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G1G GPB GPN

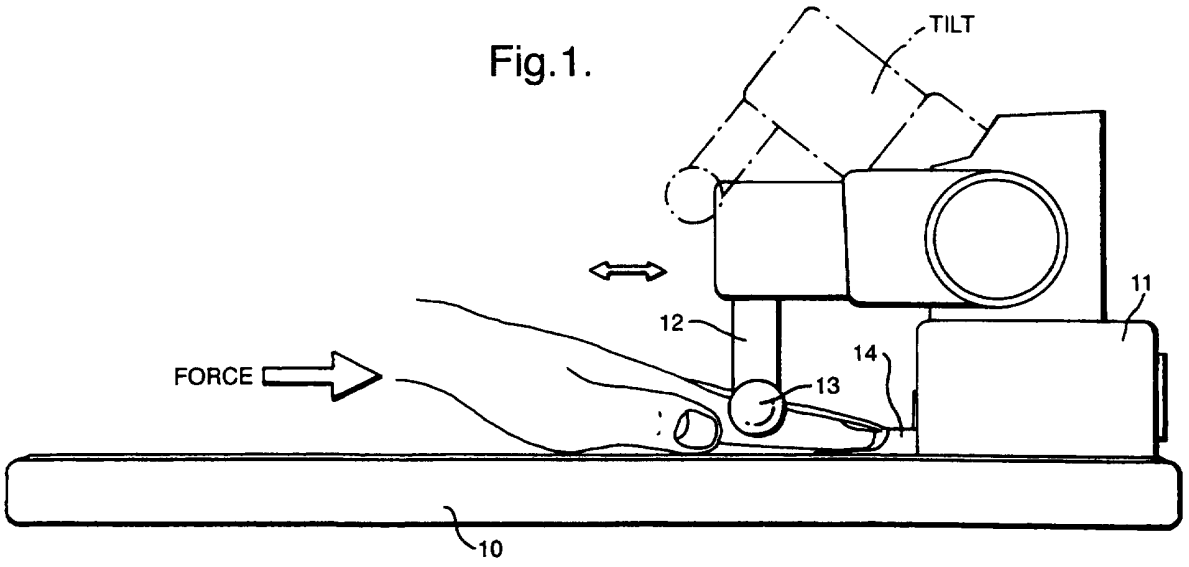
(56) Documents Cited
GB 2257253 A **EP 0765635 A2** **EP 0761169 A2**
US 5335661 A

(58) Field of Search
UK CL (Edition P) **G1G GPB GPN**
INT CL^6 **A61B 8/08**

(54) Abstract Title
Ultrasound device for measuring bone density

(57) An ultrasound measuring device for measuring the bone density of a hand placed on a sensor pad 10 with one finger pushed against an abutment 14 at one end. The force exerted by the finger on the abutment is measured and recorded. A pair of arms 12 accommodate ultrasound transducers 13 at each of their respective ends. The transducers 13 are moveable and are moved so as to be brought into contact with each side of the finger just under the knuckle. The pressure exerted on the finger by the transducer heads and the location of the transducers 13 in x, y and z directions relative to the sensor pad 10 are measured and recorded. The exact measurements are stored and can later matched so that accurate subsequent bone density measurements of that particular body part are possible.

Fig.1.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

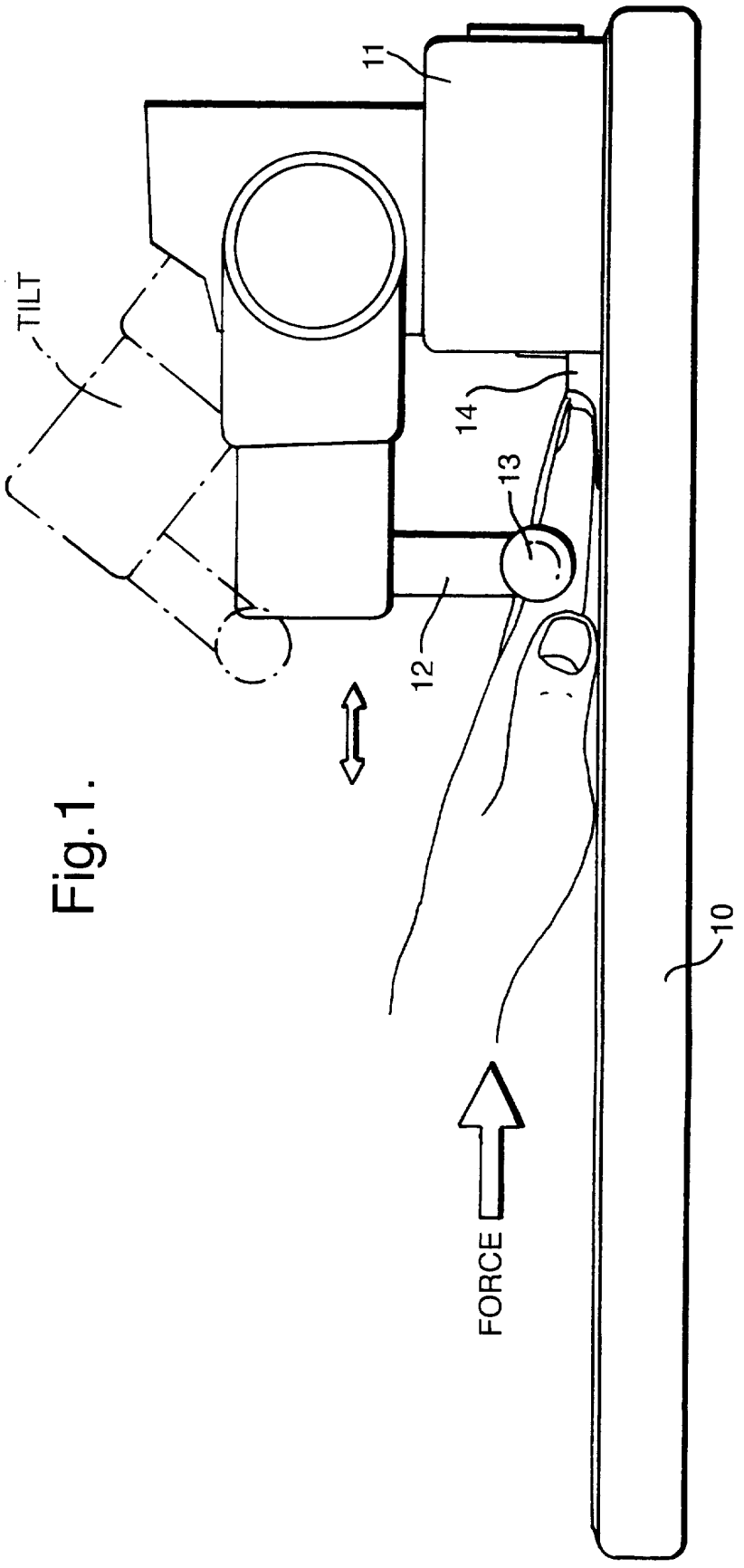


Fig.1.

Fig.2.

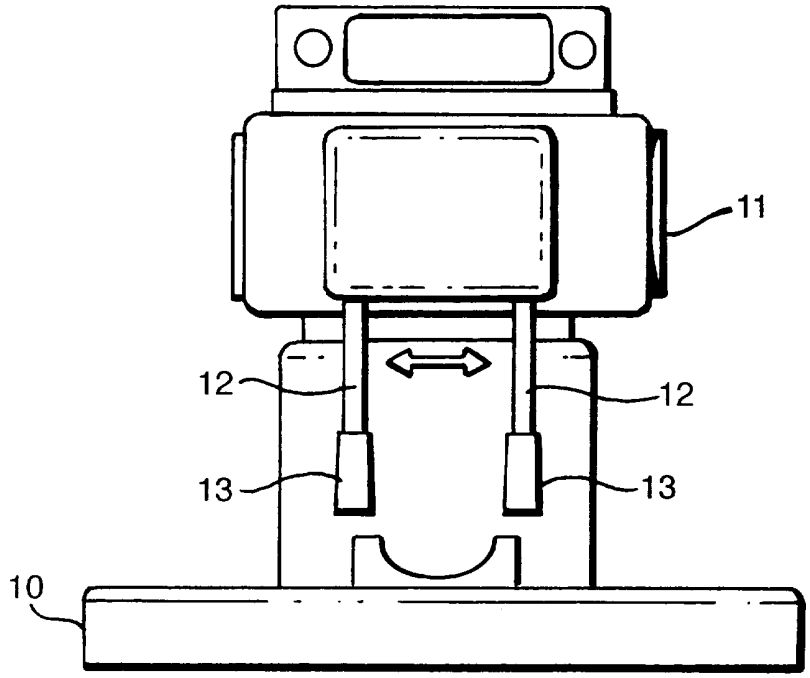
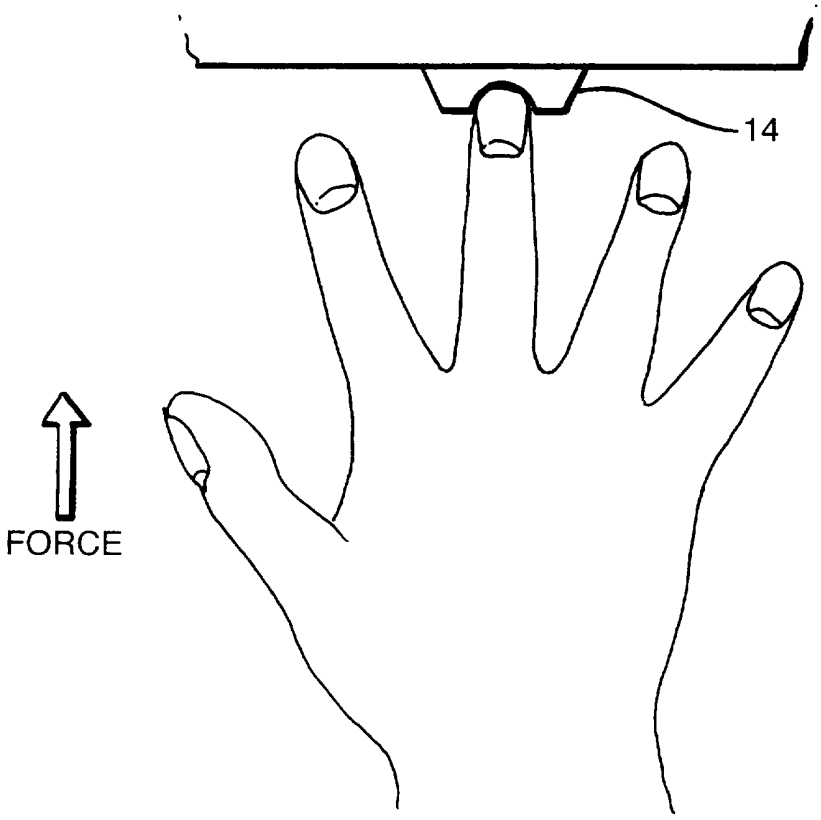


Fig.3.



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ULTRASOUND MEASURING DEVICE

This invention relates to the measurement of bone density and in particular to a device for use in the non-invasive ultrasound measurement of bone density in humans and animals.

It is known that the velocity of sound or ultrasound attenuation through a human bone is a measure of the bone's density and elasticity and devices exist whereby the transit time or attenuation of an ultrasonic pulse through a bone, for example, a heel is compared to the transit time or attenuation without a heel in the path.

The measurements of bone density can be used in the diagnosis of bone conditions such as osteoporosis (low bone density). Osteoporosis develops progressively and every patient has a different "healthy" bone density; in these cases, it is beneficial to generate some historical record of the changes in the patient's bone density and make a diagnosis using this historical record.

The measurements of bone density using ultrasound non-invasively are complicated by the presence of soft tissue surrounding most bones since the ultrasound signal is effected by the soft tissues as well as the bone. Furthermore, the accuracy with which the measurements can be repeated on a patient can be limited.

The present invention seeks to provide an improved ultrasound measuring device for the measurement of bone density.

According to the invention there is provided an ultrasound device for the measurement of bone density having abutment means to locate a patient's body part, a pair of ultrasound transducers movable to enable their respective measurement heads to contact the body part at a desired location on the body part for taking ultrasonic measurements of that body part, wherein the location of each head is automatically measured and recorded.

Therefore, the exact site location of the ultrasound measurement across the body part is accurately measured and recorded and may be stored. The recorded measurements are recalled for subsequent ultrasound measurements on the same patient and are matched before ultrasound measurement takes place, thereby ensuring that the ultrasound measurement is always taken at exactly the same site on the body part.
Preferably, both the vertical and horizontal positions of the transducer heads relative to the sensor pad are measured.

Preferably, the force exerted by the body part against the abutment means is measured and recorded so that a constant pressure is achieved against the abutment means during ultrasound measurement. Similarly, the pressure exerted by the respective transducer heads at their contact point with the body part may be measured, recorded and stored. Therefore, variances in ultrasound measurement due to differences in compression of the body part tissues may be eliminated.

Conveniently, the ultrasound measurement device includes a stationary sensor bed for location of the body part relative to the ultrasound transducer heads. Preferably, the transducers are mounted co-axially on mounting means for movement relative to the sensor pad. The transducers may preferably be mounted for vertical and horizontal movement relative to the sensor pad. Preferably, means are provided for recording the locations of the transducers longitudinally and transversely horizontally of the sensor pad and vertically relative to the sensor pad and for automatically measuring the distance between the transducer heads.

According to another aspect of the invention, there is provided a method of taking ultrasound measurements of a body part including the steps of; locating a patient's body part against an abutment means, moving the body part so that it exerts a gentle force against the abutment means, moving the transducers so that their heads respectively contact either side of the body part, recording the location of the transducer heads, recording the force at the abutment means and taking the ultrasound measurement across the body part.

Preferably for subsequent ultrasound measurements the method further includes the steps of; matching the values of the force exerted and the location of the transducer heads to the values recorded for a previous measurement and finally taking the ultrasound measurements.

An embodiment of the present invention will now be described with reference to the accompanying drawings in which:

Fig. 1 is a side view of an ultrasound measuring device according to the invention;

Fig. 2 is a front view of the device in Fig. 1;

Fig. 3 is a top view of the abutment means according to the invention

Referring now to the drawings, the ultrasound measuring device consists of a sensor bed 10 having at one end a housing 11 supporting a pair of downwardly extending members 12. The members 12 each have an ultrasound transducer 13 located at their ends. The housing 11 further accomodates the means for measuring the location of the transducers and automatically recording their location in the x, y and z axis with respect to the sensor pad. The means may be a linear voltage displacement transducer (LVDT) or a precision multi-yurn potientiometer or other such devices.

The members 12 may be supported for horizontal movement along and across the sensor bed 10 and also for vertical movement relative to the sensor bed. The members 12 may also be pivotable relative to the sensor bed 10.

The sensor bed 10 receives a patient's hand and has an abutment 14 adjacent the housing 11 for location of a finger tip with the rest of the hand splayed flat on the

sensor bed surface, as shown in Fig. 3. The sensor bed 10 may be shaped to facilitate location of a patient's hand. The size of the abutment 14 may be changed to accomodate different hands and fingers sizes of patients.

In use, the practitioner places a patient's hand on the sensor bed 10 and arranges the hand such that the middle finger rests against the abutment 14 and that the finger tip exerts a gentle pressure against the abutment 14. This force is measured, recorded and stored. The value of the force is logged against individual patients.
The force may be measured by use of conventional load cell elements, e.g. strain guages mounted on a beam or movement of a spring by a known distance or similar.

The ultrasound transducers are then brought into position such that their heads 13 are either side of the patient's middle finger just under the knuckle. The practitioner determines the desired position visually and then measures the x, y and z coordinates to fix the position of the ultrasound measuring site. The z and y coordinates fix vertical and horizontal positioning, and the x coordinates provide the distance across the ultrasound measurement site. This distance may be adjusted by the practitioner to ensure that tissue effects are minimised and that the ultrasound is measured over the same distance. It may be desirable to measure and record the pressure exerted by the transducer heads against the finger and ensure that subsequent ultrasound measurements match the pressure previously recorded, in a similar way as matching the force values against the abutment 14.

Once the location and force values are recorded the practitioner takes the ultrasound measurement across the site. The location and force can be matched for subsequent ultrasound measurements enabling accurate serial ultrasound measurements to be made at the same site, thereby facilitating monitoring of bone density changes over long periods of time.

Claims

1. An ultrasound device for the measurement of bone density comprising abutment means to locate a patient's body part, a pair of ultrasound transducers movable to enable their respective measurement heads to contact the body part at a desired location on the body part for taking ultrasonic measurements of that body part, wherein the location of each head is automatically measured and recorded.

2. An ultrasound device as claimed in claim 1, wherein both the vertical and horizontal positions of the transducer heads are measured and recorded.

3. An ultrasound device as claimed in claims 1 or 2, wherein the force exerted by the body part against the abutment means is measured and recorded so that a constant pressure is achieved against the abutment means during ultrasound measurement.

4. An ultrasound device as claimed in any preceding claim, wherein the pressure exerted by the respective transducer heads at their contact point with the body part may be measured, recorded and stored.

5. An ultrasound device as claimed in any preceding claim, wherein the ultrasound measurement device includes a stationary sensor bed for further location of the body part relative to the ultrasound transducer heads.

6. An ultrasound device as claimed in claim 5, wherein the transducers are mounted co-axially on mounting means for movement relative to the sensor pad.

7. An ultrasound device as claimed in claim 6, wherein means are provided for recording the locations of the transducers longitudinally and transversely horizontally of the sensor pad and vertically relative to the sensor pad and for automatically measuring the distance between the transducer heads.

8. A method of taking ultrasound measurements of a body part comprising the steps of; locating a patient's body part against an abutment means, moving the body part so that it exerts a gentle force against the abutment means, moving the transducers so that their heads respectively contact either side of the body part, recording the location of the transducer heads, recording the force at the abutment means and taking the ultrasound measurement across the body part.

9. An ultrasound device as claimed in claim 8, wherein for subsequent ultrasound measurements the method further includes the steps of; matching the values of the force exerted and the location of the transducer heads to the values recorded for a previous measurement and finally taking the ultrasound measurement.

The Patent Office

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Application No: GB 9702108.3 **Examiner:** Ruth Patterson
Claims searched: 1 to 9 **Date of search:** 21 April 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G1G (GPB, GPN)

Int Cl (Ed.6): A61B 8/08

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2257253 A	(LANGTON) See abstract, figures 1 & 3, page 2, line 18 to page3, line 6	1
X	EP 0765635 A2	(HOLOGIC INC.) See figure 1 and column 5, line 30 to column 7, line 2.	1
X	EP 0761169 A2	(LILLY IND.) See abstract, figure 2, column 2, lines 6 to 38, column 2, line 54 to column 3, line 13, and column3, lines 34 to 49	1,2,5,6 & 7
X	US 5335661 A	(KOBLANSKI) See abstract, figures 1, 3, 4 & 6, column 2, line 64 to column 4, line 2.	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.