar configuration, although other configurations and arrangements, such as convex or cylindrical two-dimensional arrays are contemplated.

[0013] Each acoustic element is formed from a suitable piezoelectric material and is capable of generating an acoustic pulse at a particular frequency when a driver signal is applied to the acoustic element. A number of acoustic pulses are combined into the acoustic beam 102 for impinging an acoustic target, where at least some of the energy in the acoustic beam 102 is reflected back towards the transducer assembly 114 as echo signal 104.

In addition, each acoustic element is capable of receiving the echo signal 104 from the acoustic target and generating a corresponding output signal 120. The ultrasonic imaging system has a controller 130 for generating a drive signal 122 and for electronically steering the acoustic beam 102.

[0014] Two-dimensional transducer arrays are generally employed with accompanying circuitry to produce three-dimensional ultrasonic images of the acoustic target since the acoustic beam 102 is generated by acoustic elements in both the rows and the columns of the two-dimensional transducer array. By controlling the phase differential, or the time delay, among the acoustic elements that are driven by the controller 130, a number of acoustic pulses are combined into the acoustic beam 102 that can be electronically steered by the controller 130 to acquire acoustic targets within the field of view of the ultrasonic probe 110. It is contemplated that a number of the acoustic elements in the transducer assembly 114 may be "passive" elements (i.e. not configured for generating acoustic pulses or receiving echo signals) while the remaining acoustic elements are "active" elements (i.e. configured for generating an acoustic pulse and receiving an echo signal 104). In addition, the ultrasonic imaging system 100 further includes a signal processor 140, a display device 150, and a storage device 160.

[0015] Still referring to FIG. 1, the controller 130 is coupled to the ultrasonic probe 110 via a waveform generation block 127 and a connecting means 128 for communicating the drive signal 122 to one or more of the acoustic elements of the transducer assembly 114. Additionally, the connecting means 128 communicates a control signal 124 and the output signal 120 between the ultrasonic probe 110 and the waveform generation block 127. More specifically, the controller 130 is operatively coupled to the ultrasonic transducer assembly 114 via the waveform generation block 127 for varying characteristics and properties of the generated acoustic beam 102 as discussed in further detail hereinafter. The waveform generation block 127 sends waveforms to the ultrasonic probe 110.

[0016] The connecting means 128 includes a linear high-voltage transmit amplifier 129 on each sub-channel (as shown by FIG. 2) to amplify low-voltage arbitrary shape transmit waveforms generated by the ultrasonic probe 110, thereby improving poor harmonic performance of existing transmit circuits. The amplifier operates in the range of 20 to 200 volts and preferably, in the range of 10 to 100 volts for amplifying waveforms generated in the 0 to 5 volt range to 0-100 volts. In particular, the linear high-voltage amplifier 129 amplifies low-voltage arbitrary shape transmit waveforms beam-formed by the micro-beam-former 118 of the ultrasonic imaging system 100.

[0017] Specifically, system transmit waveforms (signal 120) are either transmitted at a low-voltage or voltage divided down by a voltage divider (not shown) in order to be handled by a low-voltage analog delay ASIC 131. The signal 120 is delayed a programmable amount by the delay ASIC 131 in order to provide transmit beam formation, and then sent to the linear high-voltage transmit amplifier 129. The analog delay can be the same one that is used to beam-form receive signals (e.g., drive signals 122). Preferably, the delay time is 0 to 1usec. To share between transmit and receive, one can use analog T/R switches to control the direction of the signals through the delay line of connecting means 128. It is contemplated that one or more of the amplifiers 129 for each sub-channel can be housed within the ultrasonic probe 110, the controller 130 and/or other component of the ultrasonic imaging system 100.

[0018] The controller 130 generates a plurality of driver signals 122 that correspond to the number of acoustic elements to be activated. The controller 130 further controls the timing of the respective driver signals 122 applied to the acoustic elements (i.e. phase shifting). In a preferred embodiment, the controller 130 includes a user interface 132 and associated circuitry for controlling the timing of the drive signals 122. It is further contemplated that more than one acoustic element in the ultrasonic transducer assembly 114 may be activated by the controller 130 simultaneously thereby forming an active aperture producing the acoustic beam 102. Advantageously, the user interface 132 is operable by an operator to adjust and/or control the active aperture for acquiring the desired image. In addition, the user interface 132 is configured and adapted for affecting other aspects of the ultrasonic imaging system 100, such as starting and stopping the system, directing the image information to the display device 150, directing the image information to the storage device 160, and retrieving the image information from the storage device 160.

[0019] The controller 130 is operatively coupled to the ultrasonic transducer assembly 114 for varying characteristics and properties of the generated acoustic pulses that are included in the acoustic beam 102. The controller 130 generates a plurality of drive signals 122 that correspond to the number of acoustic elements to be activated. The controller 130 further controls the timing of the respective drive signals 122 applied to the acoustic elements (i.e. phase shifting), and the resulting acoustic beam 102 is initially generated at a first end of the ultrasonic transducer assembly 114 and advances towards a second end.

[0020] More specifically, when the acoustic beam 102 is initially formed, a number of the active acoustic elements disposed in the ultrasonic transducer assembly 114 is actuated simultaneously by corresponding drive signals 122 from the controller 130. In one embodiment, the acoustic elements are arranged in a number of rows and columns to form an array where the controller 130 activates a predetermined number of acoustic elements in the rows and columns to form the acoustic beam 102.

[0021] Alternatively, the controller 130 can actuate a number of active acoustic elements in a number of columns where the number of acoustic elements activated is less than the number of active acoustic elements in each of the columns thereby forming a smaller active aperture and acoustic beam 102. Preferably, the controller 130 causes the generation of acoustic beam 102 within the active aperture and the controller 130 is adapted to move the active aperture and the acoustic beam 102 along the row of acoustic elements. After the active aperture reaches the end of the row of acoustic elements, the controller 130 shifts the acoustic beam 102 and the active aperture by the number of previously activated columns and causes the active aperture to advance. By advantageously controlling the motion and direction of the acoustic beam 102 and resultant active aperture, a three-dimensional volume is obtainable.

[0022] In one embodiment, the associated circuitry in the controller 130 generates the control signal 124 in response to selections made by the operator in the user interface 132. The user interface 132 includes one or more user operable controls such as a rocker switch, a button, a trackball, a touchpad, a pointing stick, etc. These user operable controls permit the user to control various features and aspects of the ultrasonic imaging system 100, such as field of view of the ultrasonic probe 110, local control of the ultrasonic probe 110 (i.e. controlled by the user interface 132), or remote control of the ultrasonic probe 110 (i.e. controlled by the selector switch 116). In turn, the control signal 124, in cooperation with the associated circuitry, generates the number of drive signals 122 to generate the acoustic beam 102. In addition, the control signal 124 cooperates with the associated circuitry to control the timing of the drive signals 122, thereby controlling the active aperture and the acquired image.

[0023] In a preferred embodiment, the control signal 124 is generated by the associated circuitry 118 of the ultrasonic probe 110. More particularly, the selector switch 116 cooperates with the associated circuitry 118 to generate the control signal 124. In turn, the control signal 124 is communicated to the associated circuitry of the controller 130 via the connecting means 128. The generation and control of the drive signals 122 by the control signal 124 are identical to the previous embodiment, where the control signal 124 was generated in the controller 130. As shown by FIG. 2, the selector switch 116 is user operable for controlling characteristics of the acquired image by controlling the generation and timing of the drive signals 122. The selector switch 116 may be a rocker switch, a button, a trackball, a touchpad, a pointing stick, etc.

[0024] More particularly, when the user selects local control of the ultrasonic probe 110, the associated circuitry in the controller 130 generates the control signal 124 according to user selections on the user interface 132. Preferably, the user interface 132 includes a control device 134 having at least two positions or states for controlling the associated circuitry in response to the user's selections. The control device 134 may be a rocker switch, a button, a trackball, a touchpad, a pointing stick, etc. The control signal 124 has unique characteristics for each position or state of the control device 134. Therefore, by selecting a position on the control device 134, the user controls the associated circuitry for controlling the control signal 124 and the acquired image. For example, the operator can steer the planes of the scan in preselected modes such as lateral tilt, elevational tilt, or rotation.

[0025] By advantageously providing the selector switch 116 and the associated circuitry 118 on the ultrasonic probe 110, the operator can readily control some of the operations of the ultrasonic imaging system 100 from the ultrasonic probe 110 and need not operate user interface 132 located on the system unit. When controlling the ultrasonic probe 110 remotely, the selector switch 116 in cooperation with the associated circuitry in the ultrasonic probe 110 generates the control signal 124. Similar to local control of the ultrasonic probe 110, the associated circuitry generates the control signal 124 having unique characteristics for each position or state of the selector switch 116. Therefore, by selecting a position on the selector switch 116, the user controls the associated circuitry for controlling the control signal 124 and the acquired image. For example, the operator can steer the planes of the scan in preselected modes such as lateral tilt, elevational tilt, or rotation. Additionally, by controlling the control signal 124, and therefore the drive signals 122, from the ultrasonic probe 110 reduces the need for binding the user interface 132 to the modes of operation of the ultrasonic imaging system 100.

[0026] For example, the operator positions the ultrasonic probe 110 in contact between a patient's ribs, then holds the ultrasonic probe 110 stationary while electronically steering the scan using the same hand to operate the selector switch 116. In one embodiment, the selector switch 116 and the associated circuitry 118 adjust the binding based on the mode of operation of the ultrasonic imaging system 100. For example, when using Flow mode or Doppler mode, the generated control signal 124 moves the region of interest, whereas in the Live 3D mode, it rotates the displayed volume. Alternatively, the binding of the selector switch 116 may be user selectable.

[0027] The connecting means 128 is generally a cable including a plurality of conducting elements, such as wires. Alternatively, the connecting means 128 can significantly be improved if some of the electronics are located in the ultrasonic probe housing 112 and the connecting means is a wireless connection, such as infrared or radio frequency.

[0028] This output signal 120 is communicated through the controller 130 to the signal processor 140. In the signal processor 140, the output signal 120 of the transducer assembly 114 is transformed by associated circuitry in the signal processor 140 to generate an image signal 145. A display device 150 is operatively coupled to an output of the signal processor 140 for receiving one or more image signals 145 and for transforming the image signals 145 into a video image. Essentially, the display device 150 is capable of displaying data corresponding to the at least one image signal 145. It is preferred that the display device 150 be a video monitor that is readily viewable by attending personnel.

[0029] Alternatively, the associated circuitry in the signal processor 140 produces a data signal 147 in addition to, or in lieu of the image signal 145. In an embodiment where signal processor produces the data signal 147 in addition to the image signal 145, it is preferred that the data signal 147 includes substantially identical information as contained in the image signal 145. A storage device 160 is operatively coupled to an output of the signal processor 140 for receiving one or more data signals 147 and for transforming the at least one data signal 147 into an organized sequence representing the information included in the at least one data signal 147. Essentially, the storage device 160 is capable of storing data corresponding to the at least one data signal 147. It is preferred that the storage device is a magnetic storage device such as a magnetic disc or a magnetic tape. More preferably, the storage device is a hard drive. It is contemplated that other storage devices such as optical storage devices may be used in lieu of the hard drive without departing from the scope of the present invention.

[0030] In another embodiment, the user interface 132 is further adapted and configured to cooperate with the associated circuitry in the signal processor 140 for retrieving the data stored in the storage device 160. In this embodiment, the storage device 160 transforms the stored data into at least one data signal 147 that is communicated to the associated circuitry of the signal processor 140. The associated circuitry of the signal processor 140 transforms the at least one data signal 147 into at least one image signal 145. The at least one image signal 145 is then communicated to the display device 150 for viewing as previously discussed.

[0031] The described embodiments of the present invention are intended to be illustrative rather than restrictive, and are not intended to represent every embodiment of the present invention. Various modifications and variations can be made without departing from the scope of the invention as set forth in the following claims both literally and in equivalents recognized in law.

Claims

1. An ultrasonic imaging system (100), comprising:

   an ultrasonic probe (110) having a housing (112);
   a two-dimensional ultrasonic transducer array assembly (114) configured and adapted to fit within the housing (112), the ultrasonic transducer array assembly (114) being capable of generating at least one acoustic beam (102) and receiving at least one echo signal; and
   an associated circuitry (118) located within said housing (112), operatively coupled to said ultrasonic transducer array assembly (114) and including a micro-beam-former (119) for controlling the at least one acoustic beam thereof; wherein the associated circuitry (118) further comprises a delay circuit (131) and a plurality of high-voltage transmit amplifiers (129), one of said plurality of high-voltage transmit amplifiers (129) on each sub-channel of the micro-beam-former (119); and
   characterized in that the system further comprises a waveform generation block (127) communicating a signal (120), which is a low voltage arbitrary shape transmit waveform, to the associated circuitry (118) wherein the signal (120) is first delayed by a programmable amount by the delay circuitry (131) and is further sent to the high-voltage transmit amplifiers (129), which are linear amplifiers.

2. The ultrasonic imaging system of claim 1, wherein the delay circuit (131) is adapted to delay the transmitted and received signals by one programmable amount.

3. The ultrasonic imaging system of claim 2, wherein the programmable amount is in the range of 0 to 1 usec.

4. The ultrasonic imaging system of claim 1, wherein said plurality of linear high-voltage transmit amplifier operates at a voltage range of 20 to 200 volts.

5. The ultrasonic imaging system of claim 1, wherein said plurality of linear high-voltage transmit amplifier operates at a voltage range of 10 to 100 volts.

6. The ultrasonic imaging system (100), further comprising:

   a controller for electrically steering the acoustic beam (102);
   means for connecting said ultrasound probe (110) to the system (100);
   a signal processor (140) coupled to said ultrasonic transducer array assembly (114) for processing the at least one echo signal, thereby forming at least one image signal; and a display (150) for displaying the at least one image signal.

Patentansprüche

1. Ultraschallbildgebungssystem (100), das Folgendes umfasst:

   eine Ultraschallsonde (110) mit einem Gehäuse (112);

eine zweidimensionale Ultraschallwandler-Array-Baugruppe (114), die konfiguriert und dafür ausgelegt ist, in das Gehäuse (112) zu passen, wobei die Ultraschallwandler-Array-Baugruppe (114) in der Lage ist, mindestens ein akustisches Strahlenbündel (102) zu erzeugen und mindestens ein Echosignal zu empfangen; und
eine in dem genannten Gehäuse (112) befindliche zugehörige Schaltung (118), die betriebsfähig mit der genannten Ultraschallwandler-Array-Baugruppe (114) gekopppelt ist und einen Mikrostrahlformer (119) zum Steuern des mindestens einen akustischen Strahlenbündels hiervon umfasst; wobei die zugehörige Schaltung (118) weiterhin eine Verzögerungsschaltung (131) und eine Vielzahl von Hochspannungs-Sendeverstärkern (129) umfasst, einen der genannten Vielzahl von Hochspannungs-Sendeverstärkern (129) auf jedem Teilkanal des Mikrostrahlformers (119); und
dadurch gekennzeichnet, dass das System weiterhin einen Signalformerzeugungsblock (127) umfasst, der ein Signal (120), bei dem es sich um eine beliebig geformte Niederspannungs-Sendesignalform handelt, an die zugehörige Schaltung (118) kommuniziert, wobei das Signal (120) zuerst durch die Verzögerungsschaltung (131) um einen programmierbaren Betrag verzögert wird und dann an die Hochspannungs-Sendeverstärker (129) gesendet wird, bei denen es sich um lineare Verstärker handelt.

2. Ultraschallbildgebungssystem nach Anspruch 1, wobei die Verzögerungsschaltung (131) dafür ausgelegt ist, die gesendeten und empfangenen Signale um einen programmierbaren Betrag zu verzögern.

3. Ultraschallbildgebungssystem nach Anspruch 2, wobei der programmierbare Betrag im Bereich von 0 bis 1 μs liegt.

4. Ultraschallbildgebungssystem nach Anspruch 1, wobei die genannte Vielzahl von linearen Hochspannungs-Sendverstärkern in einem Spannungsbereich von 20 bis 200 Volt arbeitet.

5. Ultraschallbildgebungssystem nach Anspruch 1, wobei die genannte Vielzahl von linearen Hochspannungs-Sendeverstärkern in einem Spannungsbereich von 10 bis 100 Volt arbeitet.

6. Ultraschallbildgebungssystem (100), das weiterhin Folgendes umfasst:

eine Steuereinheit zum elektrischen Lenken des akustischen Strahlenbündels (102);
Mittel zum Verbinden der genannten Ultraschallsonde (110) mit dem System (100);
einen mit der genannten Ultraschallwandler-Array-Baugruppe (114) gekoppelten Signalprozessor (140) zum Verarbeiten des mindestens einen Echosignals, wodurch mindestens ein Bildsignal gebildet wird; und
eine Anzeige (150) zum Anzeigen des mindestens einen Bildsignals.

Revendications

1. Système d'imagerie ultrasonique (100), comprenant :

une sonde ultrasonique (110) ayant un logement (112) ;
un ensemble de réseau de transducteur ultrasonique bidimensionnel (114) configuré pour et apte à être ajusté à l'intérieur du logement (112), l'ensemble de réseau de transducteur ultrasonique (114) étant capable de générer au moins un faisceau acoustique (102) et de recevoir au moins un signal d'écho ; et
un circuit associé (118) situé à l'intérieur dudit logement (112), couplé de manière opérationnelle au dit ensemble de réseau de transducteur ultrasonique (114) et comprenant un organe de formation de microfaisceau (119) pour commander l'au moins un faisceau acoustique de celui-ci ; dans lequel le circuit associé (118) comprend en outre un circuit de retard (131) et une pluralité d'amplificateurs de transmission de haute tension (129), l'un de ladite pluralité d'amplificateurs de transmission de haute tension (129) étant sur chaque sous-canal de l'organe de formation de microfaisceau (119) ; et
caractérisé en ce que le système comprend en outre un bloc de génération de forme d'onde (127) communiquant un signal (120), qui est une forme d'onde de transmission de forme arbitraire de basse tension, au circuit associé (118), dans lequel le signal (120) est d'abord retardé d'une quantité programmable par le circuit de retard (131) et est en outre envoyé aux amplificateurs de transmission de haute tension (129), qui sont des amplificateurs linéaires.

2. Système d'imagerie ultrasonique selon la revendication 1, dans lequel le circuit de retard (131) est apte à retarder les signaux transmis et reçus d'une quantité programmable.

3. Système d'imagerie ultrasonique selon la revendication 2, dans lequel la quantité programmable est dans la plage de 0 à 1 μs.

4. Système d'imagerie ultrasonique selon la revendi-

cation 1, dans lequel ladite pluralité d'amplificateurs de transmission de haute tension linéaires fonctionnent dans une plage de tension de 20 à 200 volts.

5. Système d'imagerie ultrasonique selon la revendication 1, dans lequel ladite pluralité d'amplificateurs de transmission de haute tension linéaire fonctionnent dans une plage de tension de 10 à 100 volts.

6. Système d'imagerie ultrasonique (100), comprenant en outre :

un organe de commande pour diriger électriquement le faisceau acoustique (102) ;
un moyen pour relier ladite sonde ultrasonique (110) au système (100) ;
un processeur de signal (140) couplé au dit ensemble de réseau de transducteur ultrasonique (114) pour traiter l'au moins un signal d'écho, en formant de ce fait au moins un signal d'image ; et
un affichage (150) pour afficher l'au moins un signal d'image.

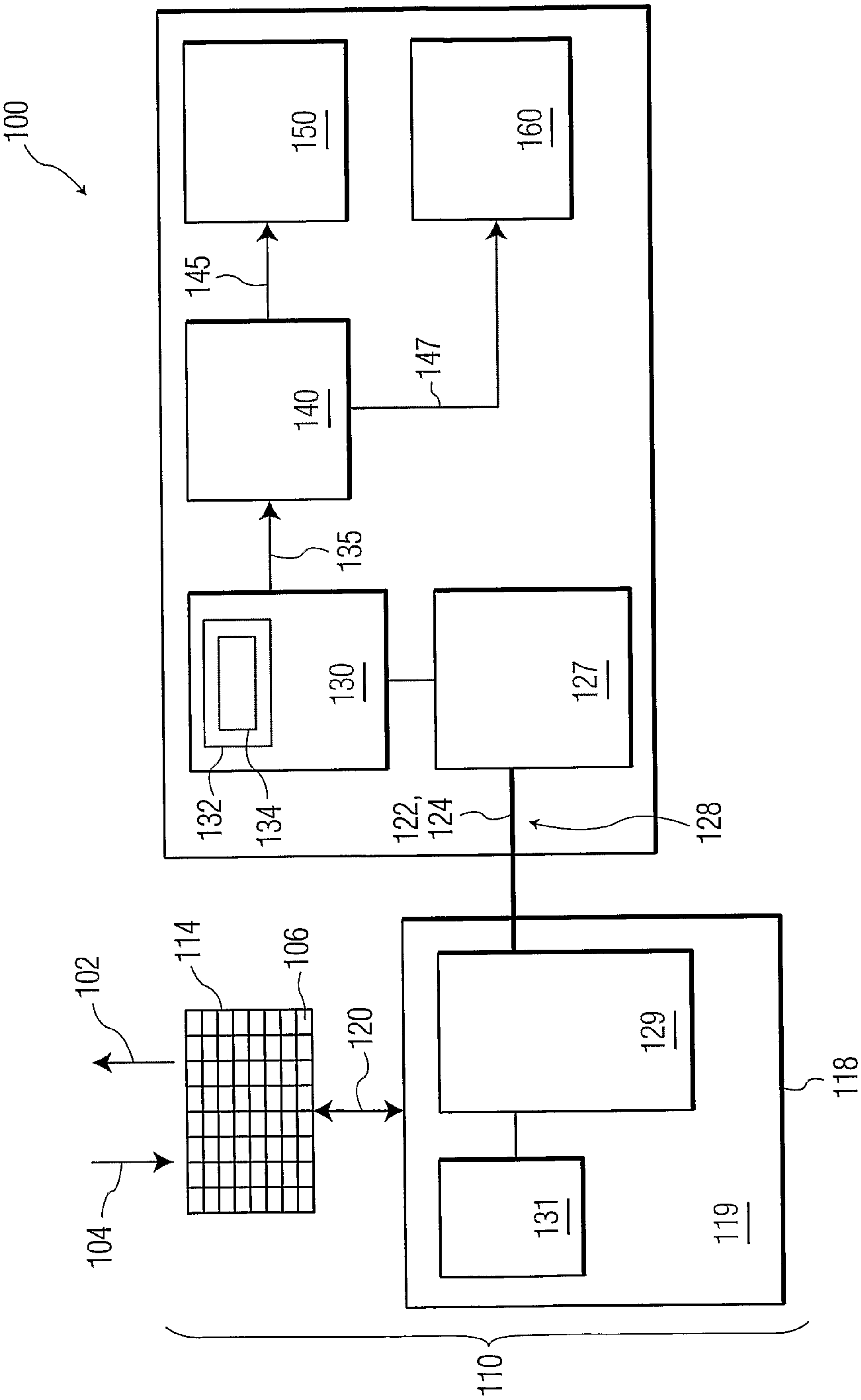
100
150
160
145
147
140
135
130
127
132
134
122,
124
128
102
114
106
120
129
104
131
119
118
110

FIG. 1

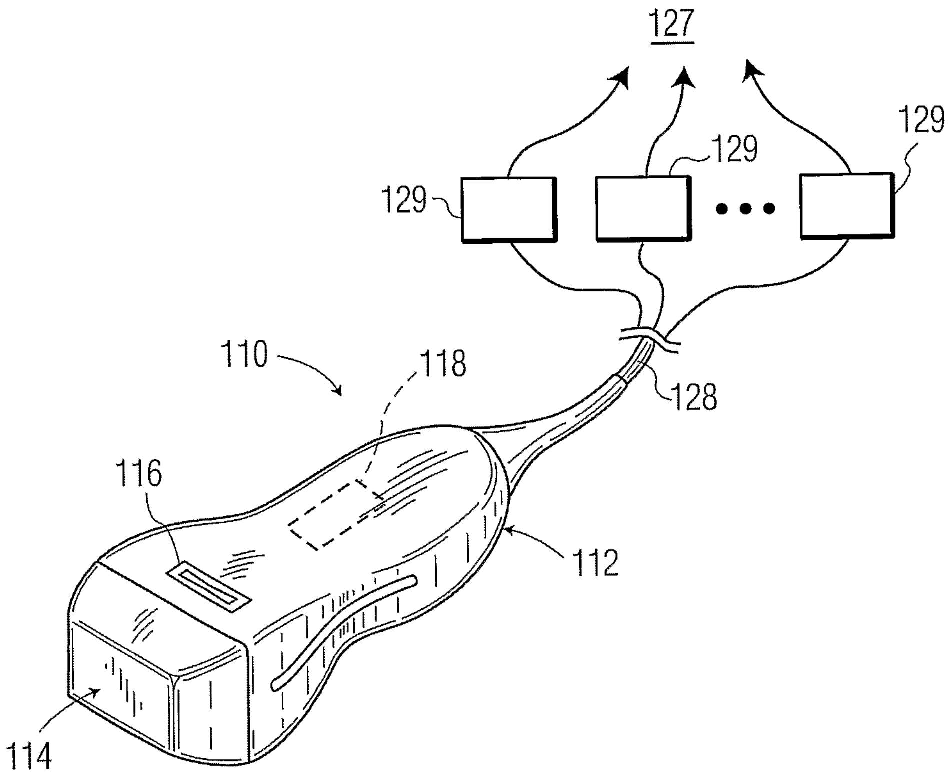

FIG. 2

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5997479 A **[0005]**
- US 20010043090 A1 **[0005]**
- US 2004030227 A1 **[0005]**

专利名称(译)	用于放大由超声波系统产生的发射波形的系统		
公开(公告)号	EP1804669B1	公开(公告)日	2015-08-26
申请号	EP2005754944	申请日	2005-06-27
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦电子N.V.		
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IPC分类号	A61B8/00 B06B1/02 G10K11/34 G01N29/22 G01S7/524 G01N29/34		
CPC分类号	A61B8/00 B06B1/0629 B06B2201/76 G01S7/52017 G01S7/5208 G10K11/343		
代理机构(译)	ROCHE，DENIS		
优先权	60/583490 2004-06-28 US		
其他公开文献	EP1804669A1		
外部链接	Espacenet		

摘要(译)

一种超声成像系统（100），具有超声探头（110），通过在每个子通道上使用线性高压发射放大器（129）来改善现有发射电路的低谐波性能，以放大低压任意形状发射给出了由超声波系统（100）产生的波形。超声波探头（110）的线性高压放大器（129）放大由超声波系统（100）的微波束形成器（119）光束形成的低压任意形状发射波形。

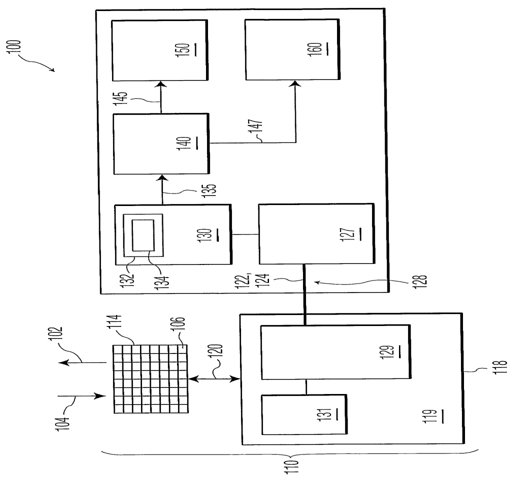

FIG. 1