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- (71) **Applicant:** NEUROLOGICA CORP. [US/US]; 14 Electronics Avenue, Danvers, MA 01923 (US).
- (72) **Inventors:** BAILEY, Eric; 18 Vrylenas Way, Hampton, NH 03842 (US). DICKMAN, Matthew; 950 Broadway, Unit #35, Chelsea, MA 02150 (US). LIMOLI, Michael; 5 Chase Crescent, Merrimac, MA 01860 (US).
- (74) **Agent:** PANDISCIO, Mark, J.; Pandiscio & Pandiscio, 436 Boston Post Road, Weston, MA 02493 (US).
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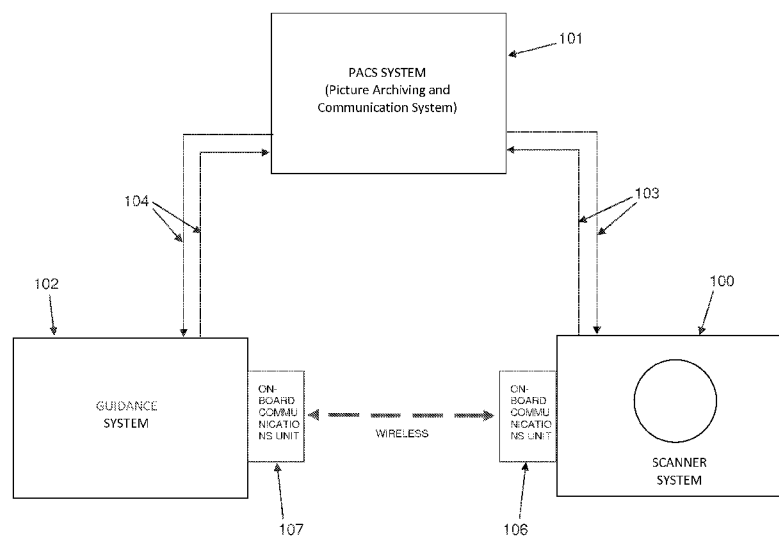


FIG. 7

(57) **Abstract:** A wireless imaging system comprising: a scanner for creating an image of an interior portion of an object; a guidance system for using an image of an interior portion of an object to provide guidance to an individual with respect to the object; the scanner comprising an on-board wireless communication unit, and the guidance system comprising an on-board communication unit, the on-board wireless communication unit of the scanner and the on-board communication unit of the guidance system being configured to wirelessly transfer images created by the scanner directly to the guidance system.

WIRELESS IMAGING SYSTEM

Applicant

Neurologica Corp.

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Inventors

Eric Bailey

Matthew Dickman

Michael Limoli

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Reference To Pending Prior Patent Application

This patent application claims benefit of pending prior U.S. Provisional Patent Application Serial No. 61/624,522, filed 04/16/12 by Eric Bailey for WIRELESS IMAGING SYSTEM (Attorney's Docket No. NEUROLOGICA-46 PROV), which patent application is hereby incorporated herein by reference.

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Field Of The Invention

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This invention relates to anatomical imaging systems in general, and more particularly to wireless imaging systems.

5      Background Of The Invention

Strokes are currently the third leading cause of death in the United States, causing approximately 177,000 deaths per year, and strokes are currently the number one cause of long-term disability in the United States, currently affecting nearly 5 million people. Strokes are caused by an abrupt interruption of the blood supply to the brain or spinal cord, thereby depriving the tissue of oxygen and resulting in tissue damage.

15      Strokes typically occur in one of two forms: (i) hemorrhagic strokes, which occur with the rupture of a blood vessel; and (ii) ischemic strokes, which occur with the obstruction of a blood vessel.

Rapid diagnosis is a key component of stroke treatment. This is because the treatment for an ischemic stroke may be contra-indicated for the

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treatment for a hemorrhagic stroke and, furthermore,  
the effectiveness of a particular treatment may be  
time-sensitive. More particularly, the current  
preferred treatment for an acute ischemic stroke,  
5 i.e., the administration of tPA to eliminate blood  
clots, is contra-indicated for a hemorrhagic stroke.  
Furthermore, the clinical data suggests that the  
medication used to treat ischemic strokes (i.e., tPA)  
is most effective if it is administered within 3 hours  
10 of the onset of the stroke. However, current  
diagnosis times, i.e., the time needed to identify  
that the patient is suffering from a stroke and to  
identify the hemorrhagic or ischemic nature of the  
stroke, frequently exceeds this 3 hour window. As a  
15 result, only a fraction of current ischemic stroke  
victims are timely treated with tPA.

Imaging is generally necessary to properly  
diagnose (and hence properly treat) a stroke. More  
particularly, imaging is generally necessary to: (i)  
20 distinguish strokes from other medical conditions;  
(ii) distinguish between the different types of

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strokes (i.e., hemorrhagic or ischemic); and (iii) determine appropriate treatments (e.g., the administration of tPA in the case of an ischemic stroke).

5           Computerized Tomography (CT) has emerged as the key imaging modality in the diagnosis of strokes. CT scanners generally operate by directing X-rays into the body from a variety of positions, detecting the X-rays passing through the body, and then processing  
10           the detected X-rays so as to build a computer model of the patient's anatomy. This computer model can then be visualized so as to provide images of the patient's anatomy. It has been found that such CT scanning, including non-enhanced CT scanning, CT angiography  
15           scanning and CT perfusion scanning, is able to provide substantially all of the information needed to effectively diagnose (and hence properly treat) a stroke.

20           Unfortunately, in practice, the CT machine is typically located in the hospital's radiology department and the patient is typically received in

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the hospital's emergency room, and the "round-trip"  
time between the emergency room and the radiology  
department can frequently involve substantial delays,  
even in the best of hospitals. As a result, the time  
5 spent in transporting the patient from the emergency  
room to the radiology department and then back again  
can consume critical time which can compromise proper  
treatment of the patient (e.g., it can prevent  
ischemic stroke victims from being timely treated with  
10 tPA).

Thus, there is an urgent need for a new and  
improved CT machine which is particularly well suited  
for use in stroke applications. More particularly,  
there is an urgent need for a small, mobile CT machine  
15 which can be pre-positioned in the emergency room and  
moved to the patient so that the patient can be  
scanned at their current location, thus effectively  
eliminating "round-trip" delays and dramatically  
reducing the time needed to properly diagnose the  
20 patient. It is also important that the CT machine be  
relatively inexpensive, so as to facilitate its rapid

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proliferation and widespread use, e.g.,  
pre-positioning in substantially all hospital  
emergency rooms and wide availability in outlying,  
low-volume settings (e.g., rural hospitals, ships,  
5 etc.).

In this respect it should also be appreciated  
that current CT scanners are typically accompanied by  
a significant amount of physical cabling. This  
physical cabling generally takes the form of (i)  
10 electrical cables used to deliver electrical power to  
the CT scanner, and (ii) networking cables used to  
connect the CT scanner to a workstation, whereby to  
permit medical personnel to issue scanning  
instructions to the CT scanner using the workstation,  
15 and whereby to enable the CT scanner to send images  
and scanner data to the workstation for viewing by  
medical personnel. The workstation can, in turn, be  
connected to a hospital PACs (Picture Archive and  
Communication) system or other IT network, so as to  
20 permit the CT scanner to be controlled from remote  
locations and so as to permit images and scanner data

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to be viewed by medical personnel at remote locations.  
Alternatively, the CT scanner can be directly  
connected to a hospital PACs system or other IT  
network.

5           The aforementioned physical cabling generally  
does not present significant issues with conventional  
CT scanners, since such conventional CT scanners are  
designed for fixed-position installations. Thus, with  
fixed-position CT scanners, the disposition of the  
10       physical cabling can be addressed at the time of CT  
scanner installation so as to make the physical  
cabling relatively inobtrusive (e.g., the physical  
cabling can be carefully positioned so that it is out  
of the way of patients and medical personnel).

15           However, if the CT scanner is to be highly mobile  
so that the CT scanner can be brought to the bedside  
of the patient, conventional physical cabling presents  
a significant problem, since it can interfere with the  
delivery of time-critical medical treatment and  
20       present a physical hazard to medical personnel focused  
on delivering such medical treatment.

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By way of example but not limitation, suppose a patient arrives in an emergency room presenting symptoms of stroke. In this situation, it is imperative that CT scanning be effected as quickly as possible, even as other medical testing and/or treatment is being administered to the patient. Medical personnel must work quickly and efficiently in this situation, with their focus on the delivery of time-critical patient care. If a mobile CT scanner were equipped with conventional physical cabling, bringing the mobile CT scanner to the patient would require the introduction of this conventional physical cabling to the point of care. This physical cabling would present a significant intrusion into the point of care, complicating the delivery of time-critical medical treatment and presenting a physical hazard to medical personnel working around the patient. This is particularly true where the mobile CT scanner is deployed hurriedly, e.g, in the case of a possible stroke patient just arriving at an emergency room.

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Thus, there is a need for a new and improved approach for (i) providing the electrical power needed to operate the mobile CT scanner, and (ii) connecting the CT scanner to a workstation, hospital PACs system or other IT network, all without the use of the physical cabling normally associated with a conventional CT scanner.

#### Summary Of The Invention

In accordance with the present invention, there is provided a novel approach for (i) providing the electrical power needed to operate the mobile CT scanner, and (ii) connecting the CT scanner to a workstation, hospital PACs system or other IT network, all without the use of the physical cabling normally associated with a conventional CT scanner.

And there is provided a novel mobile CT machine with cordless and wireless capabilities, such that the novel CT machine does not require physical cabling to (i) provide the electrical power needed to operate the mobile CT scanner, and (ii) connecting the CT scanner

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to a workstation, hospital PACs system or other IT network.

And there is provided a wireless imaging system which allows scan data to be wirelessly transferred from the imaging system to a surgical guidance system.

In one form of the invention, there is provided a wireless imaging system comprising:

a scanner for creating an image of an interior portion of an object;

a guidance system for using an image of an interior portion of an object to provide guidance to an individual with respect to the object;

the scanner comprising an on-board wireless communication unit, and the guidance system comprising an on-board communication unit, the on-board wireless communication unit of the scanner and the on-board communication unit of the guidance system being configured to wirelessly transfer images created by the scanner directly to the guidance system.

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In another form of the invention, there is provided a method for providing images to a guidance system, the method comprising:

providing a wireless imaging system comprising:

5                   a scanner for creating an image of an interior portion of an object;

                  a guidance system for using an image of an interior portion of an object to provide guidance to an individual with respect to the object;

10                   the scanner comprising an on-board wireless communication unit, and the guidance system comprising an on-board communication unit, the on-board wireless communication unit of the scanner and the on-board communication unit of the guidance system being  
15                   configured to wirelessly transfer images created by the scanner directly to the guidance system;

                  creating an image of an interior portion of an object using the scanner; and

                  wirelessly transferring the image created by the  
20                   scanner to the guidance system.

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Brief Description Of The Drawings

These and other objects and features of the present invention will be more fully disclosed or rendered obvious by the following detailed description  
5 of the preferred embodiments of the invention, which is to be considered together with the accompanying drawings wherein like numbers refer to like parts, and further wherein:

Figs. 1 and 2 are schematic external views of a  
10 novel mobile CT imaging system formed in accordance with the present invention;

Fig. 3 is a schematic internal view of the novel mobile CT imaging system shown in Figs. 1 and 2;

Fig. 4 is a schematic view showing a novel on-  
15 board power unit for providing the electrical power needed to operate the mobile CT imaging system without requiring the use of conventional physical cabling during the same;

Fig. 5 is a schematic view showing a novel on-  
20 board networking unit for connecting the mobile CT imaging system to a workstation, hospital PACs system

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or other IT network without requiring the use of  
conventional physical cabling during the same;

Fig. 6 is a schematic view showing a conventional  
way for linking a scanner system to a guidance system  
via a PACS system; and

Fig. 7 is a schematic view showing a novel method  
for wirelessly linking a scanner system to a guidance  
system.

#### Detailed Description Of The Preferred Embodiments

##### The Mobile CT Imaging System In General

Looking first at Figs. 1 and 2, there is shown a  
novel mobile CT imaging system 5 formed in accordance  
with the present invention. Mobile CT imaging system  
5 generally comprises a torus 10 which is supported by  
a base 15. Torus 10 and base 15 together comprise a  
frame for mobile CT imaging system 5. A center  
opening 20 is formed in torus 10. Center opening 20  
receives the patient anatomy which is to be scanned,

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i.e., the head of the patient when mobile CT imaging system 5 is to be used in stroke applications.

Looking next at Fig. 3, torus 10 generally comprises a X-ray tube assembly 25, an X-ray detector assembly 30, and a rotating drum assembly 35. X-ray tube assembly 25 and X-ray detector assembly 30 are mounted to the rotating drum assembly 35 in diametrically-opposing relation, such that the X-ray beam 40 (generated by X-ray tube assembly 25 and detected by X-ray detector assembly 30) is passed through the patient anatomy disposed in center opening 20. Furthermore, since X-ray tube assembly 25 and X-ray detector assembly 30 are mounted on the rotating drum assembly 35 so that they are rotated concentrically about center opening 20, the X-ray beam 40 will be passed through the patient's anatomy along a full range of radial positions, so as to enable the mobile CT imaging system 5 to create the desired computer model of the scanned anatomy.

The various electronic hardware and software for controlling the operation of X-ray tube assembly 25,

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X-ray detector assembly 30, and rotating drum assembly 35, as well as for processing the acquired scan data so as to generate the desired computer model, may be of the sort well known in the art and may be located in torus 10 and/or base 15.

Still looking now at Fig. 3, base 15 comprises a transport assembly 50 for moving mobile CT imaging system 5 about relative to the patient. More particularly, as disclosed in U.S. Patent No.

7,397,895, which patent is hereby incorporated herein by reference, transport assembly 50 preferably comprises (i) a gross movement mechanism 55 for moving mobile CT imaging system 5 relatively quickly across room distances, so that the mobile CT imaging system can be quickly and easily brought to the patient, and (ii) a fine movement mechanism 60 for moving the mobile CT imaging system precisely, relative to the patient, during scanning, so that the patient can be scanned without being moved. As discussed in detail in the aforementioned U.S. Patent No. 7,397,895, gross movement mechanism 55 preferably comprises a plurality

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of free-rolling casters, and fine movement mechanism  
60 preferably comprises a plurality of centipede belt  
drives (which can be configured for either stepped or  
continuous motion, whereby to provide either stepped  
5 or continuous scanning). Hydraulic apparatus 65  
permits either gross movement mechanism 55 or fine  
movement mechanism 60 to be engaged with the floor,  
whereby to facilitate appropriate movement of mobile  
CT imaging system 5. However, as also discussed in  
10 detail in the aforementioned U.S. Patent No.  
7,397,895, gross movement mechanism 55 may be omitted  
entirely, and only fine movement mechanism 60 may be  
provided, in which case fine movement mechanism 60 is  
used to both (i) move mobile CT imaging system 5 to  
15 the patient prior to scanning, and (ii) move the  
mobile CT imaging system relative to the patient  
during scanning.

Mobile CT imaging system 5 also comprises  
cordless and wireless capabilities, such that the  
20 mobile CT imaging system does not require physical  
cabling to (i) provide the electrical power needed to

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operate the mobile CT imaging system, and (ii)  
connecting the mobile CT imaging system to a  
workstation, hospital PACs system or other IT network.

More particularly, and as will hereinafter be  
discussed in further detail below, mobile CT imaging  
system 5 also comprises a novel on-board power unit 70  
for providing the electrical power needed to operate  
the mobile CT imaging system without requiring the use  
of conventional physical cabling during the same, and  
a novel on-board networking unit 71 for connecting the  
mobile CT imaging system to a workstation, hospital  
PACs system or other IT network without requiring the  
use of conventional physical cabling during the same.

#### On-Board Power Unit 70

As noted above, and looking now at Figs. 3 and 4,  
mobile CT imaging system 5 comprises an on-board power  
unit 70 for providing the electrical power needed to  
operate the mobile CT imaging system without requiring  
the use of conventional physical cabling during the  
same. The provision of such an on-board power unit

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has been heretofore unnecessary, inasmuch as conventional CT scanners are fixed-position devices which can have their power cabling carefully arranged at the time of CT scanner installation so as to make the power cabling relatively inobtrusive (e.g., the power cabling can be carefully positioned so that it is out of the way of patients and medical personnel). However, mobile CT imaging system 5 is intended to be quickly and easily deployed in critical-care situations where there is seldom time to carefully arrange the power cabling so as to keep it out of the way. Thus, the creation of a mobile CT imaging system has now created the need for a novel on-board power unit for providing the electrical power needed to operate the mobile CT imaging system without requiring the use of conventional physical cabling during the same. On-board power unit 70 is designed to address this need.

Looking now at Fig. 4, on-board power unit 70 comprises one or more batteries 75 configured to output the electrical power needed to operate mobile

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CT imaging system 5. In one preferred form of the invention, mobile CT imaging system 5 requires 48 V DC, and batteries 75 comprises four 12 V batteries. Batteries 75 are preferably of the sort well known in the art.

On-board power unit 70 also comprises a transformer/charger 80. Transformer/charger 80 is constructed so that when the on-board power unit's plug 85 is plugged into a standard wall outlet, transformer/charger 80 will charge batteries 75. By way of example but not limitation, transformer/charger 80 may be configured to take 90-260 V, single phase, 50-60 Hertz AC power and convert it to 48 V DC power. Thus, between uses, mobile CT imaging system 5 may be positioned next to a standard wall outlet and plug 85 used, in conjunction with transformer/charger 80, to charge batteries 75. When mobile CT imaging system 5 is thereafter to be used, plug 85 is unplugged from the wall outlet, and then the mobile CT imaging system is moved (i.e., using transport assembly 50) to the patient for scanning.

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In some circumstances it may be acceptable to use mobile CT imaging system 5 while plug 85 is plugged into a standard wall outlet. To this end, on-board power unit 70 is also configured so that when plug 85 is plugged into a wall outlet, mobile CT imaging system 5 will draw power directly from transformer/charger 80, with or without also drawing power out of batteries 75.

On-board power unit 70 is mounted to the frame of mobile CT imaging system 5 so that the on-board power unit will move with the remainder of the system. In one preferred form of the invention, on-board power unit 70 is mounted in base 15.

#### On-Board Networking Unit 71

As noted above, and looking now at Figs. 3 and 5, mobile CT imaging system 5 comprises a novel on-board networking unit 71 for connecting the mobile CT imaging system to a workstation, hospital PACs system or other IT network without requiring the use of conventional physical cabling during the same.

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The provision of such an on-board networking unit has been heretofore unnecessary, inasmuch as conventional CT scanners are fixed-position devices which can have their network cabling carefully arranged at the time of CT scanner installation so as to make the network cabling relatively inobtrusive (e.g., the network cabling can be carefully positioned so that it is out of the way of patients and medical personnel). However, mobile CT imaging system 5 is intended to be quickly and easily deployed in critical-care situations where there is seldom time to carefully arrange the network cabling so as to keep it out of the way. Thus, the creation of a mobile CT imaging system has now created the need for a novel on-board networking unit for connecting the mobile CT imaging system to a workstation, hospital PACs system or other IT network without requiring the use of conventional physical cabling during the same.

Looking now at Fig. 5, on-board networking unit 71 comprises a wireless interface 90 configured to wirelessly connect mobile CT imaging system 5 to a

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workstation 95, whereby to permit medical personnel to  
issue scanning instructions to mobile CT imaging  
system 5 using the workstation, and whereby to enable  
the mobile CT imaging system to send images and  
5 scanner data to the workstation for viewing by medical  
personnel. Workstation 95 can, in turn, be connected  
to a hospital PACs system or other IT network 100, so  
as to permit mobile CT imaging system 5 to be  
controlled from remote locations and so as to permit  
10 images and scanner data to be viewed by medical  
personnel at remote locations. Alternatively,  
wireless interface 90 can be directly connected to the  
hospital PACs system or other IT network 100.

Wireless interface 90 is preferably of the sort  
15 well known in the art, e.g., a WIFI interface  
conforming to appropriate IEEE standards such as  
802.11b, 802.11g, etc.

On-board networking unit 71 is mounted to the  
frame of mobile CT imaging system 5 so that the on-  
20 board networking unit will move with the remainder of

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the system. In one preferred form of the invention, on-board networking unit 71 is mounted in base 15.

### Use

5            Mobile CT imaging system 5 is preferably used as follows.

          When not in use, mobile CT imaging system 5 is preferably stored in the emergency room (or other intended place of use), in an out-of-the-way location,  
10           raised on its gross movement mechanism 55 (i.e., its casters), and with its plug 85 plugged into a standard wall outlet so that batteries 75 are fully charged.

          When a patient arrives at the emergency room presenting stroke-like symptoms, the patient is  
15           quickly scanned in the emergency room, on their gurney, using mobile CT imaging system 5. More particularly, mobile CT imaging system 5 is unplugged from the wall, and the CT imaging system is then moved on its casters to the patient, so that the patient  
20           (while still lying on their gurney) is positioned within the center opening 20 of CT imaging system 5.

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Thereafter, using on-board power unit 70, hydraulic apparatus 65 is activated so that CT imaging system 5 is supported on its fine movement mechanism 60 (i.e., the centipede belt drives). Using on-board power unit 5 70 and on-board networking unit 71, scanning is then commenced, with fine movement mechanism 60 precision-advancing CT machine 5 relative to the patient during scanning. Image data is off-loaded (to work station 95, and/or the hospital PACs system or 10 other IT network 100 using on-board networking unit 71.

Thus, with the present invention, there is provided a novel mobile CT machine with cordless and wireless capabilities, such that the novel CT machine 15 does not require physical cabling to (i) provide the electrical power needed to operate the mobile CT scanner, and (ii) connecting the CT scanner to a workstation, hospital PACs system or other IT network.

#### Application To Other Types Of Scanning Systems

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It should be appreciated that the present invention is not limited to use in medical applications or, indeed, to use with CT machines. Thus, for example, the present invention may be used  
5 in connection with CT machines used for non-medical applications, e.g., with CT machines which are used to scan inanimate objects. Furthermore, the present invention may be used with non-CT-type imaging systems. In essence, the present invention has  
10 application to any mobile imaging device which requires cordless and wireless operation.

#### Wireless Imaging System

In the foregoing document, there is disclosed a  
15 mobile imaging system (e.g., a mobile CT machine) equipped with cordless and wireless capabilities.

Among other things, the mobile imaging system comprises an on-board power unit which is adapted to provide the electrical power needed to operate the  
20 imaging system, whereby to eliminate the need to run power cables from a wall plug to the mobile imaging

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system while the imaging system is scanning a patient.  
This greatly enhances the utility of the mobile  
imaging system, since it means that scanning can occur  
without regard to the location of wall plugs, and  
5 power cables do not need to extend from a wall plug to  
the imaging system while it is imaging a patient,  
which could interrupt diagnosis and/or treatment  
workflow around the patient due to the presence of the  
power cables.

10 And among other things, the mobile imaging system  
also comprises an on-board networking unit which is  
adapted to wirelessly connect the imaging system to a  
workstation, or to a hospital PACS system (i.e., a  
hospital Picture Archiving And Communication System),  
15 or to some other IT network, etc., whereby to  
eliminate the need to run data cables from the mobile  
imaging system to a wall jack. Again, this greatly  
enhances the utility of the mobile imaging system,  
since it means that images can be sent from the  
20 imaging system to another device or system without  
regard to the location of wall jacks, and data cables

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do not need to extend from the mobile imaging system to a wall jack, particularly while it is imaging a patient, which could interrupt diagnosis and/or treatment workflow around the patient due to the presence of the data cables.

In another aspect of the invention, a mobile imaging system equipped with an on-board networking unit for wirelessly connecting the imaging system to a workstation, a hospital PACS system (i.e., a hospital Picture Archiving And Communication System), some other IT network, etc. may be advantageously used in conjunction with a surgical guidance system (e.g., a surgical navigation system, a surgical robotics system, a surgical planning system, and/or any other system utilizing image data to provide guidance during a medical procedure, e.g., real-time DICOM images to provide real-time guidance during a surgical procedure). In this respect it will be appreciated that the provision of a mobile imaging system equipped with cordless and wireless capabilities is particularly well suited to use in an operating room,

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whereby to provide intraoperative imaging for a patient undergoing a procedure.

More particularly, Fig. 6 shows a typical conventional approach for connecting an imaging system 100 (e.g., a fixed-position CT machine), a hospital PACS system 101 and a surgical guidance system 102 (e.g., a surgical navigation system). In this conventional approach, the imaging system 100 (e.g., the fixed-position CT machine) is connected (e.g., with data cables 103) to the hospital PACS system 101, and the surgical guidance system 102 (e.g., a surgical navigation system) is connected (e.g., with data cables 104) to the hospital PACS system 101. In use, the imaging system 100 (e.g., the fixed-position CT machine) is typically employed sometime prior to the surgery (e.g., the night before the surgery) to image the anatomy which is to be operated on. The images from the imaging system 100 (e.g., the fixed-position CT machine) are sent from the imaging system 100 (e.g., the fixed-position CT machine) to the hospital PACS system 101 (e.g., by data cables 103) for

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storage. At the time of surgery, the surgical  
guidance system 102 retrieves (e.g., by data cabling  
104) the stored images from the hospital PACS system  
101 and, using fiducial markers positioned on the  
5 anatomy at the time of imaging (and hence included in  
the images), or using anatomical landmarks easily  
located on the anatomy and on the images, places the  
images "into registration" with the surgical guidance  
system 102 and the anatomy, so that the images which  
10 were previously obtained by the imaging system 100  
(e.g., the fixed-position CT machine) can be used by  
the surgical guidance system 102 (e.g., a surgical  
navigation system, a surgical robotics system, a  
surgical planning system, and/or any other system  
15 utilizing image data such as DICOM images to provide  
guidance) during the actual surgery. Alternatively,  
images from the imaging system 100 (e.g., the fixed-  
position CT machine) or the hospital PACS system 101  
may be transferred to the surgical guidance system 102  
20 using physical media (e.g., CD, DVD, USB key, etc.).

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While this approach is effective and is currently in widespread use, it puts a substantial strain on the IT network of the hospital, including the hospital PACS system 101, since images from the imaging system 100 (e.g., the fixed-position CT machine) must be:

(i) transferred from the imaging system 100 (e.g., the fixed-position CT machine) to the hospital PACS system 101;

(ii) stored on the hospital PACS system 101 until the time of surgery; and

(iii) transferred from the hospital PACS system 101 to the surgical guidance system 102 at the time of surgery.

In this respect it will be appreciated that the images being transferred from the imaging system 100 (e.g., the fixed-position CT machine) to the hospital PACS system 101, and from the hospital PACS system 101 to the surgical guidance system 102, are typically large data files which consume significant system resources, particularly within the hospital PACS system 101. Furthermore, there can be substantial

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delays while waiting for images to be transferred from the imaging system 100 (e.g., the fixed-position CT machine) to the hospital PACS system 101, and/or from the hospital PACS system 101 to the surgical guidance system 102, which can result in delays before and during surgery. This is particularly problematic when the delays occur intraoperatively.

Alternatively, images from the imaging system 100 (e.g., the fixed-position CT machine) or the hospital PACS system 101 may be transferred to the surgical guidance system 102 using physical media (e.g., CD, DVD, USB key, etc.). However, this approach is both time-consuming and inconvenient.

In accordance with the present invention, and looking now at Fig. 7, the wireless capability of mobile CT imaging system 5 (see above) can be harnessed to send images from the mobile CT imaging system 5 directly to the surgical guidance system 102, thereby completely sidestepping the hospital PACS system 101 at the time of image transmission, and/or eliminating the need for the use of physical storage

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media (e.g., CD, DVD, USB key, etc.) to transfer the images from CT imaging system 5 and/or the hospital PACS system 101 to surgical guidance system 102. In this form of the invention, imaging system 100 (e.g.,  
5 mobile CT imaging system 5) comprises an on-board communications unit 106 (e.g., the on-board networking unit 71 of mobile CT imaging system 5), and surgical guidance system 102 comprises an on-board communications unit 107, wherein the on-board  
10 communications unit 106 of imaging system 100 is configured to wirelessly communicate with the on-board communications unit 107 of surgical guidance system 102, whereby to enable the exchange of data, e.g., images, computer models, etc., therebetween. As a  
15 result, images from imaging system 100 (e.g., mobile CT imaging system 5) can be delivered to the surgical guidance system 102 more quickly, which can be of significant advantage when performing a surgical procedure with the surgical guidance system 102. In  
20 addition, since such image transmissions completely sidestep the hospital PACS system 101, the load on the

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IT network of the hospital, and particularly the load  
on the hospital PACS system 101, is significantly  
reduced. Of course, it is anticipated that the images  
captured by mobile imaging system 5 will still be  
5 forwarded to the hospital PACS system 101 at some  
point for archiving (e.g., via data cables 103), but  
this may be done at a time when the load on the IT  
network of the hospital, and particularly the load on  
the hospital PACS system 101, is reduced, e.g., at  
10 night.

Significantly, the present invention is  
particularly advantageous where scanning is done  
intraoperatively (e.g., with a mobile CT imaging  
system 5 having cordless and wireless capabilities and  
15 being physically located in the operating room), and  
real-time imaging data needs to be transferred from  
the imaging system 100 (e.g., the CT machine 5) to the  
surgical guidance system 102 (e.g., a surgical  
navigation system, a surgical robotics system, a  
20 surgical planning system, and/or any other system

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utilizing image data such as DICOM images to provide guidance).

It should also be appreciated that, if desired, the surgical guidance system 102 (e.g., a surgical navigation system, a surgical robotics system, a surgical planning system, and/or any other system utilizing image data to provide guidance) can also pull images from the hospital PACS system 101 if desired (e.g., via data cables 104), which allows multiple imaging modalities to be fused within the surgical guidance system 102. By way of example but not limitation, where the imaging system 100 comprises a mobile cordless, wireless CT machine 5 (or another CT machine equipped with wireless communications) which is present in the operating room, the surgical guidance system 102 can also pull images created by other imaging modalities (e.g., MRI, PET, SPECT, ultrasound, etc.) from the hospital PACS system 101 so that images from multiple modalities are available to the surgical guidance system 102. Alternatively, where imaging system 100 comprises an MRI machine

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which is present in the operating room, the surgical guidance system 102 can also pull images created by other imaging modalities (e.g., CT, PET, SPECT, ultrasound, etc.) from hospital PACS system 101, so that images from multiple modalities are available to the surgical guidance system 102.

If desired, imaging system 100 can pull image data out of the hospital PACS system 101 and wirelessly send that image data to surgical guidance system 102.

With respect to the foregoing, it should be appreciated that the present invention is applicable to substantially any type of imaging system equipped with wireless communication capabilities, e.g., a mobile CT machine, a fixed-position CT machine, an MRI machine, an ultrasound machine, a SPECT machine, a PET machine, an X-ray machine, etc.

In one preferred form of the invention, the imaging system of the present invention comprises the CERETOM® mobile CT machine and/or the BODYTOM® mobile

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CT machine manufactured by NeuroLogica Corporation of Danvers, Massachusetts.

In one preferred form of the invention, the imaging system 100 (e.g., mobile CT machine 5) is connected to the surgical guidance system 102 using a Wireless IEEE 802.11 a/b/g/n transfer protocol, with the connection being configured as either an ad-hoc point-to-point network or as access points through a router. In another preferred form of the invention, the imaging system 100 (e.g., mobile CT machine 5) is connected to the surgical guidance system 102 using Bluetooth, Infrared (IR) or other communication apparatus and/or protocols. The image transfer syntax is compliant with the DICOM 3.1 standard for medical image transfer and/or other industry standards.

#### Non-Medical Applications

In the preceding discussion, the present invention is discussed in the context of medical applications, e.g., scanning anatomy in order to provide a physician with information about that

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anatomy and/or to provide images to a surgical  
guidance system whereby to provide surgical guidance  
to a physician during a surgical procedure. However,  
it is also possible to use the present invention in  
5 non-medical applications, e.g., to scan objects for  
security purposes (such as luggage, handbags,  
backpacks, packages, shipping containers, etc. at an  
airport security station, etc.) and/or to provide  
images to an operational guidance system whereby to  
10 provide operational guidance to a user during an  
operational procedure (such as remote bomb  
deactivation, etc).

#### Modifications

15 It will be appreciated that still further  
embodiments of the present invention will be apparent  
to those skilled in the art in view of the present  
disclosure. It is to be understood that the present  
invention is by no means limited to the particular  
20 constructions herein disclosed and/or shown in the  
drawings, but also comprises any modifications or

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equivalents within the scope of the invention.

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What Is Claimed Is:

1. A wireless imaging system comprising:  
a scanner for creating an image of an interior  
5 portion of an object;

a guidance system for using an image of an  
interior portion of an object to provide guidance to  
an individual with respect to the object;

the scanner comprising an on-board wireless  
10 communication unit, and the guidance system comprising  
an on-board communication unit, the on-board wireless  
communication unit of the scanner and the on-board  
communication unit of the guidance system being  
configured to wirelessly transfer images created by  
15 the scanner directly to the guidance system.

2. A wireless imaging system according to claim  
1 wherein the object comprises organic tissue.

20 3. A wireless imaging system according to claim  
1 wherein the object comprises at least one from the

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group consisting of piece of luggage, a handbag, a backpack, a package, and a shipping container.

4. A wireless imaging system according to claim  
5 1 wherein the scanner comprises at least one from the group consisting of a CT machine, an MRI machine, a PET machine, a SPECT machine, and an ultrasound machine.

10 5. A wireless imaging system according to claim 1 wherein the scanner is mobile.

6. A wireless imaging system according to claim  
5 5 wherein the scanner moves relative to the object during scanning.

7. A wireless imaging system according to claim  
1 wherein the scanner is a fixed-position scanner.

20 8. A wireless imaging system according to claim 1 wherein the guidance system comprises at least one

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from the group consisting of a surgical navigation system, a surgical robotics system, a surgical planning system, and another system utilizing image data to provide guidance.

5

9. A wireless imaging system according to claim 1 wherein the on-board wireless communication unit of the scanner and the on-board communication unit of the guidance system are configured to transfer images created by the scanner directly to the guidance system using at least one from the group consisting of a Wireless IEEE 802.11 a/b/g/n transfer system, a Bluetooth system, an Infrared (IR) system and another communication system.

15

10. A method for providing images to a guidance system, the method comprising:

providing a wireless imaging system comprising:

a scanner for creating an image of an

20

interior portion of an object;

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a guidance system for using an image of an interior portion of an object to provide guidance to an individual with respect to the object;

5 the scanner comprising an on-board wireless communication unit, and the guidance system comprising an on-board communication unit, the on-board wireless communication unit of the scanner and the on-board communication unit of the guidance system being configured to wirelessly transfer images created by  
10 the scanner directly to the guidance system;

creating an image of an interior portion of an object using the scanner; and

wirelessly transferring the image created by the scanner to the guidance system.

15

11. A method according to claim 10 wherein the object comprises organic tissue.

12. A method according to claim 10 wherein the  
20 object comprises at least one from the group

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consisting of piece of luggage, a handbag, a backpack,  
a package, and a shipping container.

13. A method according to claim 10 wherein the  
5 scanner comprises at least one from the group  
consisting of a CT machine, an MRI machine, a PET  
machine, a SPECT machine, and an ultrasound machine.

14. A method according to claim 13 wherein the  
10 scanner is mobile.

15. A method according to claim 14 wherein the  
scanner moves relative to the object during scanning.

16. A method according to claim 14 wherein the  
15 scanner is a fixed-position scanner.

17. A method according to claim 10 wherein the  
guidance system comprises at least one from the group  
20 consisting of a surgical navigation system, a surgical  
robotics system, a surgical planning system, and

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another system utilizing image data to provide guidance.

18. A method according to claim 9 wherein the  
5 on-board wireless communication unit of the scanner  
and the on-board communication unit of the guidance  
system are configured to transfer images created by  
the scanner directly to the guidance system using at  
least one from the group consisting of a Wireless IEEE  
10 802.11 a/b/g/n transfer system, a Bluetooth system, an  
Infrared (IR) system and another communication system.

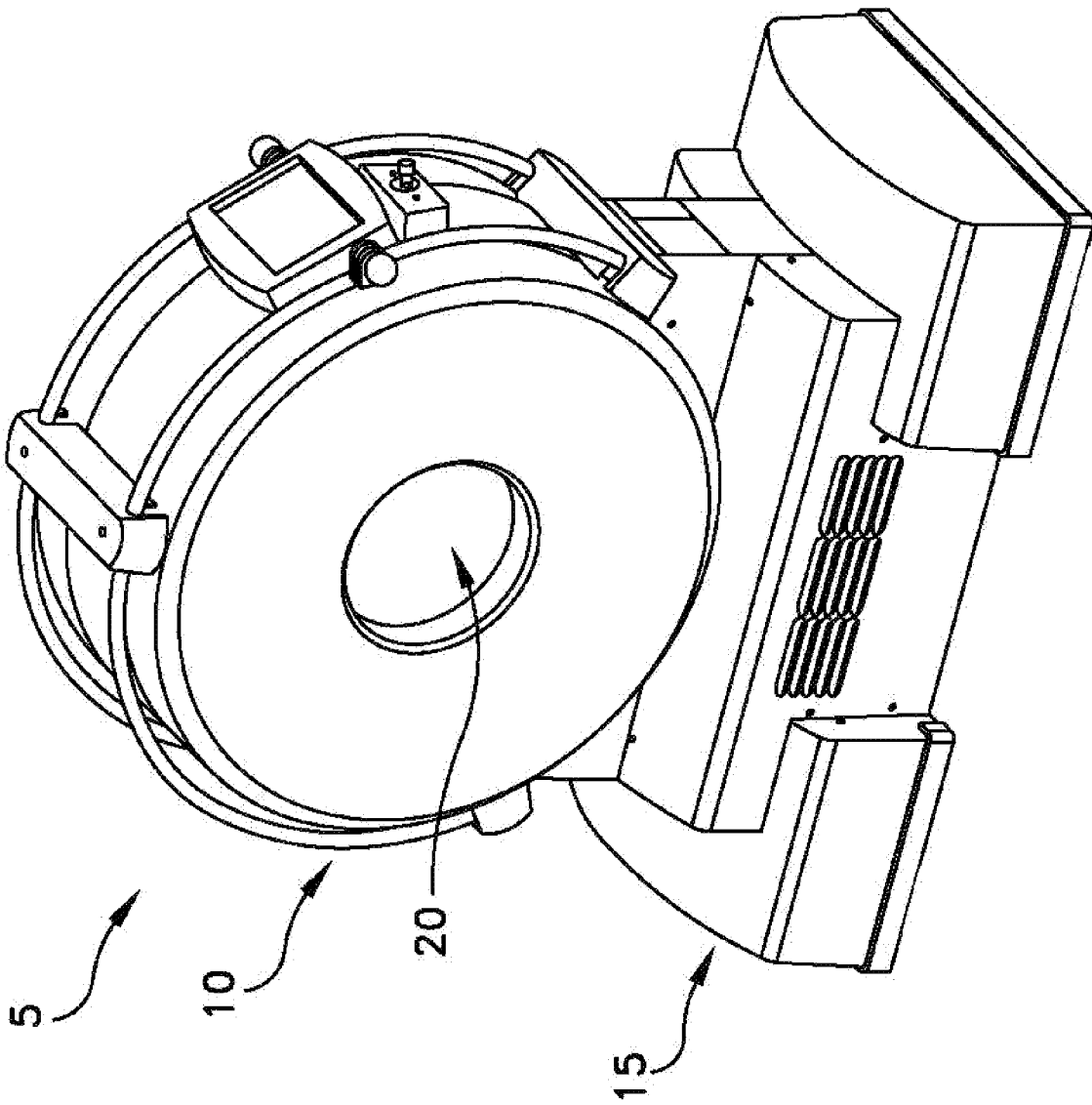


FIG. 1

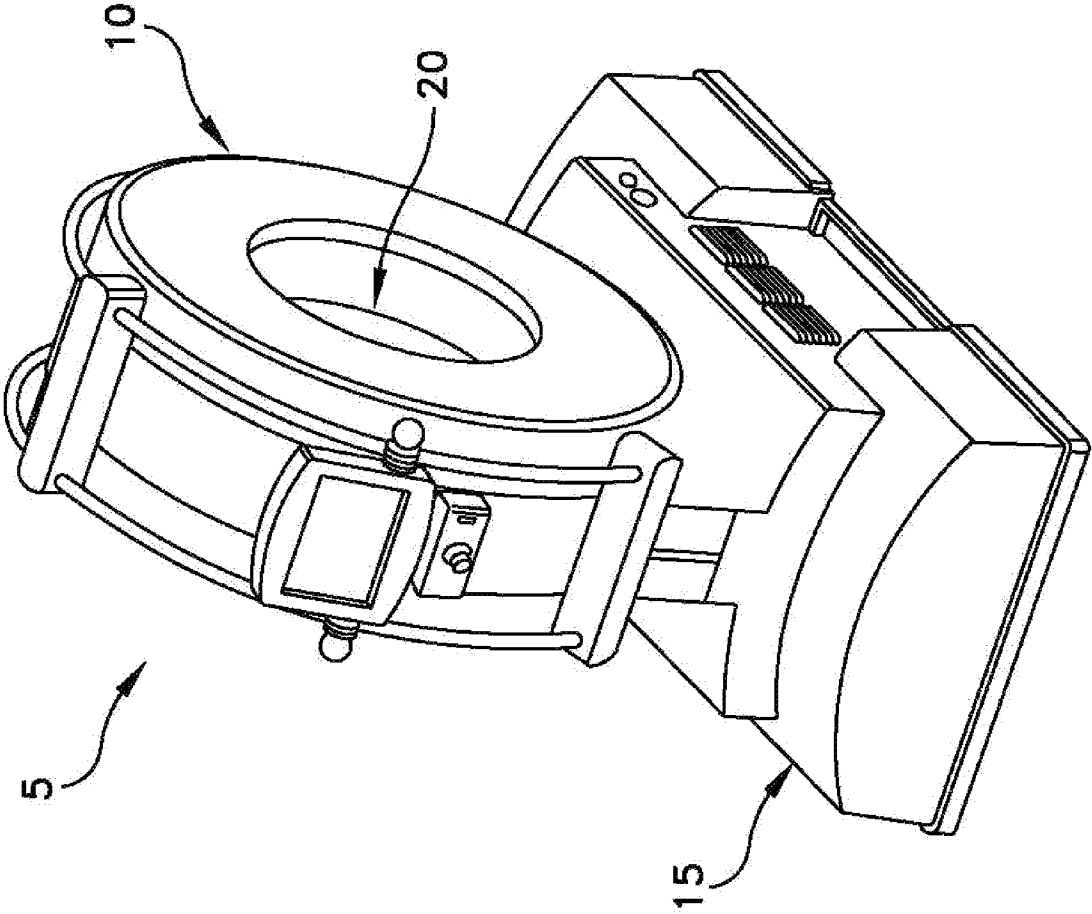


FIG. 2

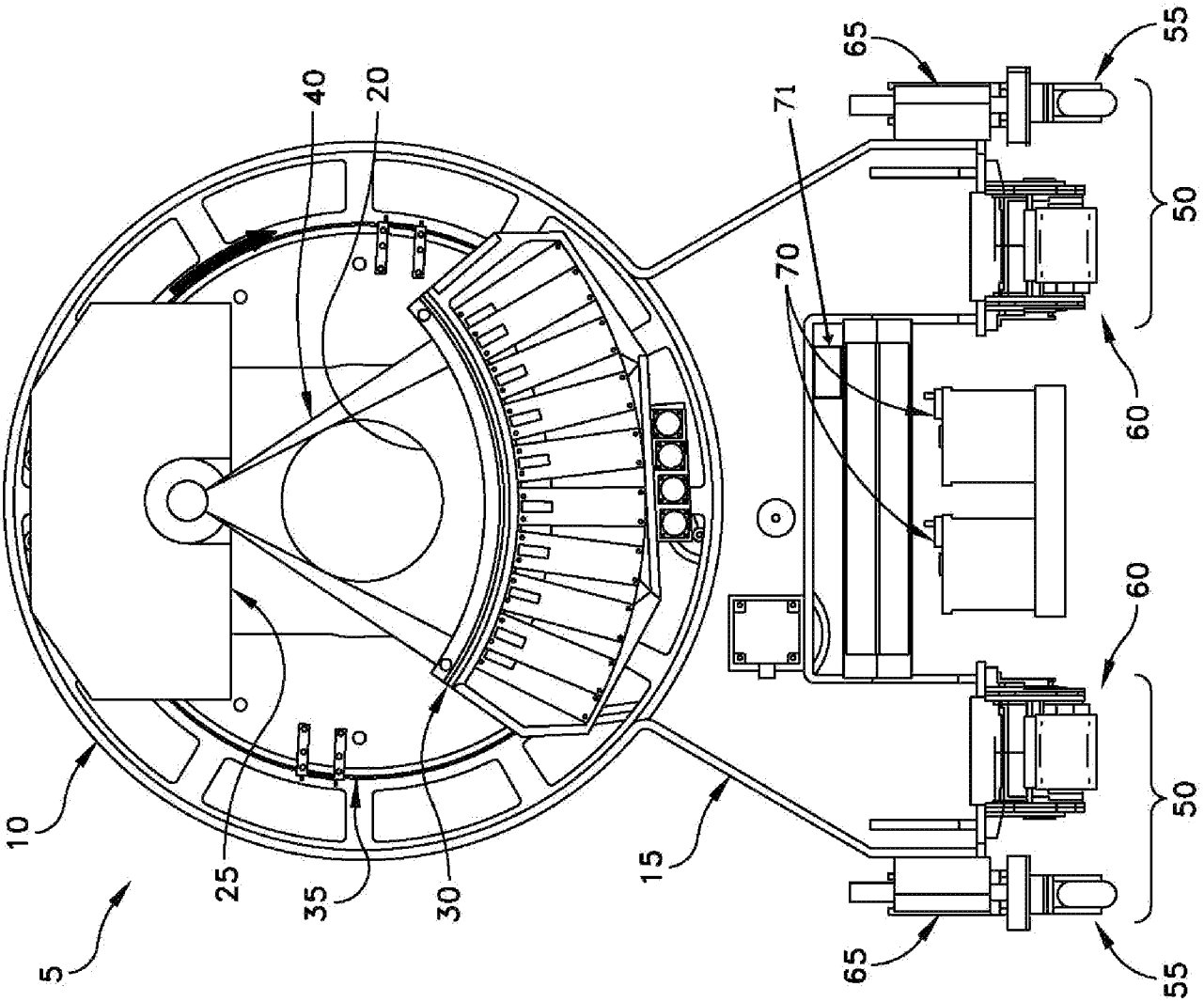


FIG. 3

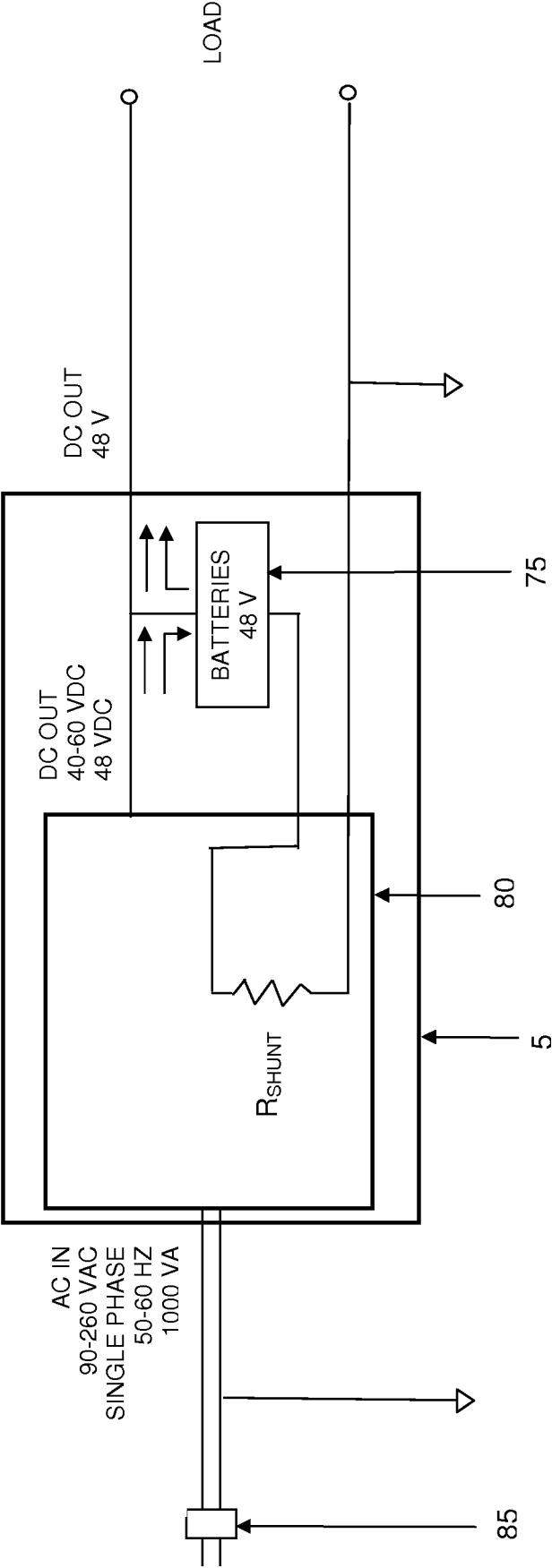


FIG. 4

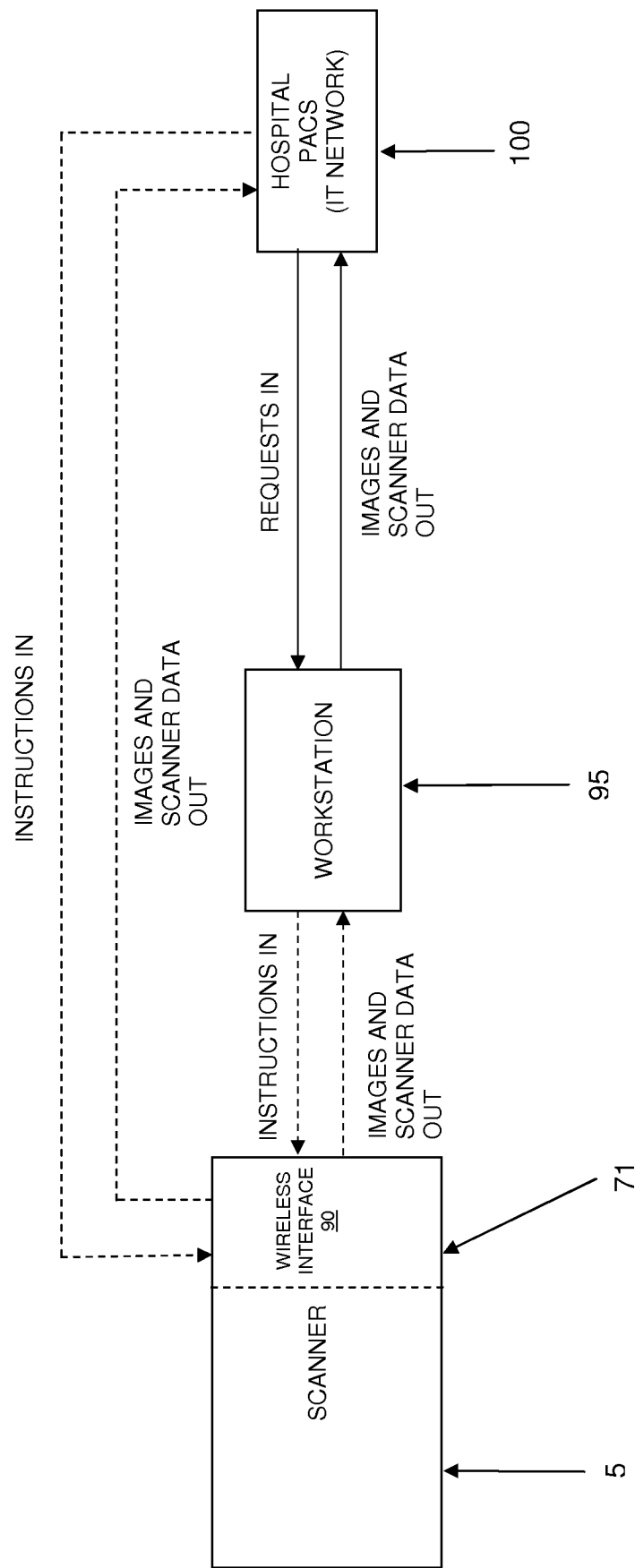
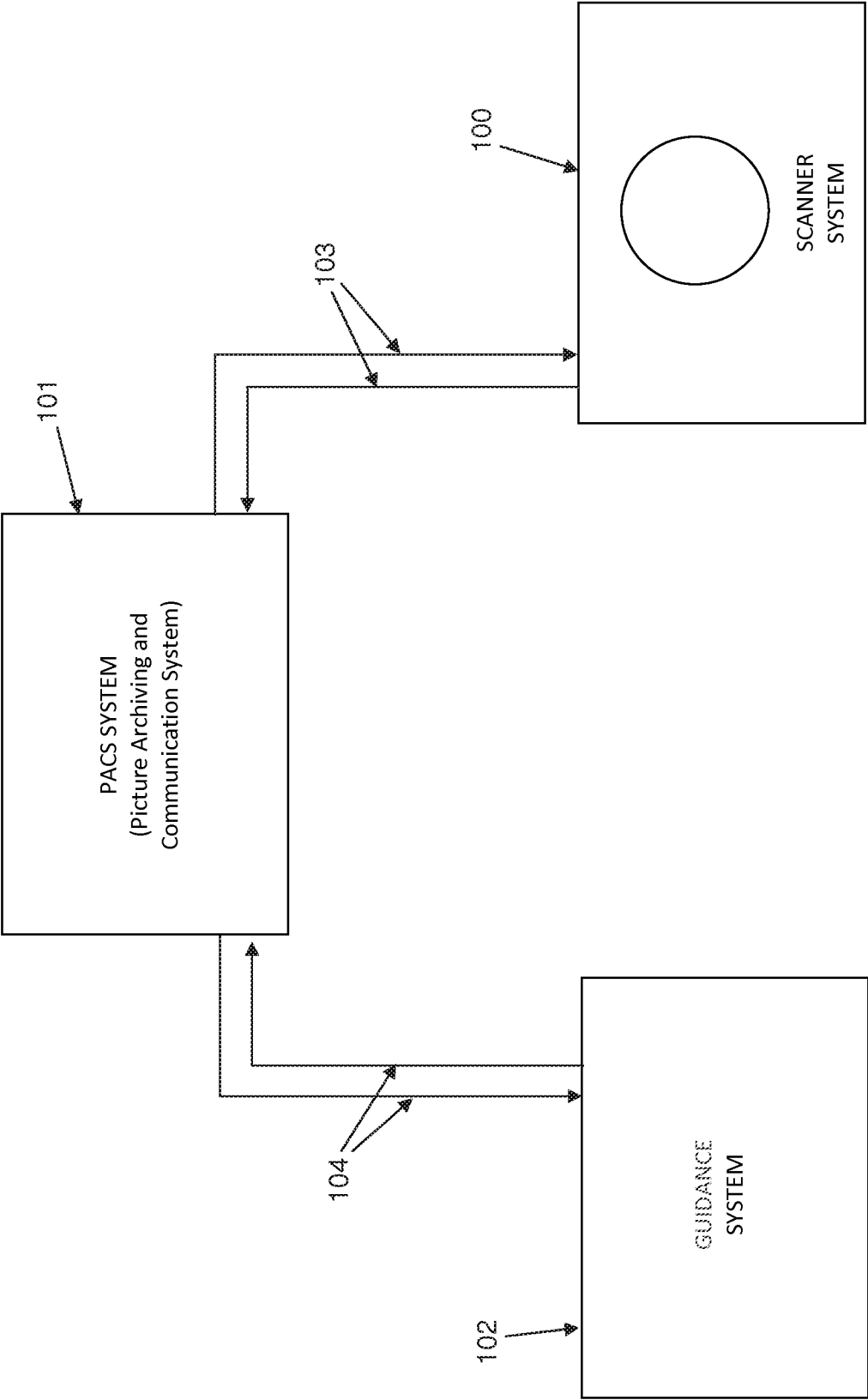


FIG. 5



(PRIOR ART)

FIG. 6

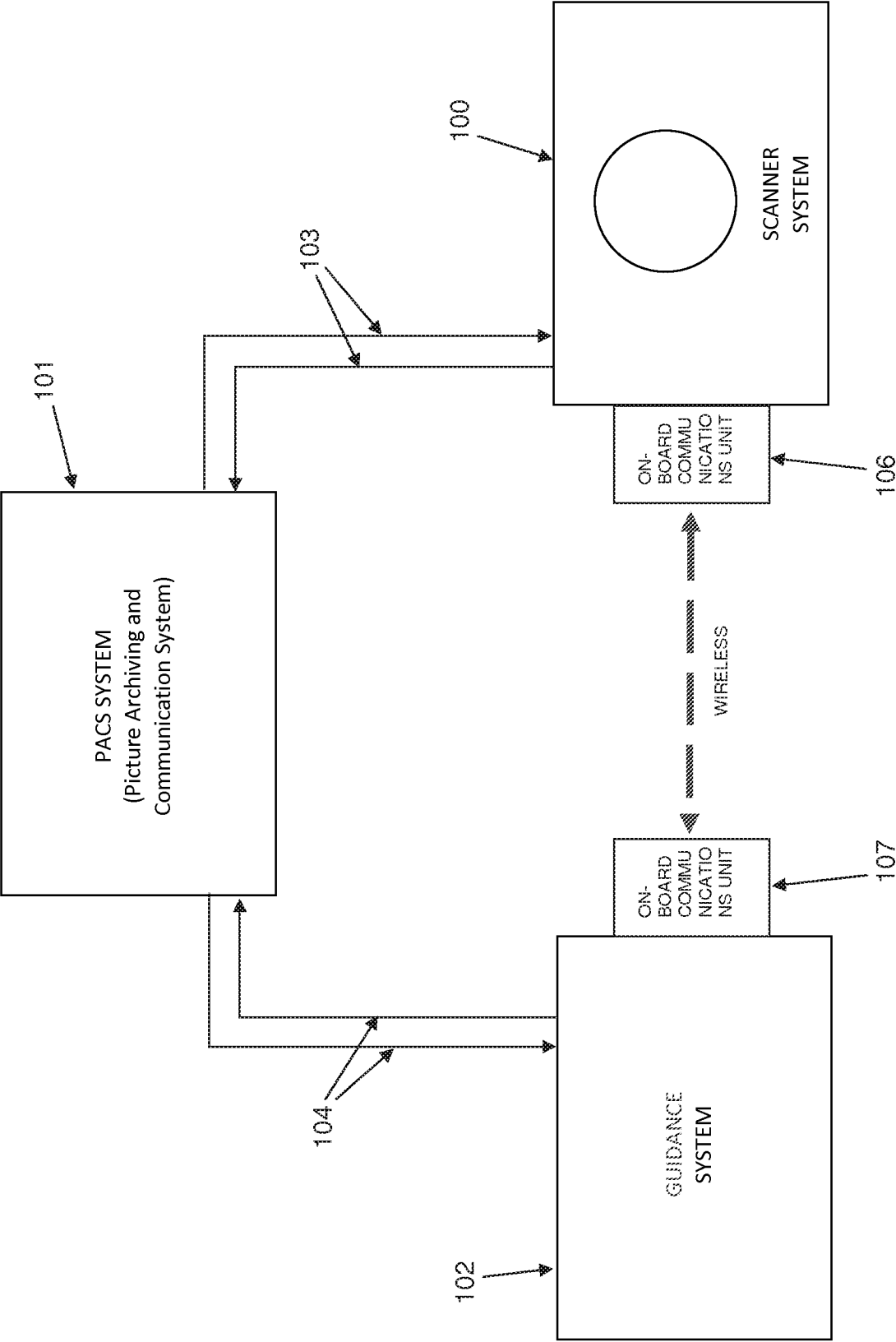


FIG. 7

## INTERNATIONAL SEARCH REPORT

PCT/US2013/036777 16 AUG 2013

International application No.

PCT/US2013/036777

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61B 6/03 (2013.01)

USPC - 250/363.03

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - A61B 1/00, 6/03, 19/00; G01N 23/00; G01T 1/166 (2013.01)

USPC - 250/363.03, 363.04, 370.08; 378/4, 12, 15; 606/130

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

CPC - A61B 1/00016, 5/055, 6/032, 6/037 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Google Patents, Google Scholar, Patbase, East

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No.     |
|-----------|------------------------------------------------------------------------------------|---------------------------|
| X         | US 2009/0192519 A1 (OMORI) 30 July 2009 (30.07.2009) entire document               | 1, 2, 4, 8-11, 13, 17, 18 |
| Y         |                                                                                    | 3, 5-7, 12, 14-16         |
| Y         | US 2009/0034790 A1 (SONG et al) 05 February 2009 (05.02.2009) entire document      | 3, 12                     |
| Y         | US 2007/0183588 A1 (BAILEY et al) 09 August 2007 (09.08.2007) entire document      | 5, 6, 14-16               |
| Y         | US 2012/0078236 A1 (SCHOEPP) 29 March 2012 (29.03.2012) entire document            | 7, 16                     |

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

09 August 2013

Date of mailing of the international search report

16 AUG 2013

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Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

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