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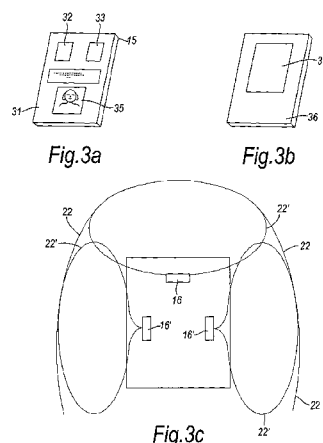
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(54) Title: SYSTEM, APPARATUS AND METHOD FOR MANAGEMENT OF HAND HYGIENE



(57) Abstract: The present invention relates to a system, apparatus and method for recording, monitoring and reporting hygiene activity. In particular, but not necessarily restricted thereto, the present invention relates to preventing the spread of infection, especially in hospitals and like institutions. Equally the invention finds utility in food preparation areas. Infections that are acquired in hospital are responsible in the United Kingdom for several thousands of deaths annually. The situation is similar in other countries; it is not unusual for ten percent or more of patients in hospital acquiring a new infection during their stay. Such nosocomial infections increase the burden on healthcare systems. It is believed that fifty per cent of nosocomial infection arise, at least in part due to poor hand hygiene issues. It is accepted that simple hand-washing routines can inhibit significantly the transfer of pathogens present on the skin of doctors and nurses. The present invention seeks to provide an effective solution and provides a wireless monitoring system.

SYSTEM, APPARATUS AND METHOD FOR MANAGEMENT OF HAND HYGIENEField of the Invention

5 The present invention relates to a system, apparatus and method for management of hand hygiene activity. In particular, but not necessarily restricted thereto, the present invention relates to prevention of the spread of infection, especially in hospitals and like institutions, arising from point of care contact.

Background to the Invention

10 Infections that are acquired in hospital are known, not surprisingly, as hospital acquired infections, or HAIs, and are responsible in the United Kingdom for several thousands of deaths annually. The situation is similar in other countries; it is not unusual for ten percent or more of patients in hospital acquiring a new infection during their stay.

15 Such nosocomial infections increase the burden on healthcare systems. It is believed that fifty per cent of nosocomial infection arise, at least in part due to poor hand hygiene issues. It is accepted that simple hand-washing routines can inhibit significantly the transfer of pathogens present on the skin of doctors and nurses.

20 Methicillin-resistant *Staphylococcus aureus* (MRSA) is a strain of the *Staphylococcus aureus* bacterium that has developed resistance to antibiotics. It has a high morbidity, and is a problem in hospitals, where it can spread rapidly. Hospital wards address MRSA by the provision of alcohol-based hand rub dispensing units which are placed in wards, typically
25 in foyers and thoroughfares within wards - alcohol has been shown to be effective against the bacterium.

Another problem infection is *clostridium difficile* or C-diff, which is resistant to many antibiotics and which can become a problem during treatment using antibiotics for other ailments, since the bacteria that ordinarily keep
30 c-diff under control are not present. It is spread by the fecal-oral route and infection is controlled by routine hygiene, including, importantly, hand washing.

Whilst hand hygiene (HH) – comprising the rubbing of hands with an alcohol-based solution at precise moments during patient care is seen as an important factor in preventing healthcare associated infections. Despite Even after years of HH advocacy, however, HH compliance remains
5 substandard throughout the majority of healthcare scenarios. Untrained healthcare workers (HCW) perform HH for 10% of the instances before coming into contact with a patient. Even after education and promotion, the mean compliance will rarely exceed 40%.

Even if HCWs have a clear understanding of the risks at stake and are
10 willing to engage, this goodwill fails to provide. Whilst it is known that alcohol-based hand rubs are not effective in all situations, the dispensed product and/or cleaning procedure can be changed in the event that a different disease is prevalent in a particular location. Additionally, there is considerable evidence, however, that the provision of cleaning stations for
15 alcohol rubs or similar products is not fully effective.

Simply put, nurses, other hospital staff and visitors are neglecting to take the simple measure of frequent hand washing.

In GB 2446871 M. Braddock provides a method for assisting the use of a hygiene procedure, e.g. hand-washing, the method including the restriction
20 of movement of personnel by detecting a condition indicating that a hygiene procedure has not been carried out, or by not detecting a condition indicating that a hygiene procedure has been carried out, and actuating a movement restricting condition accordingly. The movement restriction may comprise the locking, or failing to unlock, of an exit. Detection of use of
25 hygiene equipment may be sent to an ID card, preferably containing RFID technology, held by the user which may then be used to grant the user unrestricted movement, i.e. to unlock the exit. To promote further hygiene, the ID card may contain an antibacterial agent. The locking mechanism may also comprise an artificial 'nose', wherein the door is unlocked if a tracer
30 agent added to the handwash is detected on a users hands. This system suffers from complexity and only provides checking in relation to specific lockable areas. Difficulties will arise in emergency access.

WO 2008119158 to GC Hufton et al teaches a system and method of encouraging compliance of hand hygiene in an environment where users move from zone to zone and are required to perform hand hygiene between the zones. Users carry a wearable zone sensor which detects zones, detects
5 hand hygiene actions, logs time of changing zones, and hand hygiene actions. The wearable sensor can be integral with a wearable hand hygiene product dispenser and/ or can operate in cooperation with a fixed dispenser configured to transmit hand hygiene actions to the wearable zone sensor. The wearable zone sensors are configured to be useable anonymously or to
10 be associated with a user identifier, and to interface with a central computer via a docking station or communication interface to transfer data for later analysis. This system is of enormous complexity and still does not address many basic issues; the system is zoned to a ward extent and is not patient specific.

15 WO2009097096 (Deutsch, R) provides a macro system for monitoring personnel within a private hospital room and the like. The system provides cameras, motion detectors – which are shielded to ignore patient movement - within a wireless mesh network over a building together with proximity sensors such as pressure sensors, charge transfer sensors, piezoresistive
20 sensing floor strips, and PIR Digital motion detectors. In a preferred embodiment, the system employs a charge transfer sensor that is worn or affixed to the patient or the patient's bed cover and/or mattress. In summary, a very complex system is provided which will be open to abuse or cause unnecessary delay in seeking to attend to several non-intuitive
25 procedures, including the wearing of special tags for patients, which will be found to be intrusive near contact with a patient or an electrically conductive article worn by, covering or otherwise contacting the patient by a HCW or other person in order for a signal to be generated. A preferred system includes an indicator device is operatively associated with a
30 capacitive proximity sensor in such a system. Health care workers are provided with wrist strap devices which can vibrate, provide electrical shocks which are liable to improper fitment. This system suffers from complexity and difficulties will arise in ordinary use.

Hygiene activity is currently monitored substantially by means of visual observation and optionally recording and manual logging of events. Electronic systems such as the system to Deutsch, above, have not been widely accepted nor adopted. Accordingly, there is a need for a simple yet effective system for controlling the cleanliness of health care workers and visitors who congregate around patients at point of care, whereby to control a primary infection/re-infection route controlled by routine hygiene, and simple to implement and operate procedures.

Object to the Invention

The present invention seeks to provide an improved hygiene assurance system. The present invention seeks to provide an improved hygiene system which overcomes at least some of the problems that have become apparent with regard to known systems.

The present invention further seeks to provide an improved hygiene recording system. The present invention also seeks to provide a method for assuring and confirming hand hygiene and also improved devices and equipment for assuring and confirming hand hygiene.

Summary of the Invention

In accordance with a first aspect of the invention, there is provided a point of care hygiene assurance system, including a virtual curtain area associated with a subject, wireless communication device operable to define the virtual curtain area, wireless communication identity tags which communicate with the wireless communication device and a hand hygiene wash arrangement;

wherein the wireless communication device can communicate with the wireless identity tag whereby:

the wireless identity tag operates in a first mode of operation to indicate a first state of cleanliness and in a second mode of operation to indicate a second state of cleanliness;

wherein a visit to a hand hygiene wash station and completing an action enables the identity tag to indicate a second state of cleanliness being a

good state of cleanliness, the tag indicating at least aurally or visibly that the personnel is in at least one state of cleanliness.

The peripheral edge of the zone or the virtual curtain is defined by the minimum signal emitted by the wireless communication device that can be
5 detected by the identity tags worn by HCWs. The system, in a basic arrangement, assumes or considers that a second, clean state of hygiene is achieved upon the identity tag remaining within a particular area associated with the hand hygiene wash for a pre-determined time. A clock or a
10 repeating display may be used as guidance by an HCW to determine an appropriate amount of time. Conveniently, however, a sensor operable upon depression of a gel plunger may indicate that a hand hygiene procedure has been completed. Alternatively a positive action from the personnel could indicate a hand wash completion, for example the continued depression of a
foot lever, which could also cause the hand wash facility to function.

15 In a hospital scenario, for example, a wireless controller could be present either above or underneath a patient bed, with a radio frequency effective zone mapped out by one or more antennas to define a zone to the side and front of the bed, with a hand hygiene station placed at the foot of the bed, conveniently being part of a frame of the bed. The effective zone is defined
20 by the wireless emitter; the extent of the zone being defined as the minimum power which can be received by a wireless tag worn by personnel. In a simple embodiment, presence of a person wearing a wireless tag for a pre-defined period of time before the hand hygiene station would be interpreted by the controller that a hand hygiene procedure has been
25 completed. The tag would then receive a transmission from the wireless controller whereby to enable a second state of cleanliness to be indicated; the personnel may proceed to administer a check-up/medical procedure etc., with direct hand contact with the patient, if necessary.

Similarly, in a food processing factory, a production line worker may be
30 monitored in a similar fashion; before entry to a working zone, then a hand hygiene procedure must be followed. This hand hygiene procedure may

need to be repeated after a period of time; the procedure may need to be performed upon exit from a production area.

By the use of multiple antennas specific radio frequency working zones may be defined. Similarly, infra-red working zones may be defined.

- 5 In one mode of operation, the tag may indicate a state of cleanliness by operating in a particular colour. For example a green LED light may operate, which could readily be identified by patients and other personnel that the person wearing the tag was indeed clean. An audible indication may be provided as an additional indicator. Conveniently, the audible
- 10 indicator would advise the wearer that, for example they has another minute to continue operating before they left the work area or patient zone. The noise may be intermittent with an increasing loudness and/or duration as the period approaches a re-set expiry time. Equally this indicator would remind the personnel to cleanse their hands as they left a work area or
- 15 patient zone.

In accordance with a further aspect of the invention, there is provided a method of operating a hygiene monitor system, including a virtual curtain area associated with a subject, a wireless communication device having an effective range to define the virtual curtain area, wireless communication

20 identity tags which communicate with the wireless communication device and a hand hygiene wash arrangement, the wireless communication device being operable to communicate with identity tags as worn by personnel about the subject;

wherein the wireless communication device can communicate with the

25 wireless identity tag; the method including the steps of;

in a first mode of operation the wireless identity tag is operable to indicate a first state of cleanliness; and,

in a second mode of operation the wireless identity tag is operable to indicate a second state of cleanliness;

- 30 in a third mode of operation, following a visit to a hand hygiene wash station for a predetermined period of time, the identity tag indicates a

second state of cleanliness being a good state of cleanliness, the tag indicating at least aurally or visibly that the personnel is in at least one state of cleanliness.

5 A system, according to the present invention, enables hygiene compliance in a specific zone within a facility to be evaluated and can cover the whole of a facility. In contrast to general hygiene maintenance within a ward or similar, the present invention provides a system for encouraging the regular cleansing of hands, upon entry and exit to a patient zone defined by a virtual curtain.

10 Brief Description of the Drawings

Embodiments of the invention will now be described, by way of example only, with reference to the drawings, in which:

Figures 1 & 2 are elevation and plan views of a patient zone and virtual curtain in accordance with the present invention;

15 Figure 2a shows how a virtual curtain can be created from overlapping transceivers;

Figures 3a & 3b show a front and rear views of a tag made in accordance with the invention; and

20 Figures 4 - 4c show various scenarios how the present invention may be implemented.

Detailed Description of the Preferred Embodiments

There will now be described, by way of example only, the best mode contemplated by the inventor for carrying out the present invention. In the following description, numerous specific details are set out in order to
25 provide a complete understanding to the present invention. It will be apparent to those skilled in the art, that the present invention may be put into practice with variations of the specific.

Figure 1 depicts a first example of the invention with regard to a patient care facility, for example, in a hospital. A perspective view is shown of a
30 patient 11 lying on a bed 12. At the foot of the bed, there is a hand hygiene facility 13, where an alcohol gel dispenser is situated – although a soap wash facility may also be provided, in the event that the patient

conditions and treatment prevalent at a time dictate such. Situated above the bed there is a wireless patient transceiver operable to define a patient zone, as will be understood from the passage below. A healthcare worker (HCW) 14 is equipped with a wireless tag 15, which is recognised by the wireless patient transceiver 16. The term healthcare worker is to be understood as to be any personnel associated with any degree of patient contact, i.e. Doctors, nurses, porters, cleaners etc. Equally, in other non-healthcare environments, all personnel in a workplace are to be treated as equally susceptible of transferring possible sources of infection.

The transceiver 16 can operate at a low power radio frequency system, conveniently at 433MHz, which is a frequency known not to interfere with other hospital equipment, or in the infra-red spectrum whereby to define a minimum power level about a patient bed to define a virtual curtain, that is a zone is defined around the bed, so that movement of wireless tags can be tracked and communications between the tag and the transceiver can be established. Transceiver 16 can communicate data concerning movement of personnel to a central control unit (not shown) whereby monitoring of a healthcare facility can be enabled. As will be discussed later the same principles apply in the management of a processing unit in a food manufacturing facility, cosmetics facility, research labs and the like.

With reference to Figure 2, a plan view of the patient zone 21 is shown: wireless patient transceiver controller 16 provides a low power wireless signal which can be received by the wireless tags. Communications can be established between the wireless tag, for example upon entering a zone, through the virtual curtain 22, defined herein as the effective limit of patient transceiver – tag communications. It will be appreciated that the zone will be adjusted for position of the patient transceiver relative to the bed, both in terms of plan view and in terms of height. Each member of staff can wear a badge 15 with a unique badge ID for reporting purposes, and up to 6000 Badge IDs could be available, for example. Badges can sense the virtual curtains 22 which define each patient zone 21, and can also sense when the wearer uses a hand hygiene facility 13 ("HHD").

The patient transceiver 16 may comprise a permanent fixture or may be removably attached to a wall 19 to which the bed abuts. For example, a magnetic strip associated with transceiver may allow attachment to a ferromagnetic metal strip (not shown) permanently attached to the wall.

5 Alternatively, the patient transceiver may be mounted upon the frame of the bed, either at the head end or be associated with the hand hygiene unit 13. As will be known, a low power rf zone can be defined by the use of power control and position & relative interaction of antenna radiating elements. Similar infra-red systems are known.

10 In a hospital scenario, for example, a wireless controller 16 could be present either above or underneath a patient bed, with a radio frequency effective zone mapped out by an antenna to define, for example a zone 1.5m to the side of the bed and in front of the bed, with a hand hygiene station placed at the foot of the bed, conveniently being part of a frame of
15 the bed.

The hand hygiene facility 13 comprises a wireless module conveniently matched to standard hand hygiene alcohol dispensers and can sense when alcohol is being dispensed. In use, a hand hygiene facility 13 will communicate with an adjacent badge 15 - a badge 15 being worn by
20 someone using the dispenser and will be configured to communicate with the closest transceiver / controller 16. Conveniently, each hand hygiene facility 13 will be powered from replaceable dry cells giving typically 1000 hours operation, although alternative low voltage power supplies may be used as an alternative. It is preferable that the level of the alcohol can be
25 determined and any low-level status be communicated to the system via transceiver / controller 16. For example, an alcohol empty status or a low battery level status can be communicated to the system via transceiver / controller 16. Depending upon system set-up, the system can have a report arrangement and can be configured to generate an exception report.
30 Infrequent issues, such as battery approaching end-of-life could also be communicated to the system via transceiver / controller 16, and can be configured to generate an exception report.

The system can be configured with a hand hygiene regime which defines a Zone Arrival Delay ("ZAD" - i.e. a maximum allowable time between entering a new Zone before use of a hand hygiene dispenser module 13 and also a Zone Departure Delay ("ZDD" - i.e. a maximum allowable time
5 between using the hand hygiene dispenser module 13 and departure from the zone or a requirement to re-use the hand hygiene dispenser module 13 again.

With reference to Figure 2a, Virtual Curtain Zones 22' are defined around each bed by projecting invisible wireless or infrared (IR) Virtual Curtains.
10 Each bed Virtual Curtain Zone 22' is defined by one controller or Zone Curtain Master 16 module and up to three linked Zone Curtain Slave 16' modules. The positioning and configuration of these modules allows the size and shape of each Virtual Curtain Zone to be customized to suit the layout of the ward. In this reference, the controller and curtain definition
15 transceivers could be placed, for example, below a bed, the sub zones defined by each of the transceivers, providing an overall virtual curtain zone 22. Each Zone has a unique Zone ID for reporting purposes, and it is likely that up to 2000 Zone IDs can be provided for.

Figures 3a and 3c, show, respectively, front and reverse faces of a badge or
20 tag 15 as to be worn by a HCW. The front face 31 has two zones 32, 33, which can be illuminated to confirm a particular status; international colour codes of green for safe (i.e. recently washed hands) and red for un-safe (i.e. unclean hands). An area for the name of the HCW and an area 35 for a photograph of the HCW are provided upon the face. The second face 36
25 is provided with a clip arrangement 37 which securely attaches the tag 15 to a wearer. Means may be provided for arranging a tag on a chain, but concerns regarding visibility for certain wireless transmissions may limit the use of such forms of attachment to a HCW. In a preferred embodiment, the tag includes an audible indicator, which can emit audible indications
30 corresponding to an unclean state or that the period to update hand hygiene is approaching. The tag may be programmed such that an audible indication is made only upon the HCW being outside a patient zone 21, i.e.

the HCW 14 has passed through the virtual curtain, whereby not to disturb a patient. Simple coloured LEDs may be used.

Participating staff members are each issued with a personal badge or tag 15 which must be worn whenever on duty, each badge 15 being configured with a unique badge identity ID code, with a typical system being designed with six thousand unique badge ID codes whereby each system can operate handle up to six thousand personnel, health care workers, production workers, cleaners and visitors alike.

Each badge will contain a wireless sensor operable with a particular system, whether it is low power radio e.g. Bluetooth or infrared, whereby the sensor can detect the virtual curtain 22. It is believed that the provision of first and second LEDs, such as red and green LEDs and could be arranged to flash either red or green. A rate of flashing can indicate a degree of compliance; a different colour could determine absolute conditions. In the presence of a hand hygiene dispenser a communication can be set up with a badge, whereby to confirm that a hand cleansing operation has been performed, or not, as the case may be. Each badge can communicate with an adjacent wireless controller's hand hygiene facility 13 (i.e. a dispenser being used by the badge wearer). Each Badge can communicate with a controller 16 (i.e. when the badge is within the defined Zone). Conveniently, each badge is rechargeable, to provide, for example 16 hours operation between charges, known re-charging systems would be able to provide a full recharge within four hours.

To enable a greater understanding of the present invention, reference shall now be made to Figures 4a, 4b & 4c:

With specific reference to Figure 4a, HCW 14 carrying a wireless identity card 15 approaches a bed 12 of a patient 11. Above the bed is a wireless controller 16 which emits a wireless zone 21 to define a virtual curtain 22. As the HCW 14 approaches the virtual curtain, the wireless tag indicates to the controller 16 that the HCW 14 is not clean.

With reference to Figure 4b, the HCW 14 then approaches a hand hygiene apparatus 13, situated at the foot of the bed 12, within range of an arc of

the virtual curtain 22, which hand hygiene apparatus 13 comprises a hand cleaning device; this can conveniently be an alcohol gel, although a specific handwash solution may be appropriate for specific patients. By spending a specific period of time before the hand hygiene apparatus can be sufficient for the controller to assume that a hand hygiene operation has been completed; the system will assume that the HCW has clean hands after such a predetermined period of time. A clock may be provided or a recurring visual sequence to enable the HCW to determine that they have cleansed their hands sufficiently. In the alternative a button or switch may be depressed by the HCW to confirm that a cleansing operation has completed. For example a foot button (not shown), could be provided in the alternative whereby to positively confirm that a cleansing operation has been completed. The controller then communicates with the HCW tag 15 which then indicates that the HCW is now clean. A hand hygiene apparatus 13 associated with each alcohol dispenser and can read the badge ID of any HCW using the dispenser. This ID can then be sent to the closest controller along with, for example data relating to the status of the alcohol level and the status of the battery of the hand hygiene apparatus 13.

The tag will revert to a first "unclean" state as soon as the HCW 14 has departed the vicinity of the patient 11 as defined by the virtual curtain 22, as depicted in Figure 4c. In the alternative, after, for example a period of six minutes has elapsed, the hands of the HCW 14 may be deemed to be unclean and the HCW must return to the hand hygiene station to perform the hand hygiene operation again. Conveniently, an audible warning is provided to the wearer indicator (or some other indicator) upon the approaching expiry of the clean hands time duration. The period of time is variable and would be dependent upon the specific nature of a particular HCW's duties

Thus in accordance with the first aspect of the invention, there is provided a point of care hand management system for use in healthcare facilities and the like. The pertinent issues can be summarized as follows:

The health care worker moves into a patient zone wearing a tag which has been issued with their own personal RFID identification number. The tag, in a first state of cleanliness (unclean state) is indicating red.

5 The tag triggers a recognition device in the bed controller (patient transceiver; akin to a wireless base station, but limited to a specific patient) which has been placed above the patient's bed, at the sink or both. The recognition device now allows the HCW to continue inside the patient zone or virtual curtain. The HCW must now use the alcohol gel bottle which is on the bottom of the patient's bed, before the HCW is permitted to touch the
10 patient or before performing an aseptic task.

The movement of the alcohol gel bottle under pressure could, for example, trigger a communication with the HCW's tag which would turn green, signalling that the HCW is in a second state of cleanliness (i.e. is now clean) can now perform their clinical duties. Intermediate warning lights may also
15 be fitted, such as amber, indicating that a clean state is about to expire within a minute, for example.

In order to combat further possible transfer of pathogens / general uncleanliness, the system can be programmed to cause the HCW to again use the alcohol gel. It will be appreciated that the programming of the systems
20 will reinforce the basic training that all HCW will have undertaken.

The present invention thus provides a simple arrangement for maintaining cleanliness in a hospital environment for HCWs. Of course, the system naturally lends itself so that the system can adapt to the various functions that a HCW should undertake.

25 For example, a doctor, will undertake examination, most likely with actual contact of the patient. The present system will reinforce the operational characteristics that will be natural. Equally for nurses who, for example, may take a blood pressure reading or administer certain drugs. In the event of a person who takes orders for mealtimes, it will not be necessary
30 to undertake a hand cleaning operation for each taking of orders. However, in the event that the HCW may, for example, assist the patient in achieving a comfortable sitting position, then the facilities of the hand hygiene device

and the visual red indicator can ensure that the HCW then uses the hand hygiene device. The sensitivity of the tag may be adjusted such that audible alarms are provided to the HCW when they are within a patient zone in close proximity to the patient.

- 5 Another issue that the system can address is where there is a body fluid exposure risk. The HCW will have the badge programmed for such duties, as if they were in direct hand-to-hand contact with the patient. A similar degree of awareness must be associated with a HCW who will be handling articles with the patient's surroundings; even though objects might not
10 actually be handled by a patient, many objects are at risk of droplet contamination and all HCWs must be treated as if they were directly in contact with a patient.

The wireless patient station will therefore be able to accumulate data regarding movements of personnel about a facility, as part of an overall
15 facility system control. Each wireless controller can be arranged to communicate via GSM/GPRS with a web server which generates a website to allow authorized users to monitor the current compliance status and view reports. Exception reports can be configured to trigger SMS alerts if required. (Note that, if necessary, controllers 16 can be configured to
20 communicate with a local computer via ISM, and the local computer or data logger would communicate to the remote web server via GSM/GPRS.) All of the above activity is recorded by the patient transceiver which data can then be downloaded onto a database. All of the information downloaded is then calculated onto a format required and set up by a local infection
25 management team or other such body. The infection management team would then be able to use such data to monitor, measure and control all hand hygiene activity, and react immediately to any potential outbreak of healthcare associated infections such as MRSA / C-Diff. For example certain areas can be treated as off-limits to all but certain staff; chemical
30 preparations may be required; for example a change in the hand hygiene wash / gel composition or wash procedure.

The wireless controller can be programmed to transfer data using ordinary GSM or other mobile radio communication signals every half hour, or other suitable period, which are not known to cause interference problems with hospital equipment. This data can then be used in the determination of any unusual transfer of disease between patients in a hospital, for example. The data could also be used to monitor how certain HCWs are behaving, in the absence of direct supervisor control.

Importantly, in health care institutions the present invention can also provide a method of monitoring personnel movement. Perimeter doors - those through which members of staff enter or leave a controlled hygiene area of a building can conveniently be provided with a hand hygiene apparatus 13 mounted on the inside of a the doorway for such a doorway, and the hygiene regime would specify that this dispenser must always be used when entering the controlled hygiene area.

Interior and exterior zones could comprise special types of zone which can be set up to monitor each perimeter doorway. On the inside of each doorway a controller 16 can be used to create an interior zone, which cannot be avoided when entering through the door and which contains a hand hygiene apparatus 13. On the outside of the doorway a linked controller 16 would be used to create an exterior zone which cannot be avoided when leaving through the door. When a badge detects that it is in an exterior zone it would immediately flash red, but no exception report will be generated. When the badge returns to an interior zone and detects the hand hygiene apparatus 13 is being used it will flash green, but if the badge leaves the interior zone without the hand hygiene apparatus 13 being used it will continue to flash Red and an exception report will be generated.

Access doors to toilets and refreshment areas are examples of perimeter doors which would be monitored in this way, each would have an associated hand hygiene apparatus 13 which must always be used when re-entering the controlled hygiene area otherwise a report will be generated. It will be appreciated that within a facility there will be a system administrator who would be able to gain access to the system via an administrator password to

configure system information (such as Staff name corresponding to each badge ID and Bed location corresponding to each zone ID). The system administrator would be allocated a secure password to allow access to configure a system, possibly in conjunction with a website and web access control. The system administrator would configure the system before first use, and would update the system configuration from time to time as required. Configuration would include entering the name of a staff member for each badge ID, and a bed/ward location reference for each zone controller 16. These names and references would then be used in compliance & non-compliance reports generated by the system. System configuration could also include triggering SMS messages from exception reports.

In order for the present invention to operate properly, it must be assured that all personnel wear tags, which tags are maintained properly and are tested regularly. For example, the HCW upon placing the tag at the start of a shift, would be able to confirm, for example by use of a read-out upon a display, such as an LCD display associated with a station akin to a "clocking-on" station, where personnel could pick up their tags at a central pace, whereby movement can be controlled. Additionally, or in the alternative, the tag could display a specific sequence of flashes upon picking up after a period of inactivity, as determined, for example, by not passing through any virtual curtain or through the use of a movement sensor. Indeed, checks could be made throughout a facility by conducting a check with any adjacent patient controller unit; a test function mode can be selected and a display can determine the functionality or otherwise of a particular tag.

Whilst it is appreciated in all healthcare facilities that visitors, although likely to assist in the recovery of patients from a psychological point of view, will assist in the introduction and transfer of pathogens etc.. Accordingly, the present invention also provides a system whereby visitors to a hospital etc. can have temporary identity tags provided, which can display their name, have a digital photograph taken whereby their movements may be monitored. Accordingly, in accordance with a further aspect of the

invention, there is provided a reception station which includes a camera operable to take photographs of the visitor which may then be attached to a tag for use by visitors, with the tag making it clear to other personnel that the visitor may well need assistance in approaching patient areas and that
5 care would need to be taken with respect to touching objects etc..

Turning now to other applications, a food processing line may be subject to particular contact controls. Whilst permissible levels of bacteria count in food processing manufacturers exist, all processing must be maintained below such levels. In order to maintain high levels of satisfactory
10 cleanliness, the present invention can assist in meeting such standards. Particularly, the present invention can provide tags for use by cleaners, manufacture process workers and supervisory staff. Whilst all staff will know that they should achieve and maintain levels of hygiene, it will be appreciated that certain food manufacturing process agents will provide
15 nutrients for bacteria, insects and vermin in general. By the provision of tags which can provide visual and audible reminders of the need to maintain cleanliness before entering a food preparation zone and, importantly to wash off debris, in particular food debris after contact therewith standards of hygiene can be drastically be improved. Importantly, the tags will provide
20 an auto-stimulus; personnel using such tags will want to maintain a level of hygiene prior to, for example, emitting an annoying alarm. By the provision of tags colour-based indications of cleanliness can be readily identified by other personnel, patients and customers.

Importantly, in health care institutions, food manufacturing facilities and the
25 like, the present invention provides a method of monitoring personnel movement. All of the above activity can be recorded into the centrally. All of the information downloaded is then calculated onto a format required and set up by the Infection Control team in conjunction with a hygiene solution company.

30 This information allows the Infection Control team to monitor, measure and control all hand hygiene activity, and react immediately to any potential outbreak of healthcare associated infections.

In order for the present invention to operate properly, then it must be assured that all personnel wear tags, which tags are maintained properly and are tested regularly.

Claims

1.) A hygiene management system, including a virtual curtain area associated with a subject, a wireless communication device operable to
5 define the virtual curtain area, wireless communication identity tags worn by personnel which communicate with the wireless communication device and a hand hygiene wash arrangement;

wherein the wireless communication device can communicate with the wireless identity tag whereby:

10 the wireless identity tag is operable in a first mode of operation to indicate a first state of cleanliness and in a second mode of operation to indicate a second state of cleanliness;

wherein a visit to a hand hygiene wash station enables the identity tag to indicate a second, good state of cleanliness, the tag indicating at least
15 aurally or visibly that the personnel is in at least one state of cleanliness.

2.) A system in accordance with claim 1, wherein the wireless controller deems that a second, clean state of hygiene is achieved upon the identity tag remaining within a particular area associated with the hand hygiene wash for a pre-determined time.

20 3.) A system in accordance with claim 1, wherein the wireless controller determines that a second, clean state of hygiene has been achieved upon receipt of a signal as determined by a switch associated with the hand hygiene wash arrangement.

4.) A system in accordance with any one of claims 1 – 3, wherein the
25 wireless system is one of a radio frequency system and an infra-red system

5.) A system in accordance with any one of claims 1- 3 wherein the virtual curtain zone is defined by a number of smaller, overlapping wireless zones.

6.) A system in accordance with any one of claims 1-5 wherein the
30 system is a healthcare system.

7.) A system in accordance with any one of claims 1 – 5 wherein the system is a food processing facility.

8.) A wireless communication device operable in any one of claims 1 – 7.

9.) A RFID tag operable in any one of claims 1 – 7.

5 10.) A hand hygiene facility operable in any one of claims 1 – 7, the system.

11.) A method of operating a hygiene monitor system, including a virtual curtain area associated with a subject, a wireless communication device having an effective range to define the virtual curtain area, wireless
10 communication identity tags which communicate with the wireless communication device and a hand hygiene wash arrangement, the wireless communication device being operable to communicate with identity tags as worn by personnel about the subject;

wherein the wireless communication device can communicate with the
15 wireless identity tag; the method including the steps of;

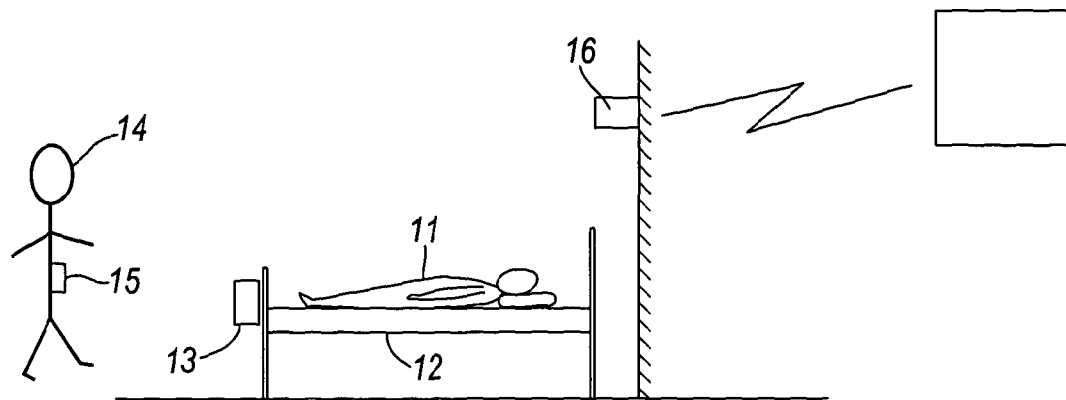
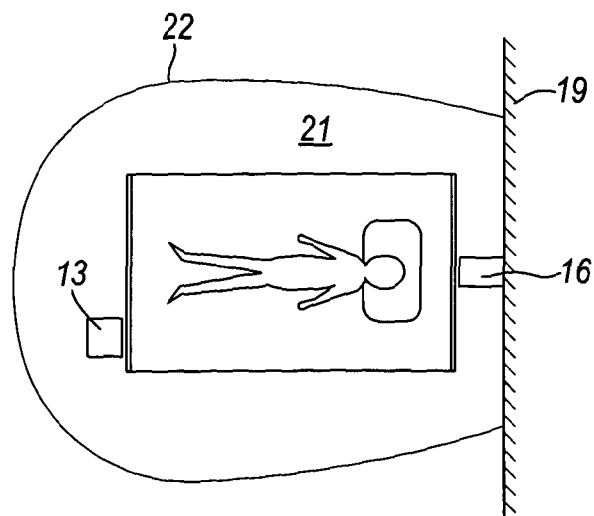
in a first mode of operation the wireless identity tag is operable to indicate a first state of cleanliness; and,

in a second mode of operation the wireless identity tag is operable to indicate a second state of cleanliness;

20 in a third mode of operation, following a visit to a hand hygiene wash station and a positive action, the identity tag indicates a second state of cleanliness being a good state of cleanliness, the tag indicating at least aurally or visibly that the personnel is in at least one state of cleanliness.

12.) A method of operating a hygiene monitor system according to claim
25 11 wherein the positive action comprises operating a switch whereby to indicate to the wash arrangement that a second state of cleanliness had been achieved.

13.) A method of operating a hygiene monitor system according to claim
30 11 wherein remaining within the wash facility for a predetermined period of time is interpreted as achieving a second state of cleanliness.

*Fig.1**Fig.2*

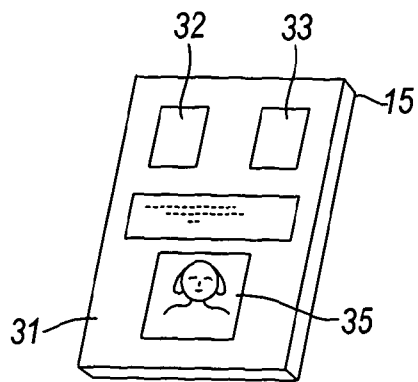


Fig.3a

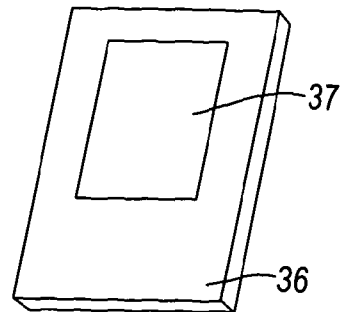


Fig.3b

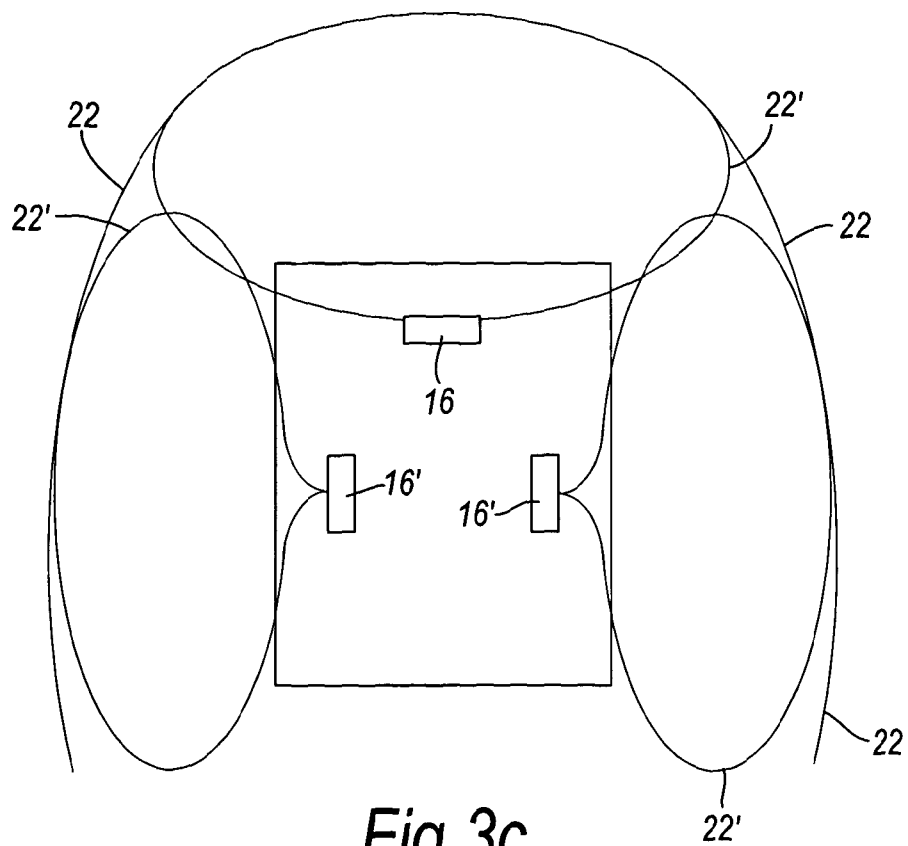
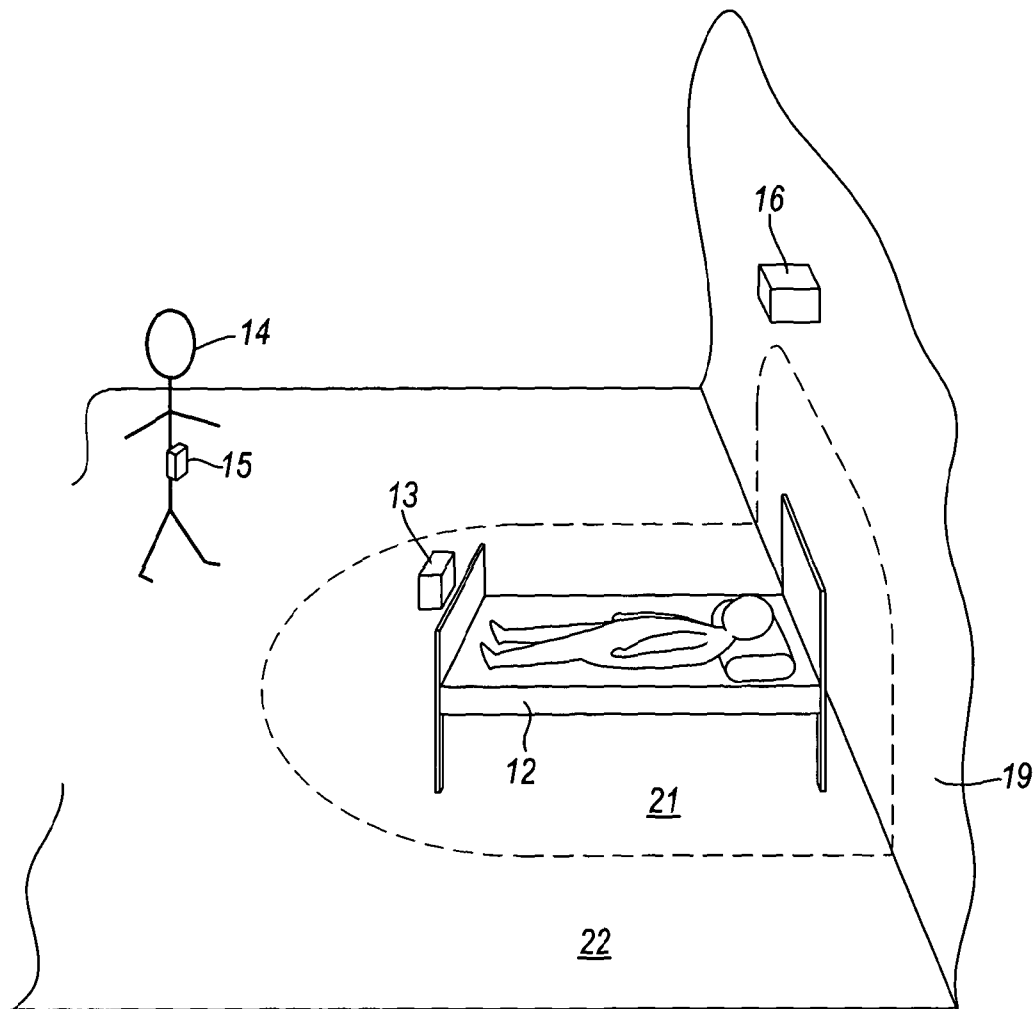
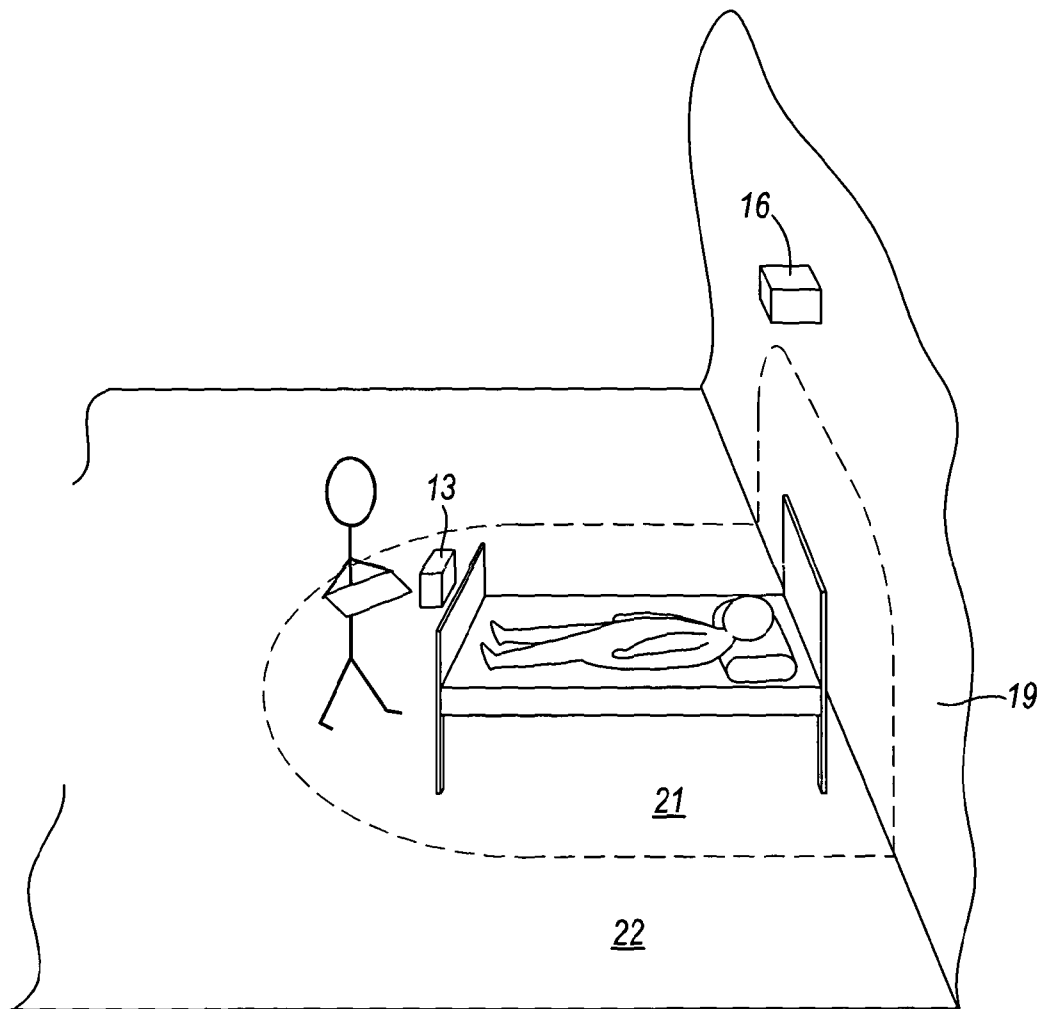
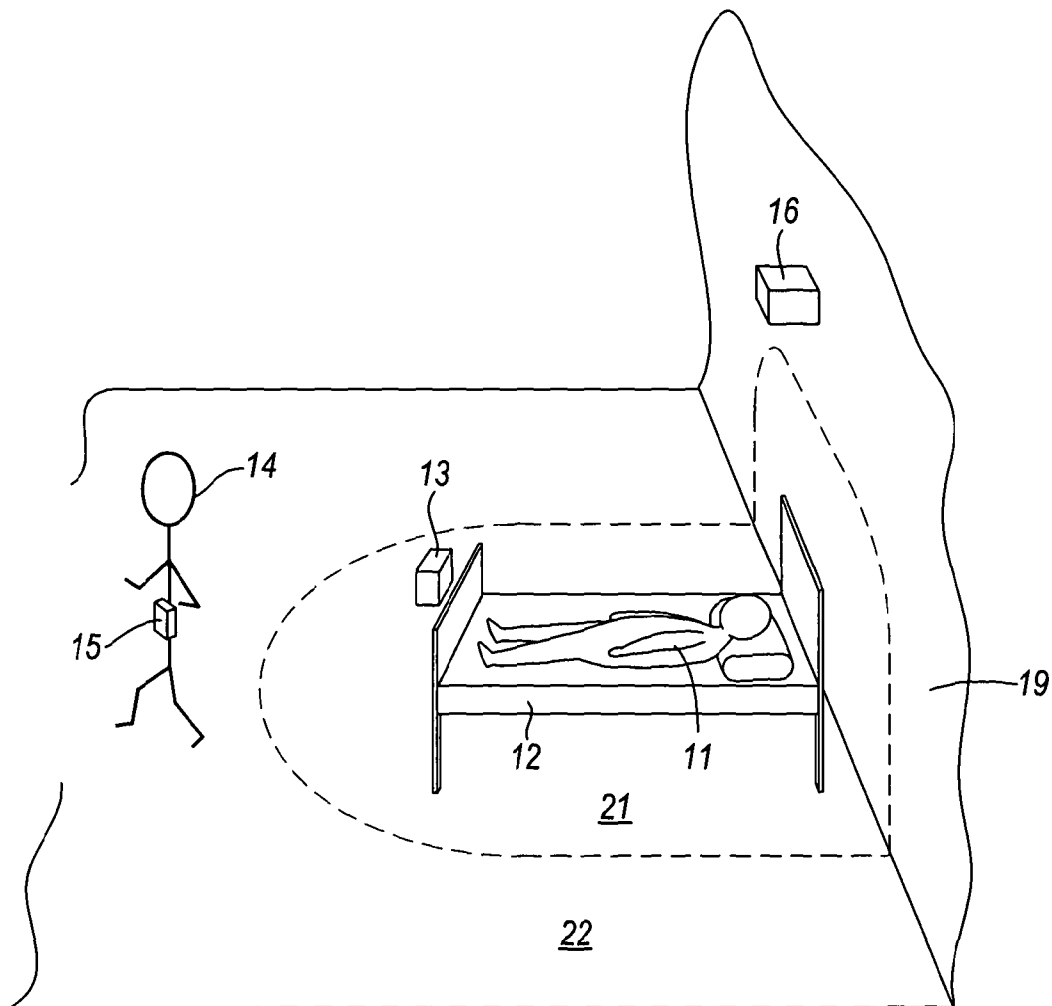


Fig.3c

*Fig.4a*

*Fig.4b*

*Fig.4c*

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2010/000814

A. CLASSIFICATION OF SUBJECT MATTER

INV. G08B21/24

ADD.

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)

G08B

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 872 802 A1 (ETHICON INC [US]) 2 January 2008 (2008-01-02)	1-6,8-13
Y	the whole document * abstract paragraphs [0003] - [0011], [0014] - [0033]; figures 1-3	7
Y	US 5 945 910 A (GORRA WILLIAM M [US]) 31 August 1999 (1999-08-31)	7
A	* abstract column 1, lines 5-11 column 4, lines 47-60; figures 1,6	3,12
A	WO 2007/047677 A2 (REVA SYSTEMS CORP [US]) 26 April 2007 (2007-04-26) * abstract page 24, line 26 - page 26, line 20; figures 4,5,6	5



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2010/000814

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1872802	A1	02-01-2008	AR 061729 A1 17-09-2008
		AU 2007202969 A1 17-01-2008	
		CA 2592814 A1 29-12-2007	
		CN 101099694 A 09-01-2008	
		CO 5840244 A1 31-12-2007	
		JP 2008027436 A 07-02-2008	
		KR 20080016775 A 22-02-2008	
		US 2008001763 A1 03-01-2008	
		ZA 200705195 A 26-08-2009	
US 5945910	A	31-08-1999	NONE
WO 2007047677	A2	26-04-2007	EP 1941385 A2 09-07-2008