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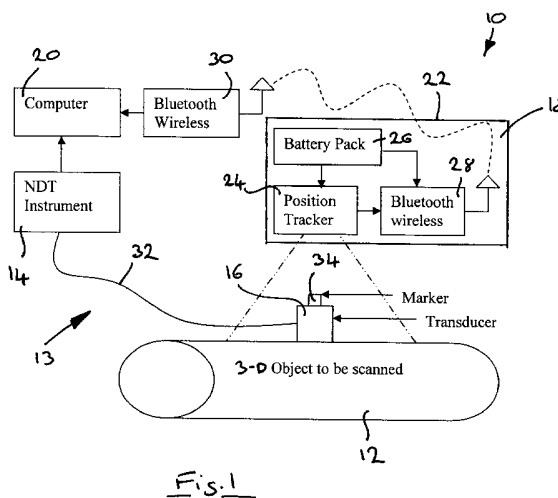
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(56) Documents Cited:
GB 2285129 A **EP 0221643 A2**

(58) Field of Search:
UK CL (Edition X) **G1A, H4D**
INT CL **G01N, G01S**
Other: **EPODOC, JAPIO, WPI**

(54) Abstract Title: **Non destructive testing inspection apparatus for three dimensional objects**

(57) A non destructive (NDT) inspection system is disclosed comprising an inspection device 16 having a transducer placeable in contact with and moveable over the surface of an object 12 to be inspected. A remote position tracking device 24 is arranged to track the movement of the inspection device 16 over the surface of the object 12. A data storage, retrieval and display device, such as a computer 20, is arranged to receive inspection data from the inspection device 16 and positional data from the position tracking device 24. The position tracking device 24 is an optical tracking device and is arranged to transmit position data to the data storage device 20 wirelessly. The NDT inspection system may operate in accordance with any conventional NDT inspection technology such as eddy current or ultrasonic technology. The optical tracking device 24 may be an optical radar device operating in the near infrared range.



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 but within the period prescribed by Rule 25(1) of the Patents Rules 1995.

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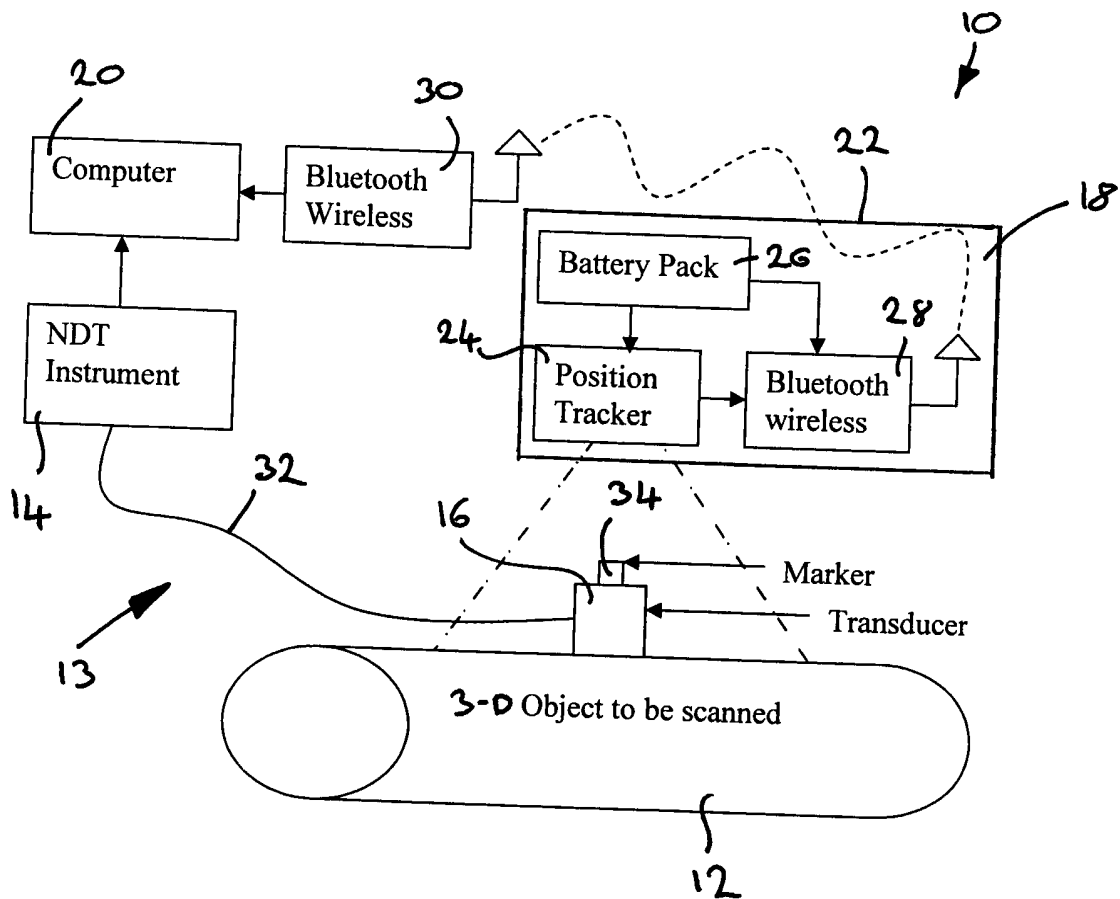


Fig. 1

90 44 28

Improved NDT Inspection Apparatus and Method

The present invention relates to non-destructive testing (NDT) inspection apparatus and in particular to NDT inspection apparatus for three dimensional objects.

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NDT inspection is used for the detection of defects in the surfaces of large objects such as, for example, aircraft wings, forgings and pipes. Such defects may not be visible to the human eye and hence an appropriately configured inspection device is moved over the surface of the object. Depending upon the nature and material of the object to be tested the inspection device may utilise, for example eddy current inspection technology or ultrasonic inspection technology.

The inspection device is moved over the surface of the object under test and the output fed to a recording device such as, for example, a computer. With the aid of appropriate software the inspection device and computer are able to produce a two dimensional map of the surface of the object which highlights any defects found.

In certain circumstances it may be advantageous to show the map in a three dimensional form which mirrors the form of the surface under test. One method of preparing such a map involves monitoring the spatial position of the inspection device as it is moved over the surface of the object. Systems have been proposed which utilise a jig which surrounds the test object and to which the inspection device is connected mechanically, for example by an articulated arm. Movement of the inspection device results in movement of the arm which in turn is recorded. An alternative system utilises a ultrasonic transmitter mounted on the inspection device and at least three ultrasonic receivers positioned around the inspection device. The position of the inspection device is determined by triangulation.

According to a first aspect of the present invention there is provided an NDT inspection system comprising an NDT inspection device having a transducer placeable in contact with and movable over the surface of an object to be inspected, a remote position

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tracking device arranged to track the movement of the NDT inspection device over the surface of the object, and a data storage, retrieval and manipulation device having a display, the data storage, retrieval and display device being arranged to receive inspection data from the NDT inspection device and positional data from the position tracking device, wherein the position tracking device is an optical tracking device and the position tracking device is arranged to transmit position data to the data storage, retrieval and manipulation device wirelessly.

The position tracking device is provided with wireless transmission device which is preferably a bluetooth device. The optical position tracking device is preferably a 3-D optical radar device. The tracking device may advantageously operate in the near infrared range. The NDT inspection device may be provided with a fixed marker which is tracked by the position tracking device.

According to a second aspect of the present invention there is provided an NDT inspection device position tracking apparatus comprising an optical position tracking device operable to track the position of a NDT inspection device situated remote from the tracking apparatus, a wireless transmission device arranged to receive data from the tracking device and transmit said data to a remote location, and a rechargeable power source arranged to power both the tracking device and the wireless transmission device.

The wireless transmission device is preferably a bluetooth device. The optical position tracking device is preferably a 3-D optical radar device. The tracking device may advantageously operate in the near infrared range.

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According to a third aspect of the present invention there is provided a method of undertaking an NDT inspection of the three dimensional object, the method comprising the steps of :

- providing an object to be inspected;
- providing an NDT inspection device having a transducer placeable in contact with and movable over the object;

providing a remote optical position tracking device arranged to track the movement of the NDT inspection device over the surface of the object,
providing a data storage, retrieval and manipulation device having a display, the data storage, retrieval and display device being arranged to receive inspection data from the
5 NDT inspection device and positional data from the position tracking device;
moving the NDT inspection device over the surface of the object and simultaneously acquiring inspection data from the NDT inspection device and position data from the optical position tracking device; and
supplying the inspection and position data to the data storage, retrieval and
10 manipulation device, wherein the step of supplying the position data from the optical position tracking device to the data storage, retrieval and manipulation device is achieved in a wireless manner.

An embodiment of the invention will now be described with reference to figure 1 which
15 shows a scanning system generally designated 10 for use in the NDT scanning of the surface of a three dimensional object 12. The object 12 is shown to be cylindrical for the purpose of illustration only and as such is not intended to be limiting upon the shape of objects which may be scanned by a system in accordance with the present invention .
The system 10 comprises an NDT inspection device 13 having a base unit 14 and an
20 inspection head or transducer 16 movable over the object 12, a position tracking apparatus 18 arranged to track the position of the transducer 16 and an information storage and retrieval device, such as a computer 20, arranged to receive information from both the NDT inspection device 14 and the position tracking apparatus 18.

25 The position tracking apparatus 18 comprises a housing 22 within which is contained an optical position tracking device 24, a power source 26 and wireless transmitter device 28 such as a Bluetooth transmission device. The position tracking device 24 comprises a 3-D optical radar device arranged to operate in the near infra red frequency band. The device 24 is provided with both an optical transmitter and an optical receiver
30 and is configured to track the position of an appropriately configured target. The optical transmitter and receiver are arranged to act through spaced apertures of the device 24 so as to provide the device with a stereo view of a target to be tracked. The

optical transmitter is configured to emit near infrared light energy, while the optical receiver is arranged to receive infrared light energy reflected by the transducer. The wireless transmitter device 28 is arranged to correspond with an appropriately configured wireless receiver device 30 associated with the computer 20. The wireless receiver device 30 may be incorporated within the computer 20 or connected thereto via an external port thereof. The power source 26 may comprise one or more rechargeable batteries which power both the optical position tracking device 24 and the wireless transmitter device 28.

10 The NDT inspection device 13 may operate in accordance with any conventional NDT inspection technology such as, for example, eddy current or ultrasonic technology. In the embodiment shown the transducer 16 is connected to the base unit 14 via a cable 32. The base unit 14 is in turn connected to the computer 20. The base unit 14 may be external to the computer 20 and connected thereto via a cable. Alternatively the base unit 14 may correspond with the computer in a wireless manner. The transducer 16 is provided with a target or marker 34 which is tracked by the position tracking device 24. The marker 34 is reflective so as to reflect near infrared light energy emitted by the position tracking device.

20 Operation of the system 10 will now be described. The position tracking apparatus 18 and object 12 to be inspected are arranged such that the position tracking apparatus has a clear, unobstructed line of sight over the entire surface of the object 12. The apparatus 18 may, for example, be mounted slightly above and to one side of the object 12 on a stand or tripod. The provision of wireless communication between the apparatus 18 and the computer 20 enables the apparatus 18 to be placed in the most advantageous position to view the object 12. An operator moves the transducer 16 to a start position on the object 12 and then commences an inspection of the surface of the object 12 by moving the transducer 16 over the surface of the object 12 in a predetermined pattern. As the transducer 16 is moved over the object 12, information relating to the state and condition of the portion of the object 12 below the transducer 16 is passed to the base unit 14 and in turn to the computer 20.

Simultaneously with the acquisition of inspection data from the NDT inspection device 13 the computer 20 is supplied with information relating to the spatial position of the transducer 16 by the position tracking apparatus 18. As the transducer 16 is moved over the object 12 the corresponding movement in three dimensions of the marker 34 is
5 observed by the position tracking device 24. Information relating to the movement of the marker 34 and hence the transducer 16 is passed to the wireless transmitter device 28 by the position tracking device 24 and subsequently sent to the wireless receiver 30 associated with the computer 20.

10 Software present upon the computer 20 is able to manipulate the positional data supplied by the position tracking apparatus 18 and the inspection data supplied by the inspection device 13 to provide a three dimensional map relating the inspection data to the surface topography of the object. The map may also be displayed in a conventional two dimensional form, which is to say in a form with the spatial position of the
15 transducer 16 removed.

It will be appreciated that for the system 10 to operate effectively care must be taken by the operator not to obstruct the “view” by the position tracking device 24 of the marker 34. The position tracking apparatus 18 may thus be provided with an alarm to alert the
20 operator in instances where the view is blocked.

Claims

1. An NDT inspection system comprising an NDT inspection device having a transducer placeable in contact with and movable over the surface of an object to be inspected, a remote position tracking device arranged to track the movement of the NDT inspection device over the surface of the object, and a data storage, retrieval and manipulation device having a display, the data storage, retrieval and display device being arranged to receive inspection data from the NDT inspection device and positional data from the position tracking device, wherein the position tracking device is an optical tracking device and the position tracking device is arranged to transmit position data to the data storage, retrieval and manipulation device wirelessly.
2. A system as claimed in claim 1, wherein the position tracking device is provided with wireless transmission device.
3. A system as claimed in claim 2 wherein the wireless transmission device is a bluetooth device.
4. A system as claimed in any preceding claim, wherein the optical position tracking device is a 3-D optical radar device.
5. A system as claimed in claim 4, wherein the tracking device operates in the near infrared range.
6. A system as claimed in any preceding claim, wherein the NDT inspection device is provided with a fixed marker which is tracked by the position tracking device.
7. An NDT inspection device position tracking apparatus comprising an optical position tracking device operable to track the position of a NDT inspection device situated remote from the tracking apparatus, a wireless transmission device arranged to receive data from the tracking device and transmit said data to a remote location, and a

rechargeable power source arranged to power both the tracking device and the wireless transmission device.

8. An inspection device as claimed in claim 7, wherein the wireless transmission
5 device is a bluetooth device.

9. An inspection device as claimed in claim 8, wherein the optical position tracking device is a 3-D optical radar device.

10. An inspection device as claimed in claim 9, wherein the tracking device operates in the near infrared range.

11. A method of undertaking an NDT inspection of the three dimensional object, the method comprising the steps of :

15 providing an object to be inspected;
providing an NDT inspection device having a transducer placeable in contact with and movable over the object;

providing a remote optical position tracking device arranged to track the movement of the NDT inspection device over the surface of the object,

20 providing a data storage, retrieval and manipulation device having a display, the data storage, retrieval and display device being arranged to receive inspection data from the NDT inspection device and positional data from the position tracking device;

moving the NDT inspection device over the surface of the object and simultaneously acquiring inspection data from the NDT inspection device and position
25 data from the optical position tracking device; and

supplying the inspection and position data to the data storage, retrieval and manipulation device, wherein the step of supplying the position data from the optical position tracking device to the data storage, retrieval and manipulation device is achieved in a wireless manner.

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Application No: GB0507288.9

Examiner: Richard Kerslake

Claims searched: 1-6 & 11

Date of search: 3 February 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	GB2285129 A (KAWASAKI et al.)
A	-	EP0221643 A2 (TEXAS INSTRUMENTS)

Categories:

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

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

G1A; H4D

Worldwide search of patent documents classified in the following areas of the IPC

G01N; G01S

The following online and other databases have been used in the preparation of this search report

EPODOC, JAPIO, WPI