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(54) **APPARATUS AND METHOD FOR AIDING
EXTREMITY ULTRASONOGRAPHY**

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(2013.01)

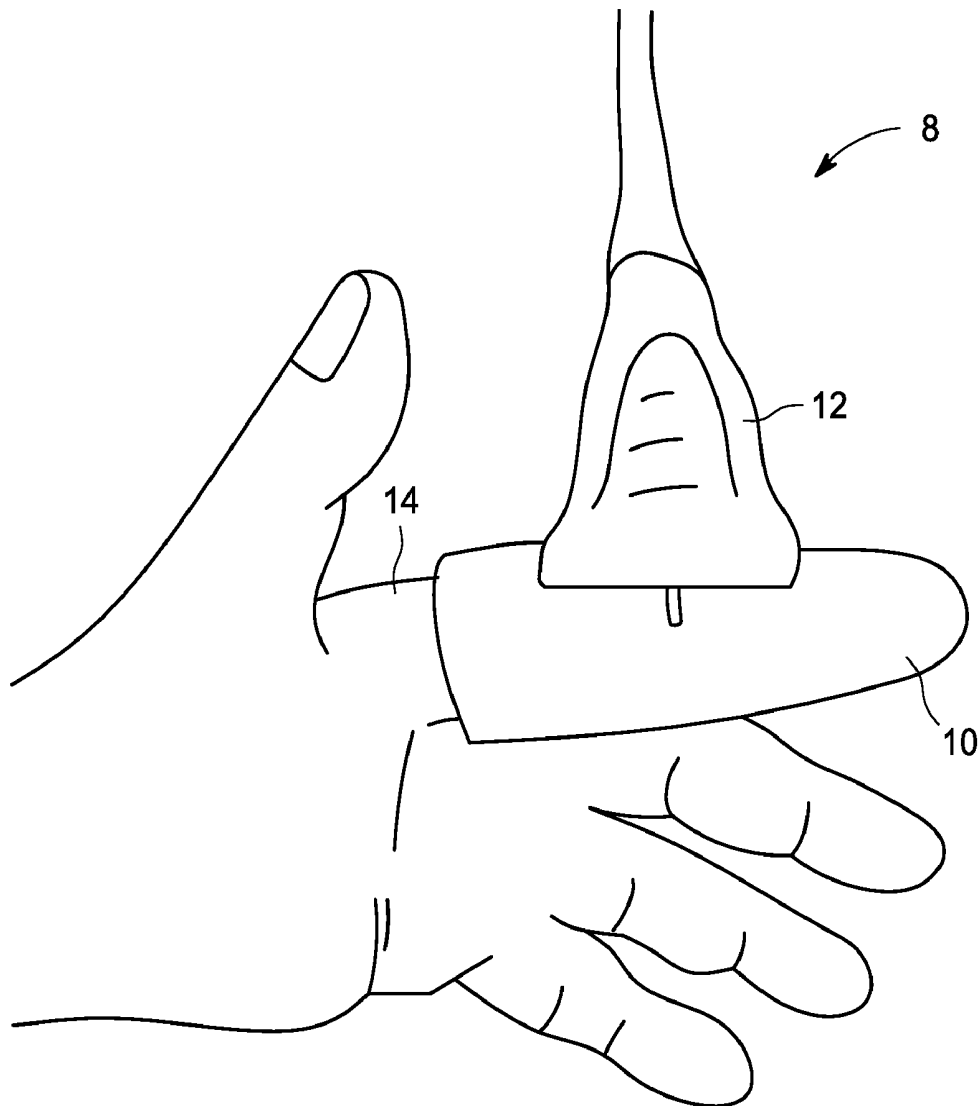
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(57) **ABSTRACT**

(21) Appl. No.: **14/144,824**

An apparatus for releasably coupling an ultrasound probe with an extremity comprises a housing adapted to substantially surround the extremity. The housing comprises a first opening adapted to receive the ultrasound probe and position the probe in contact with the extremity.

(22) Filed: **Dec. 31, 2013**



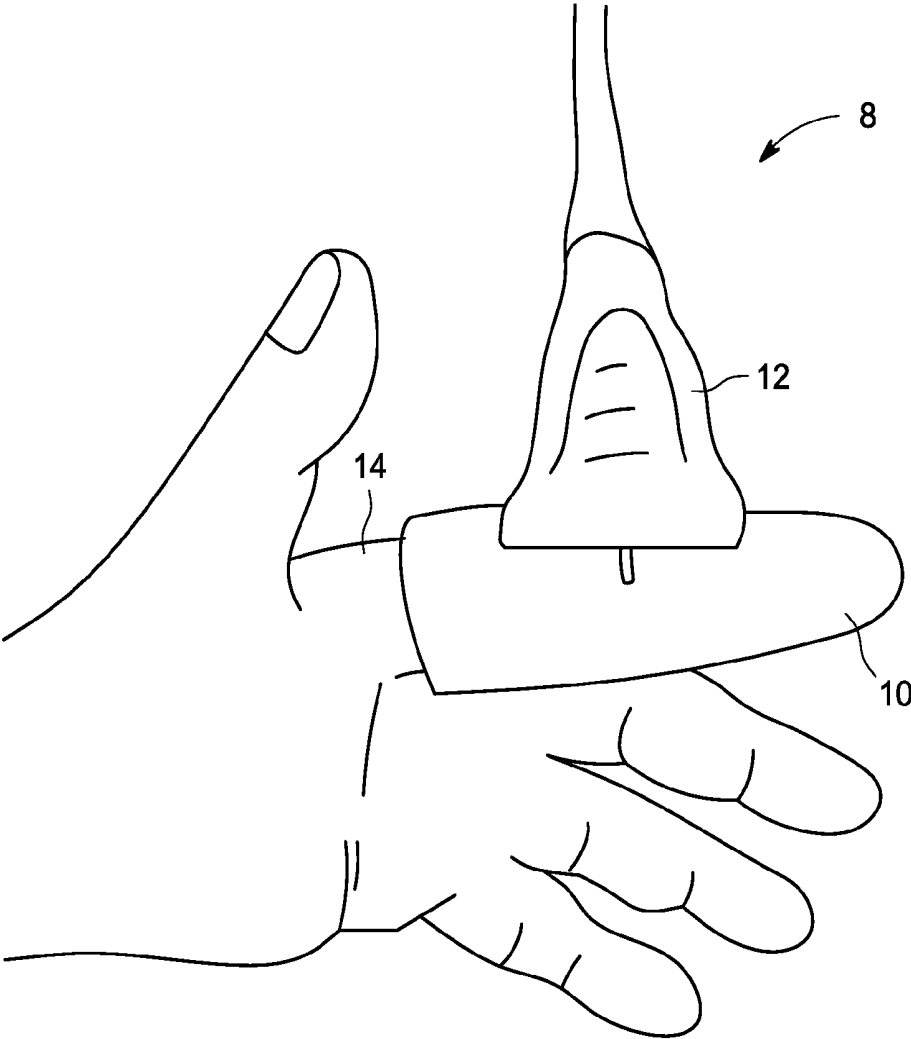


FIG. 1

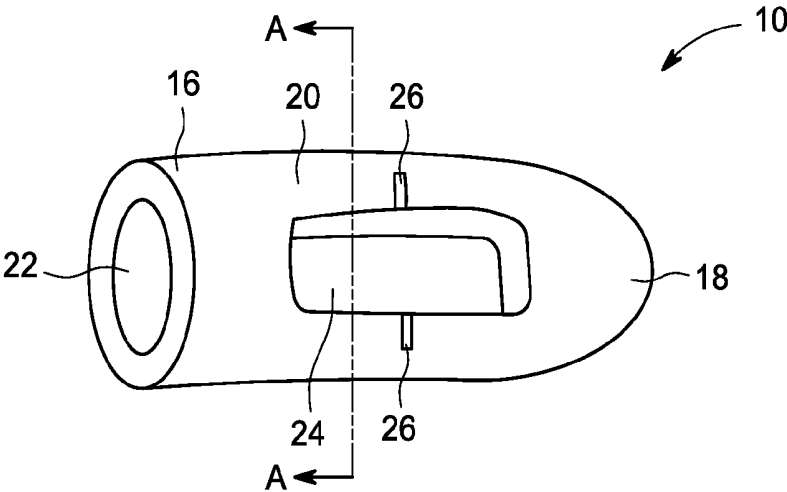


FIG. 2

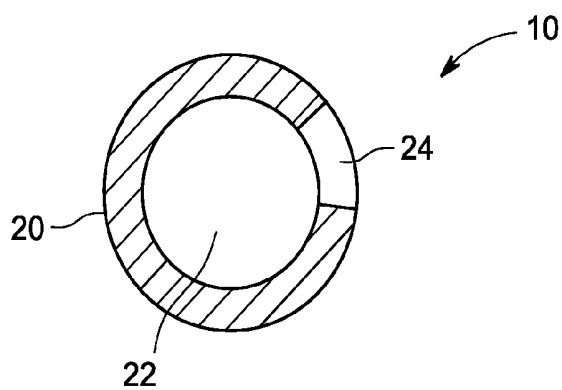


FIG. 3

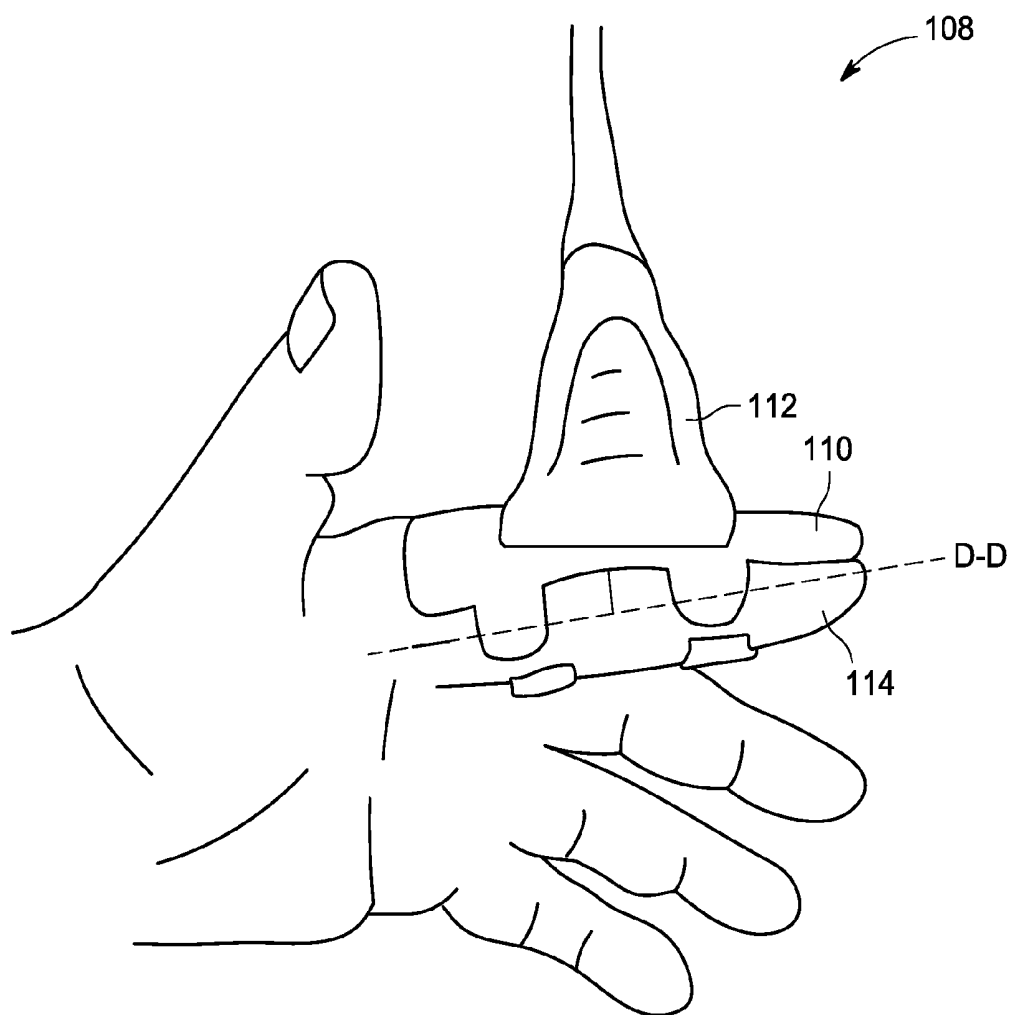


FIG. 4

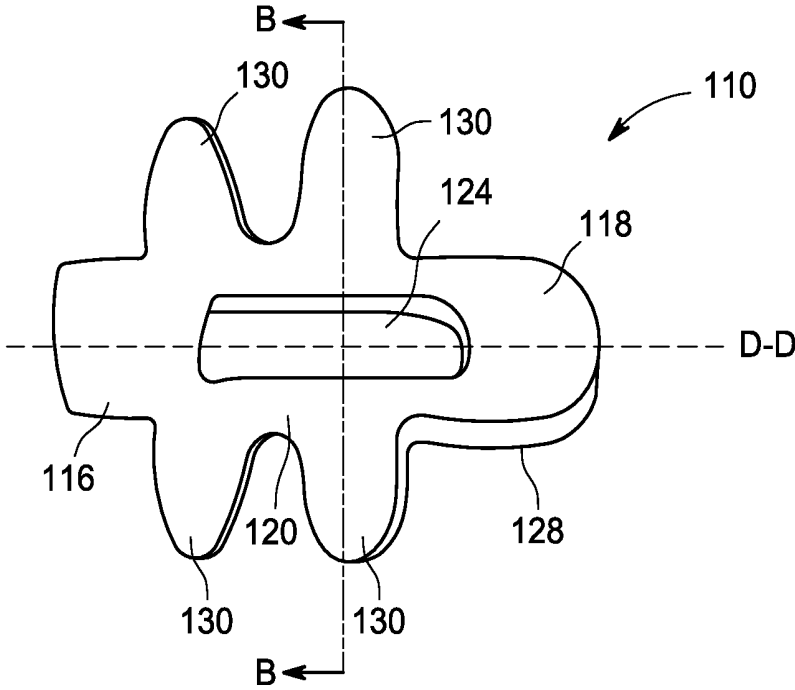


FIG. 5

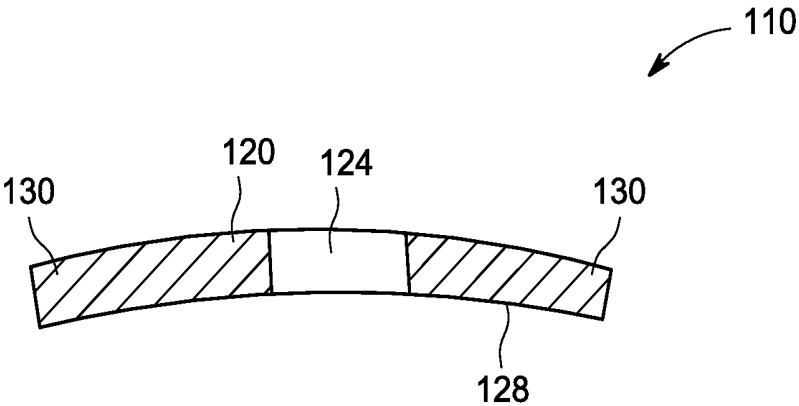


FIG. 6

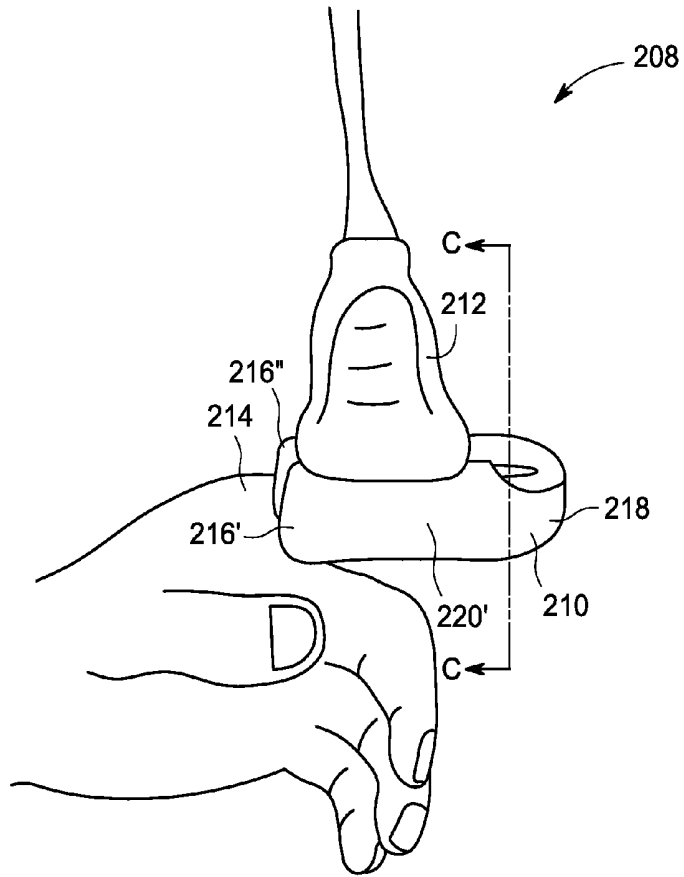


FIG. 7

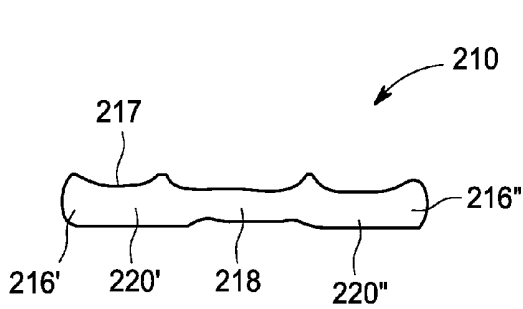


FIG. 8

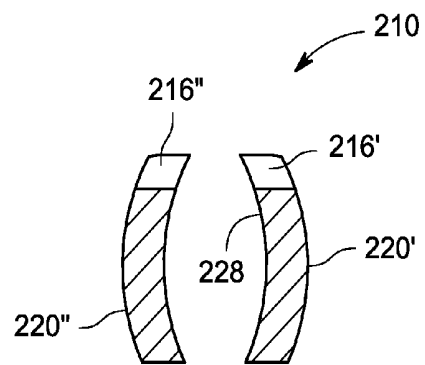


FIG. 9

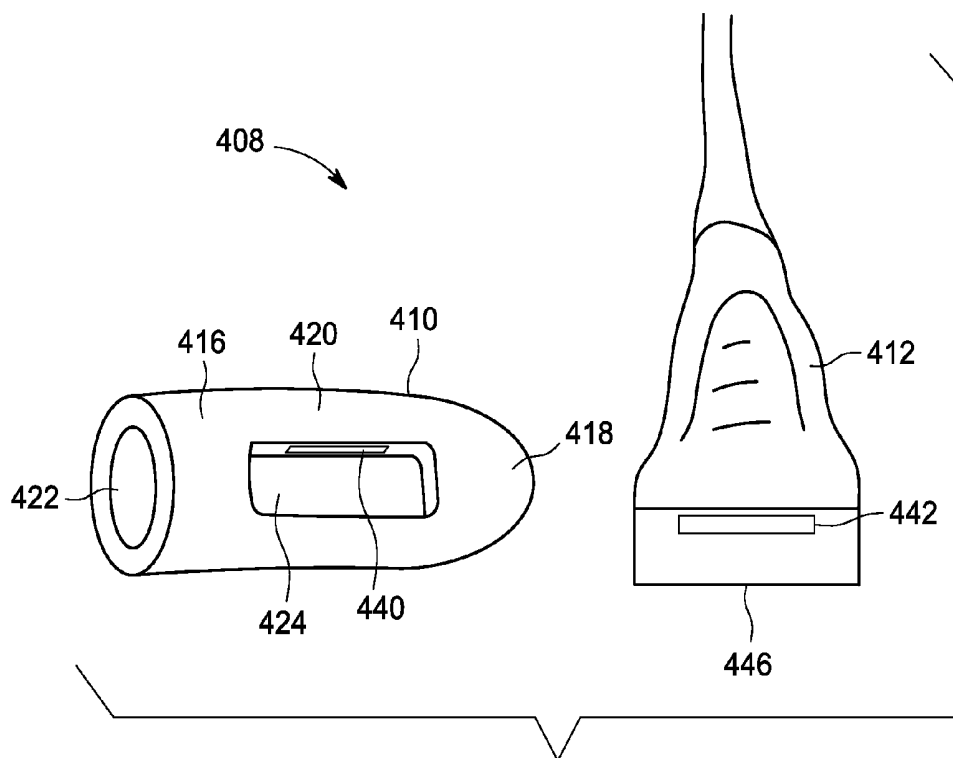


FIG. 10

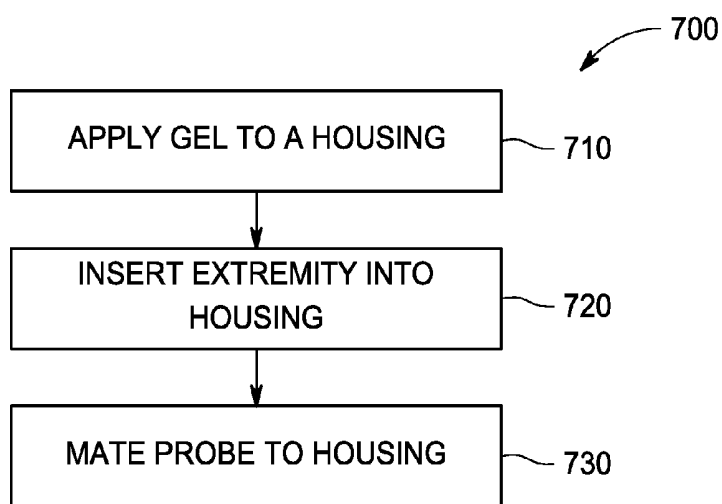


FIG. 11

APPARATUS AND METHOD FOR AIDING EXTREMITY ULTRASONOGRAPHY

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to ultrasonography of extremities, and more specifically an apparatus to aid in reducing operator variability.

[0002] A key problem in musculoskeletal (“MSK”) ultrasonography is the variability of the operator in the placement of the transducer. Both the location of the transducer and the pressure applied by the operator can impact the quality of the exam. These factors may also vary amongst operators. Holding the transducer in contact with ultrasound gel on an extremity of a patient while applying the appropriate amount of pressure is a skill that can be acquired, but is difficult. In some studies of the extremities, too much pressure on the extremity (for example a finger) can temporarily cut off circulation, which may be important to the diagnosis. Generally, operators put gel on the extremity and then work to acquire the skill required to both maintain contact while maintaining the appropriate amount of pressure and to find the peak blood flow angle. This may result in increased exam times and workflow inefficiencies.

[0003] Therefore, an apparatus and method to standardize what is typically a fairly operator-dependent procedure, by reducing variability due to transducer placement and pressure, is desired. This could lead to significantly improved inter-operator variability in MSK studies. Additionally, this approach would make the above-mentioned objective of applying the appropriate amount of pressure during scanning less skill-dependent and thus increase exam quality for less experienced operators.

BRIEF DESCRIPTION OF THE INVENTION

[0004] The above-mentioned shortcomings, disadvantages and problems are addressed herein which will be understood by reading and understanding the following specification.

[0005] In an embodiment, an apparatus for releasably coupling an ultrasound probe with an extremity comprises a housing adapted to substantially surround the extremity. The housing comprises a first opening adapted to receive the ultrasound probe and position the probe in contact with the extremity.

[0006] In another embodiment, a system for reducing variability in ultrasound procedures of an extremity comprises a housing adapted to substantially surround the extremity and comprises a first mating element. The system further comprises an ultrasound probe comprising a second mating element, wherein the first mating element and the second mating element are adapted to mate.

[0007] In another embodiment, a method of performing an ultrasound scan on a patient extremity utilizing an ultrasound probe comprises applying ultrasonic gel to an interior of a housing and positioning the housing about the extremity. The method further comprises mating an ultrasound probe to the housing, wherein when mated a tip of the ultrasound probe is in contact with the ultrasonic gel.

[0008] Various other features, objects, and advantages of the invention will be made apparent to those skilled in the art from the accompanying drawings and detailed description thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a perspective view of a system in accordance with an embodiment;

[0010] FIG. 2 is a perspective view of the housing shown in FIG. 1;

[0011] FIG. 3 is a cross-sectional view of the housing taken from the line A-A in FIG. 2;

[0012] FIG. 4 is a perspective view of a system in accordance with an embodiment;

[0013] FIG. 5 is a perspective view of the housing shown in FIG. 4;

[0014] FIG. 6 is a cross-sectional view of the housing taken from the line B-B in FIG. 3;

[0015] FIG. 7 is a perspective view of a system in accordance with an embodiment;

[0016] FIG. 8 is a side elevation view of the housing shown in FIG. 7;

[0017] FIG. 9 is a cross-sectional view of the housing taken from the line C-C in FIG. 7;

[0018] FIG. 10 is a perspective view of a system in accordance with an embodiment; and

[0019] FIG. 11 is a flow diagram illustrating a method in accordance with an embodiment of the disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0020] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific embodiments that may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the embodiments, and it is to be understood that other embodiments may be utilized and that logical, mechanical, electrical and other changes may be made without departing from the scope of the embodiments. The following detailed description is, therefore, not to be taken as limiting the scope of the invention.

[0021] Referring to FIG. 1, a perspective view of a system 8 is shown in accordance with an embodiment. The system 8 comprises a housing 10 and an ultrasound probe 12. The housing 10 will hereinafter be described as a housing for use with releasably coupling a healthcare device, such as ultrasound probe 12, with an extremity 14, such as a finger. It should be appreciated, however, that other types of healthcare devices which are required to stay in contact or close proximity with the surface of a human or animal body may be envisioned for use with the housing 10. It should further be appreciated that other extremities 14 such as a hand, wrist, toe or foot may be mated by the housing 10 to the probe 12 or healthcare device.

[0022] In accordance with an embodiment as shown in FIGS. 1-3, the housing 10 is adapted to substantially surround the extremity 14. In some embodiments, the housing 10 is comprised of a flexible material, such as a latex rubber, or a fabric. The flexible material may also be adhesive so as to stick to the extremity 14. In other embodiments, the housing 10 is comprised of a substantially rigid material that may generally immobilize the extremity 14. The housing 10 comprises a proximate end 16, a distal end 18, and a center portion 20 connecting the proximate end 16 to the distal end 18. The proximate end 16 comprises an opening 22 that is adapted to receive the extremity 14. The opening 22 may also be adapted to receive ultrasonic gel. The ultrasonic gel may be any medium known in the art to conduct ultrasound waves from

probe 12 to the imaging target, such as the extremity 14. The distal end 18 may be closed as depicted in this embodiment. Alternately, the distal end 18 may be open, as depicted in FIG. 4 and described below, thereby permitting the extremity 14 to extend beyond distal end 18 of the housing 10.

[0023] The center portion 20 comprises an opening 24 that is adapted to releasably receive the ultrasound probe 12. When the ultrasound probe 12 is received by the housing 10 via opening 24, the probe 12 is positioned in contact, or mated, with extremity 14. The opening 24 may also be adapted to receive ultrasonic gel.

[0024] The center portion 20 may also comprise one or more position marking 26. The position marking 26 is intended to aid the clinician in position the housing 10 on the extremity 14. Various embodiments of the position marking 26 may be envisioned. For example, the position marking 26 may be printed on the surface of housing 10 or etched into the surface of housing 10. The center portion 20 may further comprise a plurality of position markings 26 that are configured to indicate ideal transducer placement to capture a series of standard clinical images. In another embodiment, the markings 26 may be positioned at the proximate end 16 and distal end 18 about the circumference of the housing 10 to indicate the angulation of the probe 12 along the axis of the extremity 14.

[0025] A cross-sectional view at the center portion 20 of housing 10, taken along the line A-A in FIG. 2, is shown in FIG. 3. At the center portion 20, the housing 10 has a generally circular cross-section, configured to substantially surround the extremity 14.

[0026] Referring to FIG. 4, a perspective view of a system 108 is shown in accordance with an embodiment. The system 108 comprises a housing 110 and an ultrasound probe 112. The housing 110 will hereinafter be described as housing for use with releasably coupling a healthcare device, such as ultrasound probe 112, with an extremity 114, such as a finger. It should be appreciated, however, that other types of healthcare devices which are required to stay in contact or close proximity with the surface of a human or animal body may be envisioned for use with the housing 110. It should further be appreciated that other extremities such as a hand, wrist, toe or foot may be mated by the housing 110 to the probe 112 or healthcare device.

[0027] In accordance with the embodiment, and as shown in FIGS. 4-6, the housing 110 comprises a proximate end 116, a distal end 118, and a center portion 120 connecting the proximate end 116 to the distal end 118. The housing 110, when not positioned to substantially surround the extremity 114, has a substantially planar configuration and is generally parallel to an axis D-D extending through the extremity 114, as illustrated in FIGS. 4-6. FIG. 6 shows a cross-sectional view of the housing 110 taken along the line B-B in FIG. 5. In some embodiments, the housing 110 is comprised of a flexible material, such as a latex rubber, or a fabric. The flexible material may also be adhesive so as to stick to the extremity 114. In other embodiments, the housing 110 is comprised of a substantially rigid material that may generally immobilize the extremity 114.

[0028] Housing 110 is adapted at one or more portions to substantially surround and potentially immobilize the extremity 114, such as at protrusions or tabs 130 (see FIG. 5). The distal end 118 may be open, thereby permitting the extremity 114 to extend beyond the distal end 118 of the housing 110. The center portion 120 comprises an opening

124 that is adapted to releasably receive the ultrasound probe 112. When the ultrasound probe 112 is received by housing 110 via opening 124, the probe 112 is positioned in proper contact with extremity 114.

[0029] The tabs 130 of the housing 110 are adapted to wrap about at least a portion of the extremity 114 to securely mate the housing 110 to the extremity 114. Each tab 130 is bendable or moldable. It should be appreciated that various embodiments of the tabs 130 may be envisioned. For example, in the embodiment depicted in FIGS. 3-6, the housing 110 comprises two pairs of tabs 130, each pair configured with one tab 130 on each lateral side of the housing 110 and the axis D-D. However, the housing 110 may have fewer or more tabs. It should further be appreciated that other configurations of tabs 130 may be envisioned. For example, in the embodiment depicted in FIGS. 3-6, the tabs 130 are located in the center portion 120. However, tabs 130 could be located closer to or at the proximate end 116 or nearer the distal end 118, or any combination thereof. Additionally, the shape or geometry of the tabs 130 may vary.

[0030] The housing 110 may be configured to surround various degrees of the circumference of extremity 114. For example, as depicted in FIG. 3, the portion of housing 110 with tabs 130 may surround approximate 315 degrees of the extremity. However, it should be appreciated that at least 180 degrees of the circumference of the extremity 114 should be surrounded by at least one portion of the housing 110 to ensure the housing 110 remains securely in place without need for adhesives.

[0031] Referring to FIG. 7, a perspective view of a system 208 is shown in accordance with an embodiment. The system 208 comprises a housing 210 and an ultrasound probe 212. As with the previously described embodiments, the housing 210 will hereinafter be described as a housing for use with releasably coupling or positioning a healthcare device, such as the ultrasound probe 212, in proper contact with an extremity 214, such as a finger, for an imaging procedure. It should be appreciated, however, that other types of healthcare devices which are required to stay in contact or close proximity with the surface of a human or animal body may be envisioned for use with the housing 210. It should further be appreciated that other extremities such as a hand, wrist, toe or foot may be mated by the housing 210 to the probe 212 or healthcare device.

[0032] In accordance with the embodiment as shown in FIGS. 7-9, the housing 210 is adapted to substantially surround the extremity 214. In some embodiments, the housing 210 is comprised of a flexible material, such as a latex rubber, or a fabric. The flexible material may also be adhesive so as to stick to the extremity 214. In other embodiments, the housing 210 is comprised of a substantially rigid material that may generally immobilize the extremity 214. The housing 210 comprises proximate ends 216' and 216'', a distal end 218, and center portions 220' and 220''. Center portion 220' connects proximate end 216' to 218. Similarly, center portion 220'' connects proximate end 216'' to distal end 218.

[0033] When not substantially surrounding the extremity 214 (i.e., before the housing 210 is positioned about the extremity 214 for receiving the ultrasound probe 212 to perform the imaging procedure), the housing 210 may be substantially planar, as depicted in FIG. 8. However, to substantially surround extremity 214, as depicted in FIG. 7, the housing 210 is bent at distal end 218, thereby bringing proximal ends 216' and 216'' in closer proximity to one another. In

this position, the proximate ends **216'** and **216''** form an opening **222** that is adapted to receive the extremity **214**. Additionally, in this position, each of the center portions **220'** and **220''** includes a depression or groove **217** that together form an opening **224**, similar to openings **24** and **124** (see FIGS. **2** and **5**, respectively), configured to releasably receive and maintain the probe **212**.

[0034] Turning now to FIG. **9**, a cross-section of housing **210** at center portions **220'** and **220''** is depicted taken along line C-C in FIG. **7**. The center portions **220'** and **220''** are each generally curved and, collectively, are configured so as to generally surround the extremity **214** (not shown) when positioned for releasably receiving the probe **212**. The center portion **220** comprises a groove **217** that is adapted to releasably receive the ultrasound probe **212**. When the ultrasound probe **212** is received by housing **210** via groove **217**, the probe **212** is positioned in contact with extremity **214**.

[0035] Referring to FIG. **10**, a perspective view of a system **408** is shown in accordance with another embodiment. System **408** could be similar to any of the embodiments by any of systems **8**, **108** and **208**, except as otherwise noted below. System **408** comprises a housing **410** and a probe **412**. The housing **410** comprises a proximate end **416**, a distal end **418**, and a center portion **420** connecting the proximate end **416** to the distal end **418**. The center portion **420** comprises an opening **424** that is adapted to releasably receive the ultrasound probe **412**.

[0036] The housing **410** further comprises a first mating element **440**. The first mating element **440** may comprise a physical feature such as an indentation or a protrusion, or a combination thereof. It should be appreciated, however, that other embodiments of first mating element **440** may be envisioned.

[0037] The probe **412** comprises a front transducer face or tip **446** located at a distal end of the probe **412**. The tip **446** is configured to come into contact with the extremity (not shown) when fully inserted into opening **424**. The probe **412** further comprises a second mating element **442**. The second mating element **442** may be integral to the probe **412** or may, alternatively, be detachably coupled to the probe **412** in order to accommodate different sized probes. The second mating element **442** may comprise a physical feature such as an indentation or a protrusion, or a combination thereof. It should be appreciated, however, that other embodiments of the second mating element **442** may be envisioned.

[0038] The first mating element **440** is complementary to the second mating element **442**. When the housing **410** is firmly received within the opening **424** and in close contact with the extremity **414**, the first mating element **440** will be mated to the second mating element **442**, and the tip **446** of the probe **412** will be positioned in proper contact with the extremity (not shown).

[0039] Further embodiments of system **8** are envisioned. For example, the system **8** may comprise a plurality of housings **10**, each with opening **24** of various sizes configured to mate with a plurality of probes **12** that are of various dimensions or sizes. In another example, the system **8** may comprise a plurality of housings **10** that are of different sizes and are therefore adapted for different sized extremities. In yet another example, the probe **12** may comprise a spacer that is adapted to releasably mate with opening **24**. The system **8** may comprise a plurality of spacers that are adapted to fit a

plurality of probes **12**, so that the plurality of probes **12** are adapted to be received by housing **10** comprising opening **24** of a single size and geometry.

[0040] Having described various embodiments of the housing **10**, **110**, **210** and **410**, an exemplary method **700** of performing an ultrasound scan on a patient extremity utilizing ultrasound probe **12**, **112**, **212** and **412**, respectively, will now be described in connection with FIG. **11**.

[0041] The method **700** may include a step **710** comprising applying ultrasonic gel to an interior of the housing **10**, **110**, **210** or **410**. By applying gel to the interior of housing **10**, **110**, **210**, or **410**, the housing may be easily rotated about the extremity, or in some embodiments along the extremity, to obtain different images. Alternatively, the housing **10**, **110**, **210** or **410** could be positioned about the extremity prior to applying the gel, in which case the gel could be applied to the extremity through the opening **24**, **124**, **224** or **424**, respectively. Alternatively, the ultrasonic gel could be applied to the extremity before the housing **10**, **110**, **210**, **410** is positioned about the extremity. In any case, the ultrasonic gel may be any medium known in the art to conduct ultrasound waves from probe **12**, **112**, **212** or **412** to the imaging target, (i.e., the extremity).

[0042] The method **700** may further include a step **720** comprising positioning the housing **10**, **110**, **210** or **410** about the extremity. In the embodiment shown in FIG. **1**, this step **720** may comprise inserting the extremity **14** into opening **22** of housing **10**. In the embodiment of FIGS. **7-9**, this step **720** may comprise positioning the extremity **214** on the underside **228** so the distal tip of the extremity **214** is near the distal end **218** of housing **210** and then bending or molding the housing **210** at the distal end **218** about the distal tip of the extremity **214**, thereby bringing proximal ends **216'** and **216''** in close proximity. The step **720** may also comprise rotating the housing **10**, **110**, **210**, or **410** about the extremity.

[0043] Depending on the embodiment of housing **10**, **110**, **210** or **410**, the method **700** may further include securing at least one tab about the extremity to immobilize the extremity, to secure the housing **10**, **110**, **210** or **410** thereto, and/or to allow rotational movement of the housing **10**, **110**, **210**, or **410** about the extremity. For example, once the extremity **114** in the embodiment of FIGS. **4-6** is positioned on the underside **128**, tabs **130** may be wrapped about the extremity **114**.

[0044] The method **700** may include a step **730** comprising mating ultrasound probe **12**, **112**, **212**, **412** to the housing **10**, **110**, **210**, **410**, wherein when mated, a tip of the ultrasound probe **12**, **112**, **212**, **412** is releasably received in the opening **24**, **124**, **224** and **424**, respectively, and thus in proper contact with the ultrasonic gel for the imaging procedure. For example, this step **730** may comprise aligning first mating element **440** with second mating element **442**. The step **730** may also comprise positioning about the distal tip of probe **212** to engage the two grooves **217** and thus contact the ultrasonic gel through the opening **224**.

[0045] The system and method described herein could lead to much improved inter-operator variability in musculoskeletal ultrasound studies. Additionally, the system and method would make the contact-without-pressure problem described herein less skill-dependent and increase exam quality for less experienced operators.

[0046] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any

incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

I claim:

1. An apparatus for releasably coupling an ultrasound probe with an extremity, comprising:

a housing adapted to substantially surround the extremity, the housing comprising a first opening adapted to receive the ultrasound probe and position the probe in contact with the extremity.

2. The apparatus of claim 1, wherein the housing further comprises a proximate end, a distal end, and a center portion connecting the proximate end to the distal end.

3. The apparatus of claim 2, wherein the proximate end comprises a second opening adapted to receive the extremity.

4. The apparatus of claim 3, wherein the distal end is closed.

5. The apparatus of claim 3 wherein the distal end comprises a third opening adapted to permit the extremity to extend beyond the housing.

6. The apparatus of claim 2, wherein the center portion comprises at least one tab adapted to wrap about a portion of the extremity to secure the housing to the extremity.

7. The apparatus of claim 1, wherein the housing comprises a positioning marking.

8. The apparatus of claim 1, wherein the housing surrounds at least 180 degrees of the circumference of the extremity.

9. The apparatus of claim 1, further comprising a plurality of housings of different sizes adapted for different size extremities.

10. The apparatus of claim 2, wherein the housing when not substantially surrounding the extremity has a generally circular cross section in the center portion.

11. The apparatus of claim 1, wherein the housing when not substantially surrounding the extremity has a generally planar cross section in the center portion.

12. The apparatus of claim 2, wherein the housing when not substantially surrounding the extremity has a generally curved cross section in the center position.

13. The apparatus of claim 1, wherein the second opening comprises a groove formed by wrapping the housing around opposite sides of the extremity about a distal tip of the extremity.

14. The apparatus of claim 1, wherein the housing immobilizes the extremity.

15. The apparatus of claim 1, wherein the housing comprises a flexible material.

16. A system for reducing variability in ultrasound procedures of an extremity comprising:

a housing adapted to substantially surround the extremity, the housing comprising a first mating element; and an ultrasound probe comprising a second mating element, wherein the first mating element and the second mating element are adapted to mate.

17. The system of claim 16, wherein the housing comprises a first mating element and the ultrasound probe comprises a second mating element, wherein when the first mating element and the second mating element mate, the housing retains the probe in a substantially fixed position and in contact with the extremity.

18. A method of performing an ultrasound scan on a patient extremity utilizing an ultrasound probe, comprising: applying ultrasonic gel to an interior of a housing, positioning the housing about the extremity, and mating an ultrasound probe to the housing, wherein when mated, a tip of the ultrasound probe is in contact with the ultrasonic gel.

19. The method of claim 18, wherein the positioning step further comprises: rotating the housing about the extremity.

20. The method of claim 18, wherein the positioning step further comprises:

securing at least one tab about the extremity to immobilize the extremity.

* * * * *

专利名称(译)	用于辅助肢体超声波检查的装置和方法		
公开(公告)号	US20150182189A1	公开(公告)日	2015-07-02
申请号	US14/144824	申请日	2013-12-31
[标]申请(专利权)人(译)	通用电气公司		
申请(专利权)人(译)	通用电气公司		
当前申请(专利权)人(译)	通用电气公司		
[标]发明人	MULLEN PAUL		
发明人	MULLEN, PAUL		
IPC分类号	A61B8/00		
CPC分类号	A61B8/4227 A61B8/4281 A61B8/40 A61B8/4444 A61B8/08		
其他公开文献	US9986970		
外部链接	Espacenet USPTO		

摘要(译)

一种用于将超声探头与末端可释放地连接的装置，包括适于基本上围绕末端的壳体。壳体包括第一开口，其适于接收超声探头并将探头定位成与末端接触。

