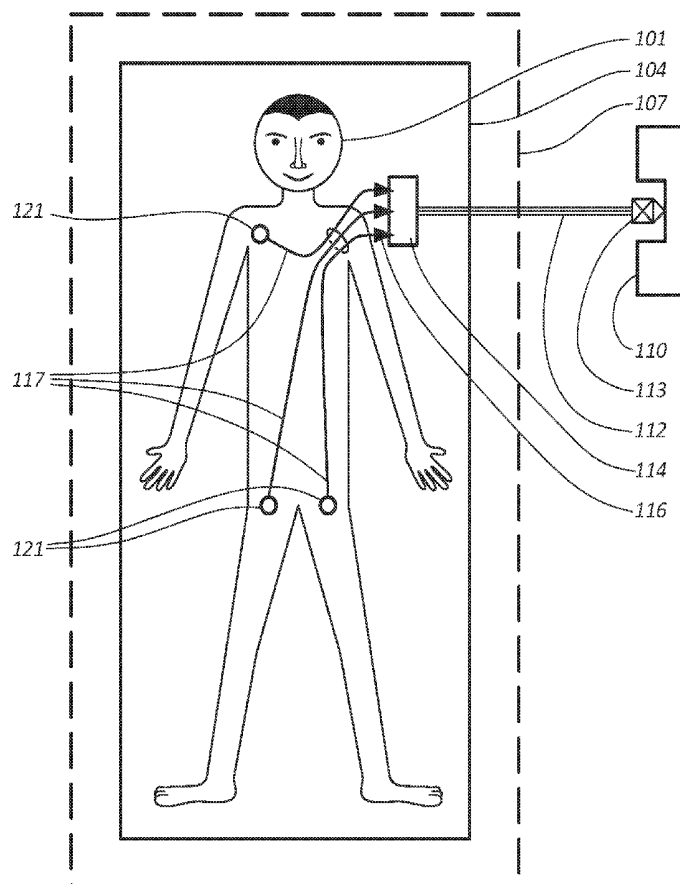




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(19) **United States**(12) **Patent Application Publication**
Grayzel et al.(10) **Pub. No.: US 2016/0183790 A1**(43) **Pub. Date: Jun. 30, 2016**(54) **SYSTEM CONFIGURATION FOR
MONITORING SYSTEMS***5/0476* (2013.01); *A61B 8/00* (2013.01); *A61B*
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Jeffrey Grayzel, Morristown, NJ (US)(21) Appl. No.: **14/836,956**(22) Filed: **Aug. 26, 2015****Related U.S. Application Data**(62) Division of application No. 13/337,034, filed on Dec.
23, 2011, now Pat. No. 9,149,186.**Publication Classification**(51) **Int. Cl.***A61B 5/00* (2006.01)*A61B 8/00* (2006.01)*A61B 5/0476* (2006.01)*A61B 5/0205* (2006.01)*A61B 5/0402* (2006.01)(52) **U.S. Cl.**CPC *A61B 5/002* (2013.01); *A61B 5/02055*
(2013.01); *A61B 5/0402* (2013.01); *A61B*(57) **ABSTRACT**

A physical configuration of cables and a wireless communication system for connecting a monitoring apparatus to a human patient, where said patient and his immediate surroundings define a potentially infectious contaminated zone. The configuration provides for the monitoring apparatus and a wireless receiver to lie outside of the contamination zone, and one or more serial cables to interface with said patient within said infectious zone. A wireless transmitter is connected to said serial cable proximal end and configured to wirelessly transmit patient information to said wireless receiver which is connected to the monitoring apparatus. This physical configuration prevents contamination of the monitoring apparatus and wireless receiver, so they may be reused on successive patients, and prevents the transfer of infective agents to a subsequent patient in a series of patients. The serial cable(s) used to contact the patient within his contamination zone may be disposable. Examples of monitoring various physiological parameters are provided to exemplify the universal concept of such physical configuration. In certain embodiments the wireless transmitter may be integrated with the sensor device attached to the patient, and/or the wireless receiver may be integrated with the monitoring apparatus.



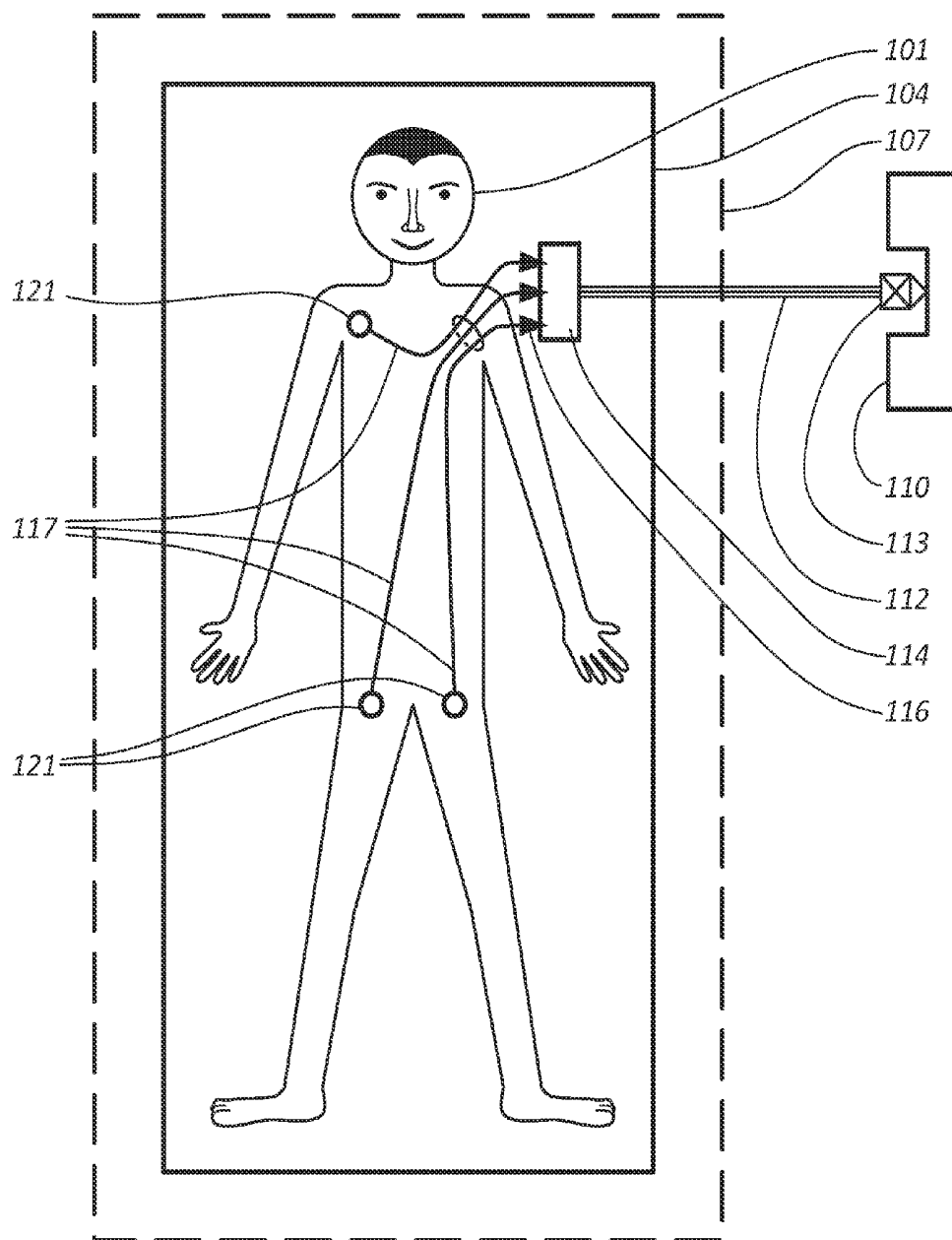


FIG. 1

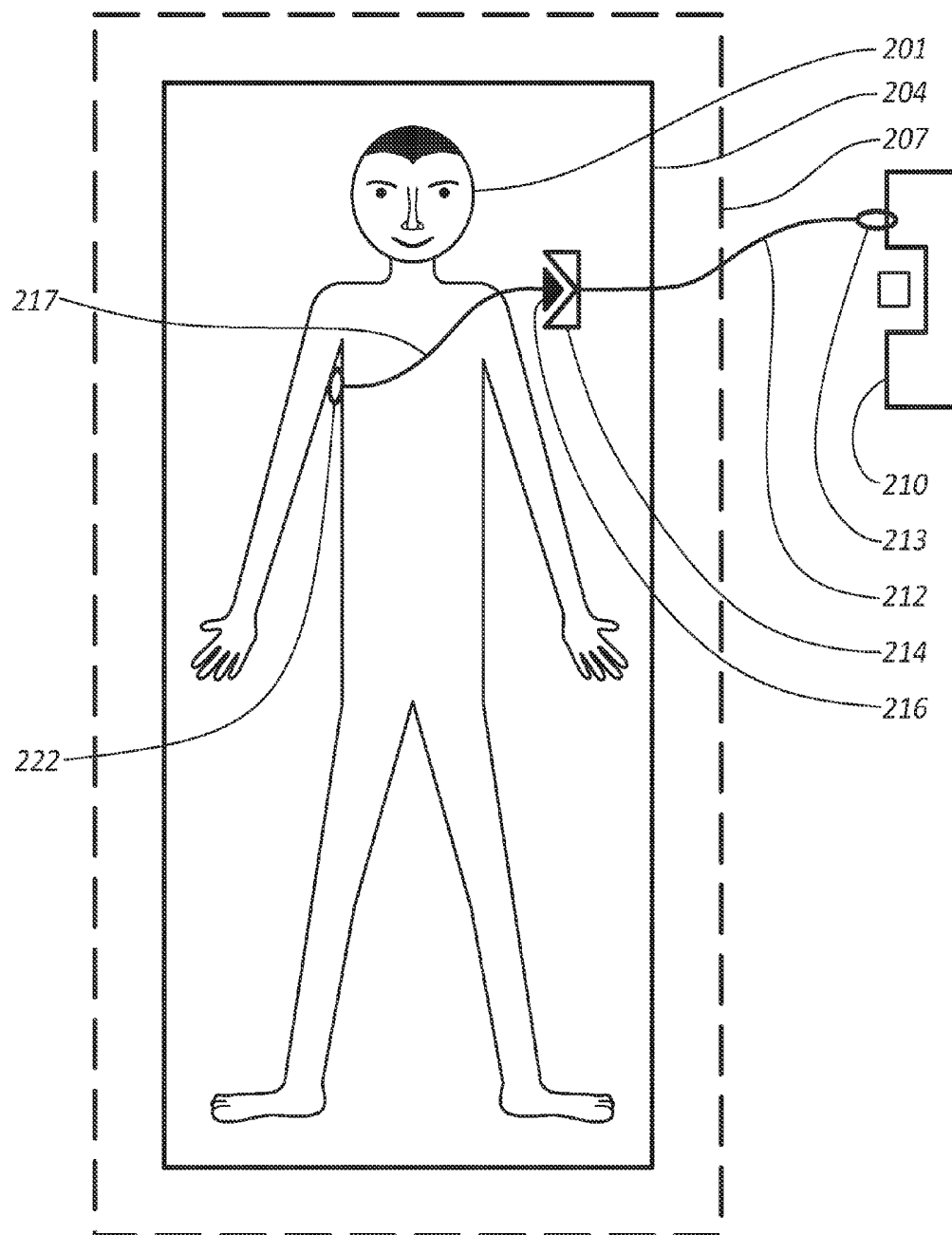


FIG. 2

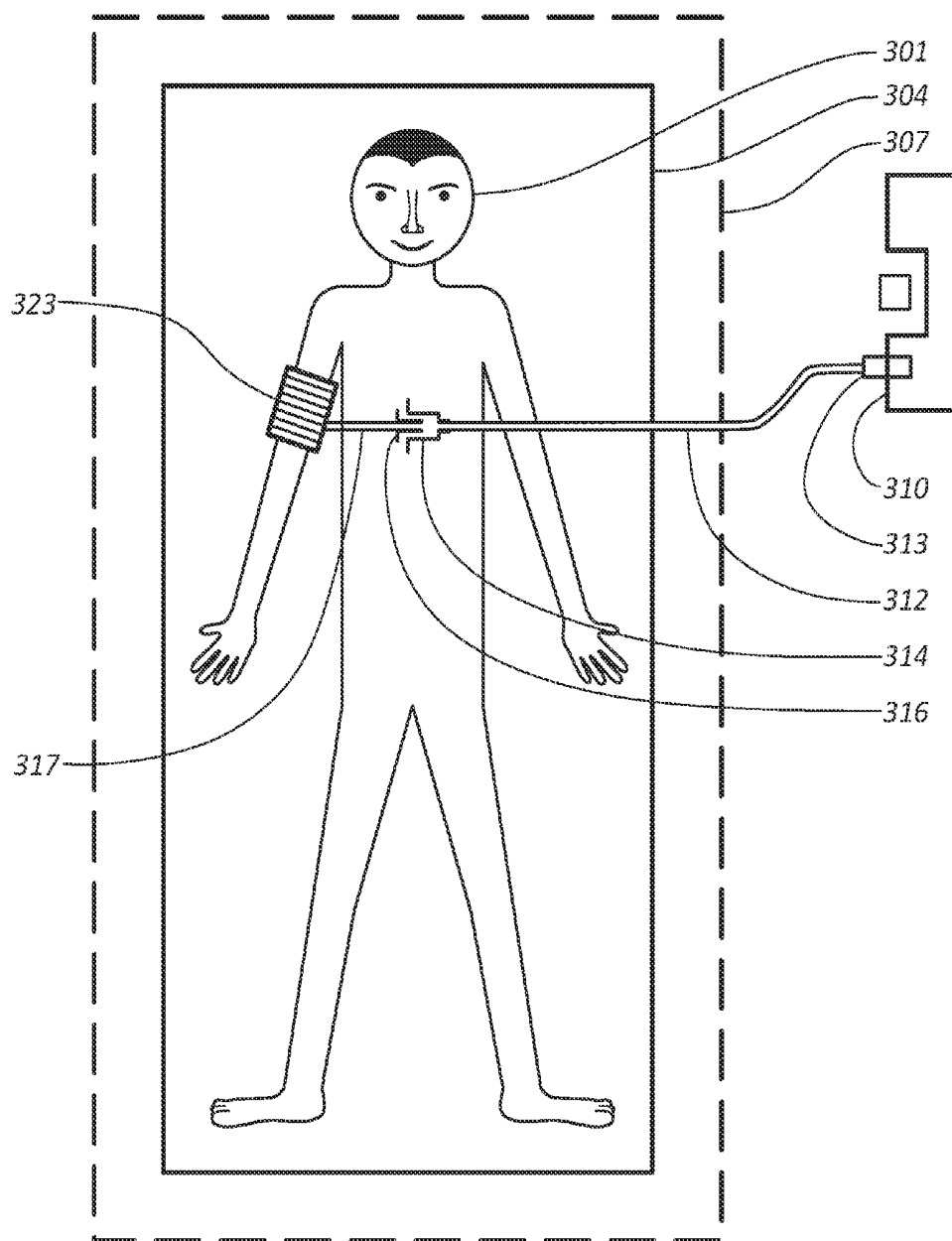


FIG. 3

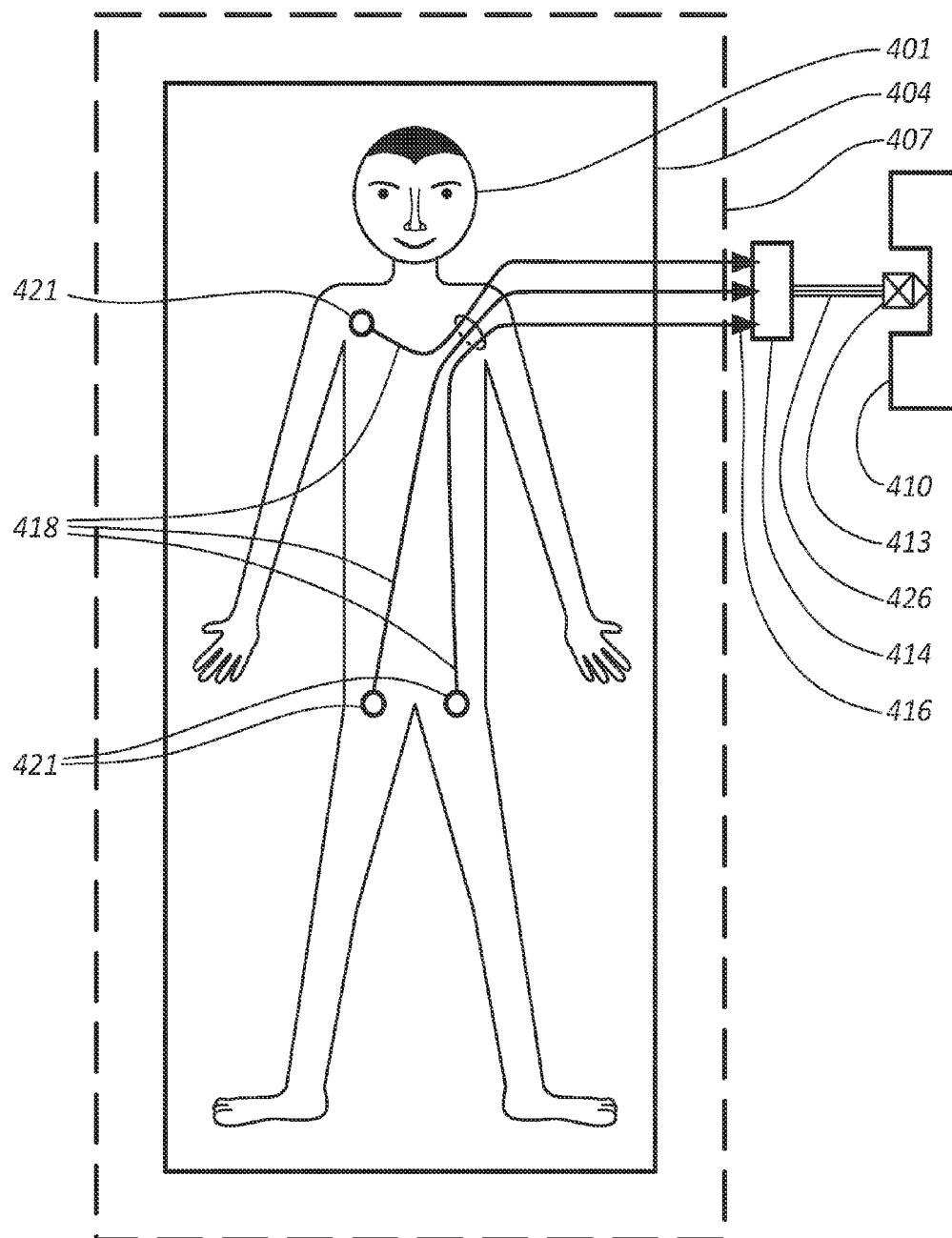


FIG. 4

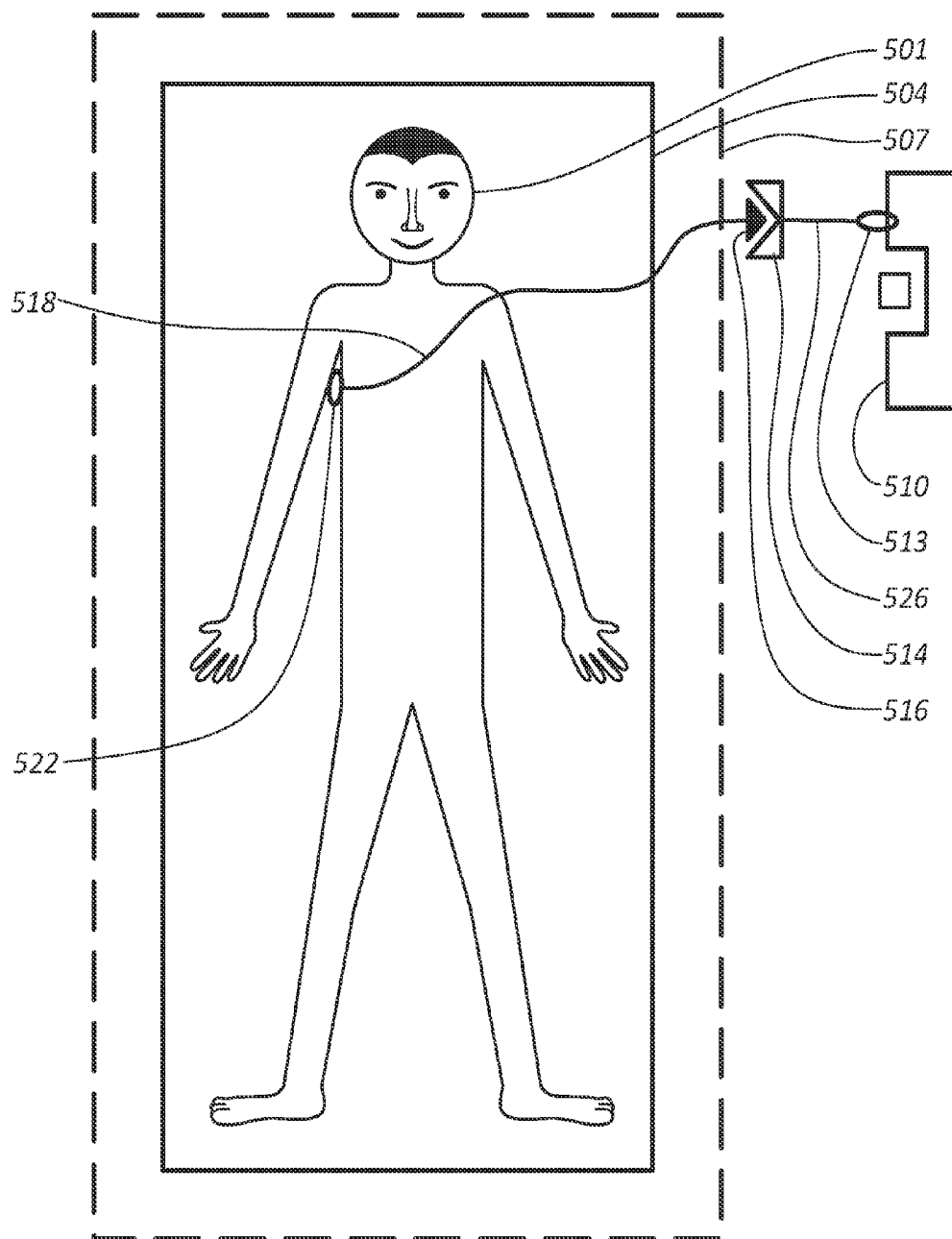


FIG. 5

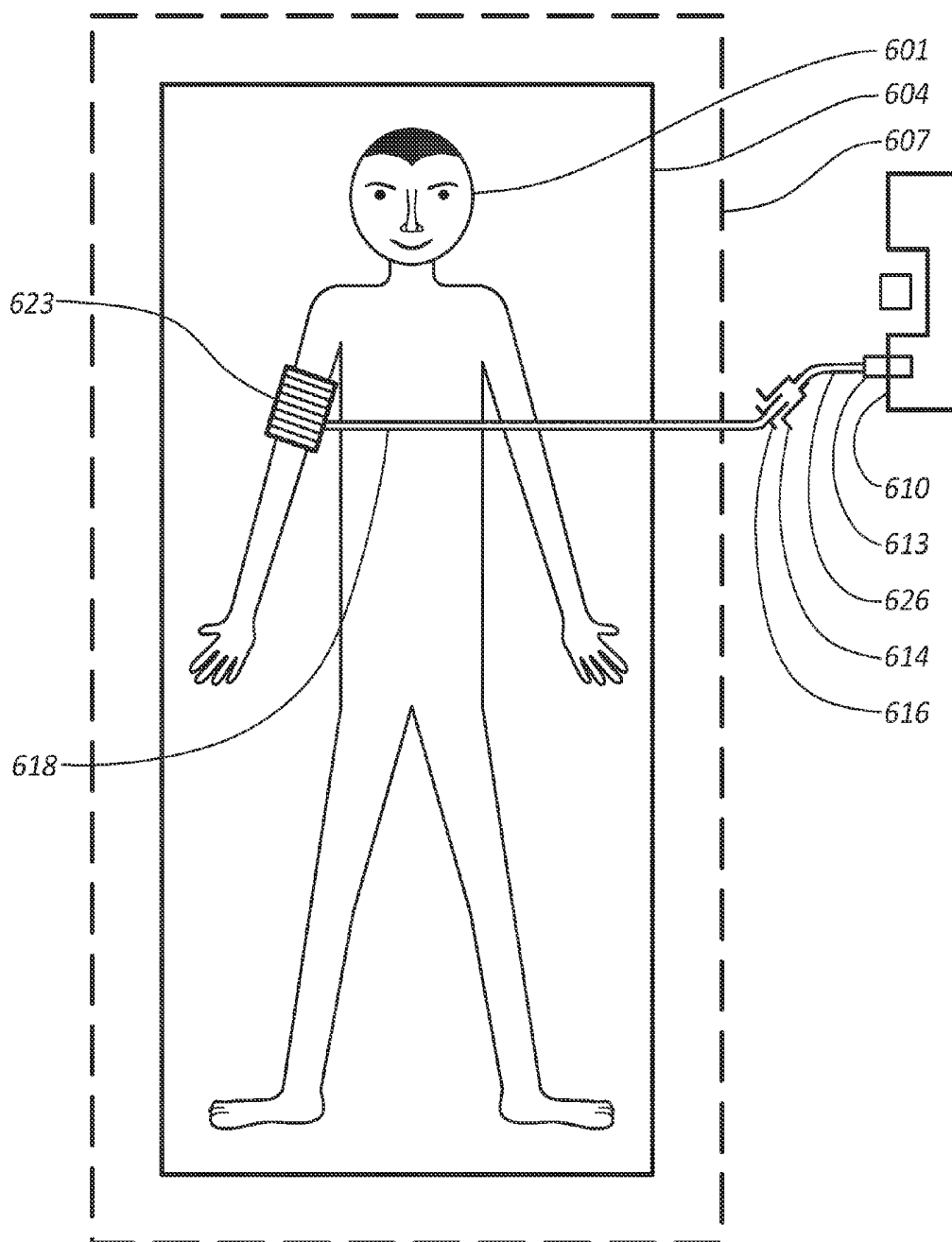


FIG. 6

FIG. 7

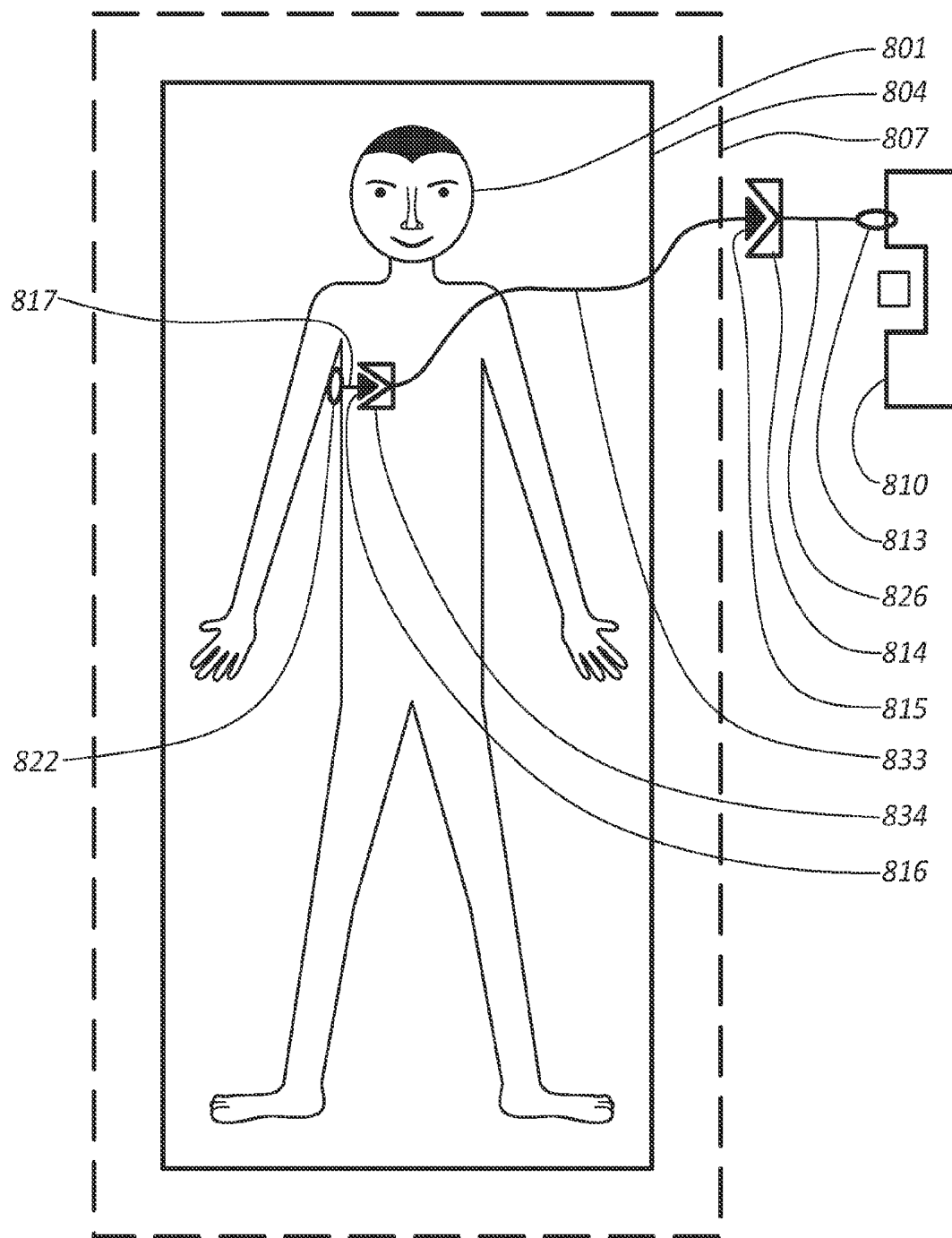


FIG. 8

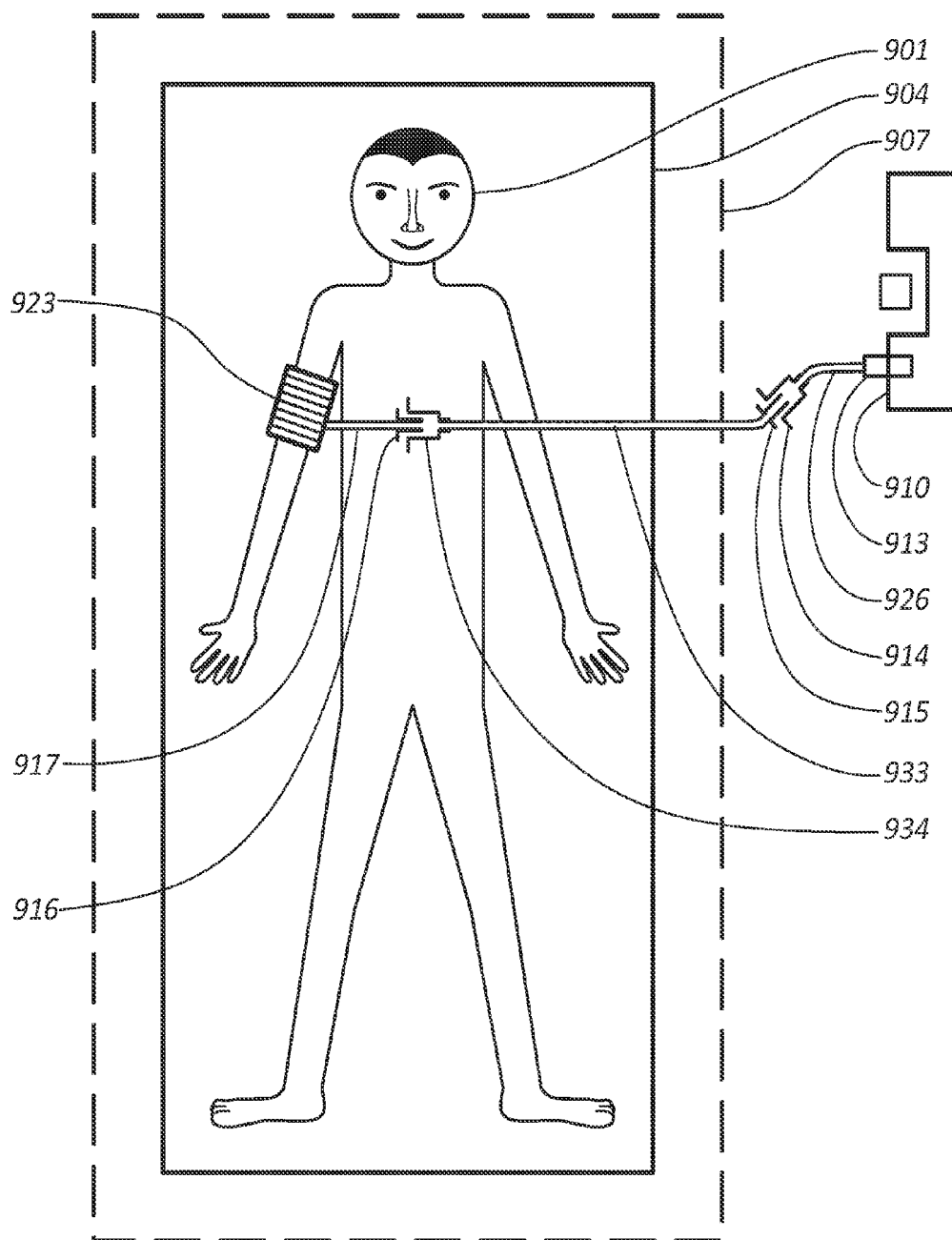


FIG. 9

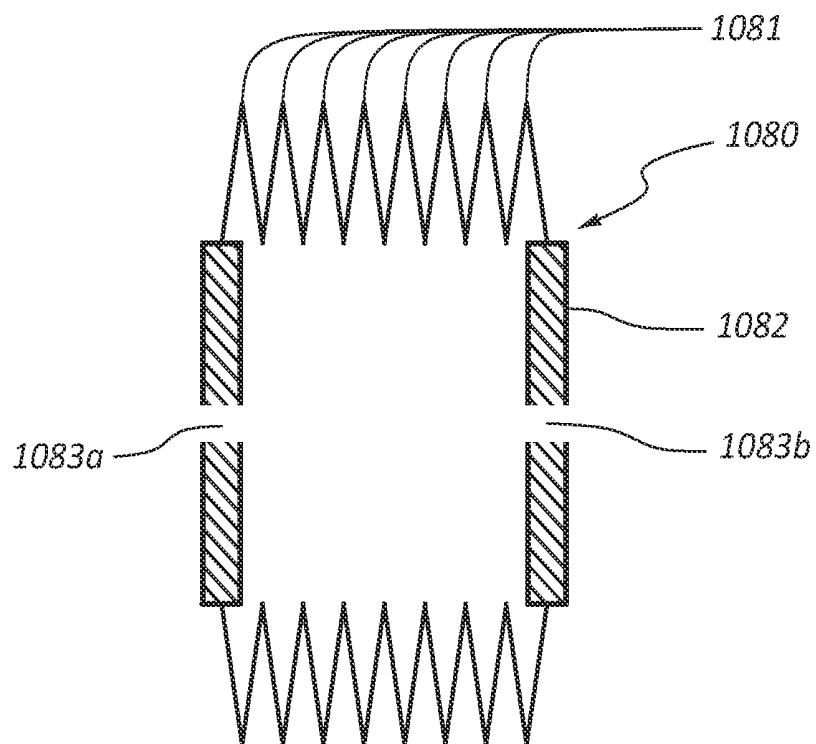


FIG. 10A

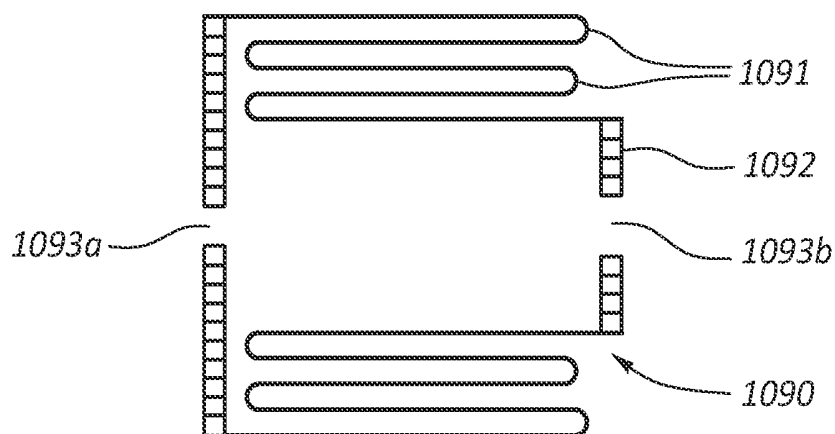


FIG. 10B

SYSTEM CONFIGURATION FOR MONITORING SYSTEMS

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/426,806 filed Dec. 23, 2010

FIELD

[0002] The invention generally relates to apparatus and configurations of apparatus for use in patient monitoring systems.

BACKGROUND

[0003] Ill patients require surveillance of essential information relating to the patient's condition. Such information may relate to physiologic or anatomic functions or status. Apparatus which perform this surveillance function are referred to as monitoring systems. The most common signal employed for continuous surveillance is the electrocardiogram (ECG). Other physiologic functions that can be monitored include, but are not limited to temperature, blood pressure, respiration, blood oximetry, cardiac bio-impedance, and others. The system comprises an electronic monitor console connected to one or more cables, which terminate with a sensor device interfaced with the patient.

[0004] The most common location for the electronic monitor console is at the patient's bedside, but the patient may reside on a reclining chair, stretcher, gurney, operating-room table, or other similar modality, with the electronic monitor console similarly nearby. Often the patient can reach out and touch the electronic monitor console. One or more cables connect the electronic console to the patient to convey information from the patient. Such cables are most often electrical/electronic lines, but may also be pneumatic, hydraulic, or fiber-optic, consistent with the information being conveyed from patient to electronic console. Henceforth, in the description below, the term cable shall be broadly defined as the means of conveying such signals from the patient to the monitor console. Thus, the term cable could mean an electrical cable, a pneumatic cable, a fiber-optic cable, or other, depending on the application.

[0005] The modality that will be employed as the paradigm for initial description of a system configuration is the ECG, followed by analogous applications to temperature and blood pressure. The ECG is a wave-form depicting the time-varying difference in electrical potential between two points on the surface of the skin. Electrical connection to the skin is provided by a conductive electrode connected to a conductive wire; the simplest arrangement consists of the two active electrodes whose potential difference is to be measured, and a third electrode serving as a ground or reference electrode. This arrangement provides one ECG signal or lead; each additional lead requires an additional electrode with attached conductive wire. Since it is often desirable to monitor several ECG leads, it is common to have four or more electrodes with wires grouped as a packaged assembly.

[0006] To limit and control the transfer of infectious agents within the hospital environment, these electrodes with attached wires are frequently discarded after each patient use, since they are considered to be contaminated by the patient and not suitable for transfer to another ill individual. Being disposable, the electrode-wire assembly employs wires of minimal length which lie entirely on the patient or on his bed.

Hereafter, we may refer to such wires as serial wires, since they are in series with the trunk cable, which then extends to the input connector of the electronic monitoring console. Thus, a bundled group of wires may constitute a cable and be denoted as the serial cable, so named as it is in series with the trunk cable. A connecting means, such as a metallic pin, located at the proximal end of each wire within the serial cable, couples to a multiple-input yoke at the distal end of a permanent trunk cable. Other connecting means may be possible. Of note, the terms proximal and distal are referenced to the electronic monitor console, proximal being closer to the console and distal being further away, in the direction of the patient.

[0007] The trunk cable extends all the way to the electronic monitor console to which it couples via a substantial multiple-conductor connector. Thus, the trunk cable contains multiple shielded wire conductors within its entire length and terminates in a multiple pin-receptive yoke at its distal end, and a substantial multiple-conductor connector at its proximal end, which is inserted into the input receptacle of the monitor console. Parenthetically, it is again noted that cables which are pneumatic, hydraulic, fiber-optic, or of a non-electronic nature will require respectively-appropriate connectors.

[0008] The trunk-cable is a relatively expensive component of the monitoring system and is not considered a disposable item, but is reused continuously through the sequence of patients to be interfaced with the monitor over time. The trunk-cable conspicuously reaches from the monitor console to the patient's bed, is contacted frequently by the patient, his bedclothes and linens, and is also handled frequently by caregivers at the patient's bedside. Thus, the trunk-cable is exposed directly to multiple sources of microbial contamination, and can transmit same to the subsequent sequence of patients for whom the monitoring system is employed.

[0009] Nosocomial infections are a major cause of in-hospital morbidity and responsible for large increases in hospital costs, for which reimbursement is not given. Hence, hospitals have intensely addressed causes of such hospital-acquired infection and have identified potential culprits. Among such sources of contamination and transmission of microbes are trunk-cables for ECG and trunk-cables for other monitored parameters, such as previously mentioned temperature, blood pressure, respiration, blood oximetry, bio-impedance, and others. Many hospitals attempt to reduce the virulence of trunk-cables by frequent wiping with anti-microbial disinfectants, but microbial cultures of trunk-cables have revealed such cleansing to be of limited value and not adequate for the objective. Hence, contamination of trunk cables remains a serious problem, contributing to the transmission of infective agents from one patient to another.

OBJECTS

[0010] It is an object of the present application to minimize or eliminate the role of trunk-cables as a discernable vehicle for the inter-patient transmission of infective agents, such as bacteria and fungi.

[0011] It is a further object of the present application to reduce hospital morbidity resulting from transmission of nosocomial infection by monitoring systems.

[0012] It is a further object of the present application to reduce hospital costs resulting from transmission of nosocomial infection by monitoring systems.

[0013] It is yet another object of the application to provide a monitoring system wherein the monitor console and trunk cable reside completely outside the infectious zone.

[0014] It is still another object of the application to provide a trunk cable of a length such that when its proximal end is attached to the monitor console, its length is insufficient to allow its distal end to reach the perimeter of the infectious zone surrounding a patient.

[0015] It is yet another object of the application to provide a serial cable that is disposable.

[0016] It is still another object of the application to provide an intermediate cable to be used when the length of the serial cable is insufficient to have its proximal end extend beyond the perimeter of the infectious zone when its distal end is coupled to the patient.

[0017] It is yet another object of the application to provide for wireless transmission of information from a transmitter located inside or outside of the infectious zone to a receiver located outside the infectious zone.

[0018] It is still another object of the application to provide a method for preventing the transfer of infective agents along a series of patients successively utilizing the same monitoring system.

SUMMARY

[0019] The present application describes spatial configurations of the monitor console and its associated cables which run from the monitor console to the patient. The patient's bed and a defined zone surrounding the bed are susceptible to contamination by the patient, and together are denoted hereafter as the Infectious Zone. The configuration described herein reduces or prevents contamination of the trunk cable, which is the expensive and reused portion among the group of cables. This is accomplished by locating the monitor console outside the infectious zone, and attaching thereto a short trunk cable whose length is not sufficient to reach the boundary of the infectious zone, thereby preventing the usual physical contact leading to contamination. The serial cable connected between the trunk cable and patient is made sufficiently long so that it extends from the trunk cable located outside the infectious zone to the patient's corpus. Thus, only the serial cable is susceptible to contamination, and it is made to be disposable and discarded. Compared to present-art cable systems, the trunk cables described herein are generally shorter than present trunk cables, and the serial cables described herein are generally longer than present-art serial cables. Both the trunk cable and the monitor console as described herein are always located outside the infectious zone.

[0020] The foregoing configuration for a monitoring system, consisting of both monitor console and trunk cable lying outside the infectious zone, and the serial cable will be described in detail for several monitoring modes, namely ECG, temperature, and blood pressure. It will then be evident to one skilled in the art the manner of applying the described system configurations to any other physiological parameter amenable to monitoring.

[0021] A second configuration is presented as follows. In the first configuration the serial cable extends from the patient to a point outside the infectious zone where it connects to the trunk cable. In the second configuration this primary serial cable remains short, not extending outside the infectious zone, and a second serial cable named the Intermediate Cable, extends from the proximal terminus of the primary serial cable to the distal end of the trunk cable lying outside of the

infectious zone. This configuration enables present-day cables to remain unchanged, utilizing the existing short serial cable, while the intermediate cable continues to a point outside the infectious zone. This second configuration also accomplishes the desired result, namely avoiding contamination of the console monitor and the non-disposable trunk cable, both of which reside outside the perimeter of the infectious zone.

[0022] The first and second configurations described above may be modified by the addition of wireless transmission of the patient's physiologic signals from the patient to the monitor. A wireless transmitter may be attached to the proximal end of a short or long serial cable, or to the proximal end of an intermediate cable. Alternatively, the transmitter may be incorporated directly into the proximal end of a short or long serial cable, or to the proximal end of an intermediate cable. Alternatively, the transmitter and the sensor may be integrated, in which case neither a serial cable nor an intermediate cable is necessary. A wireless receiver may be attached to or incorporated into the distal end of the trunk cable. Alternatively, a receiver may be connected directly to the monitor or incorporated into the monitor and contained within the monitor's enclosure.

[0023] For the case where a short serial cable is employed, this arrangement does present the additional problem caused by the transmitter residing inside the infectious zone, since the transmitter is often costly and usually not treated as disposable. In the case where the transmitter will be reused, it would be advantageous for the transmitter to be enclosed within a disposable container which protects it from contamination. This is easily accomplished, for example, with a clear plastic bag-like envelope with a sealable opening, which maintains the cleanliness of the transmitter, yet permits it to be easily removed from the container or bag for subsequent use. A clear plastic material permits RF transmission, optical transmission, infra-red transmission, and other modalities through its protective envelope. Other types of containers could also be designed, including those that are more substantial, such as a plastic enclosure, and amenable to sterilization. The addition of wireless transmission may also be incorporated into other configurations described within this specification.

[0024] The configurations described above and in detail below may be advantageously applied to other monitoring systems to capture any information relating to a patient's condition that is amenable to patient monitoring.

[0025] In yet another configuration, the elimination of sequential infectious contamination by a reusable cable of a monitoring system employed among a series of patients may also be accomplished by sheathing or otherwise entirely enclosing the reusable trunk cable from its proximal to distal end in a covering, which herein will be referred to as a sheath. Such a sheath could be inexpensive and disposable after each patient use. This is advantageously accomplished by a lightweight flexible tubular structure, such as a thin-walled impermeable plastic tube or envelope, preferably transparent so that proper disposition of the cable within the plastic tube can be observed at all times. Alternatively, the sheath could be made from a polymeric film. It would be desirable that the sheath be capable of assuming a collapsed or compacted form, which can be expanded longitudinally to the full length of the trunk cable. For example, the thin-walled envelope could possess a series of radially-oriented pleats, analogous to pleats on an accordion, which would permit the envelope to be com-

pressed into a compact structure for packaging, shipping and handling, and then be expanded longitudinally over and around the trunk cable along its full length. An alternate structure for the sheath would be a telescopic disposition of the sheath with adjacent lengths folded sequentially within one another. This structure would also be initially compact, and then expanded longitudinally to envelop the entire length of the trunk cable. A third structure, less ordered than the foregoing, would simply be a thin-walled tubular plastic film crumpled along its axis. In some configurations the sheath would extend to a point that would encompass the proximal end of the serial cable or the wireless receiver if one is being utilized. In yet other configurations the sheath may extend even further and may be of a length to reach from the monitor console to the patient.

[0026] Since it is desirable to have the trunk cable sealed and isolated within the sheath, the ends of the sheath would comprise a means to seal it around the cable or the connector. The open ends may be occluded with a partition, generally perpendicular to the long axis of the sheath. Such an occlusive end-member is advantageously composed of an elastic material, such as a latex-like rubber or a compressible sponge. The elastic end-partition would possess a central slit or puncture through which the cable could be inserted into the sheath, yet the elastic end-partition would recoil snugly around the cable in a conforming manner to provide a sufficiently tight seal around the end of the cable to prevent entry of contaminants. Other means of sealing the end of the sheath are also contemplated. To further accomplish the objective of a contaminant-free cable, the interior of the sheath could possess an antimicrobial chemical or other active substance, such as an interior coating to the sheath, or dispersion in powder form, or a liquid impregnated into the end-partition which is wiped along the cable as it is inserted into the sheath.

[0027] The foregoing configurations enable methods of reducing the transmission of infection from patient to patient amongst a series of patients successively utilizing the same monitoring system. Such methods include the steps of assessing the infectious zone and defining its perimeter; placing the monitor console outside said perimeter; attaching the proximal end of the trunk cable to the monitor console and placing the entirety of the trunk cable in a position outside of the infectious zone; connecting the trunk cable distal end to the serial cable proximal end such that both ends are positioned outside the perimeter of said infectious zone; extending the serial cable distal end into the infectious zone; coupling the sensor device located at the distal end of the serial cable to the patient; if necessary due to insufficient combined length of the trunk cable and the serial cable, attaching an intermediate cable to both the serial cable proximal end and the trunk cable distal end to complete a transmission pathway for the patient information to be transmitted from the patient to the monitor console. In yet another configuration, the intermediate cable can be replaced by a wireless transmission device. In yet another configuration, the trunk cable and/or serial cable and/or intermediate cable is encased in a sheath that is deployed over the cable, where said sheath is comprised of an impervious material constituting an effective barrier against microbial agents.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The accompanying drawings which are incorporated in and constitute part of this specification, illustrate some, although not all, possible system configurations.

[0029] FIG. 1 depicts a present-art system configuration for ECG monitoring

[0030] FIG. 2 depicts a present-art system configuration for temperature monitoring.

[0031] FIG. 3 depicts a present-art system configuration for blood-pressure monitoring.

[0032] FIG. 4 depicts a configuration as applied to ECG monitoring.

[0033] FIG. 5 depicts a configuration as applied to temperature monitoring.

[0034] FIG. 6 depicts a configuration as applied to blood-pressure monitoring.

[0035] FIG. 7 depicts a configuration as applied to ECG monitoring.

[0036] FIG. 8 depicts a configuration as applied to temperature monitoring.

[0037] FIG. 9 depicts a configuration as applied to blood-pressure monitoring.

[0038] FIGS. 10A-10B depicts configurations of a sheath for encasing the cables.

DETAILED DESCRIPTION

[0039] FIG. 1 depicts a present-art monitoring system for the ECG. The patient 101 is shown supine on bed 104 or analogous surface for repose or transport. Outside and beyond the perimeter 104 of the bed, dashed lines 107 demarcate the outer boundary or perimeter of the infectious zone, which is beyond the patient's reach. Electronic monitor console 110 is shown outside the infectious zone, although it is frequently positioned at the patient's bedside and within reach of the patient, hence within the infectious zone. Present-art practice generally locates the monitor console according to physical constraints of the available space and operator convenience, without attention to issues of contamination by the patient. Trunk Cable 112 is shown connected to the console by connector 113 at its proximal end, and possesses a connector or yoke 114 at its distal end. Three conductive wires 117 comprise the serial cable shown herein, but more elaborate serial cables contain additional electrical wires to enable multiple ECG leads (waveforms). Each conductive wire comprising the serial cable terminates at its distal end in a conductive electrode 121 which is conductively coupled to the skin surface. Other types of conductive couplings may be used, not shown, such as subcutaneous or intravascular. The proximal end of the serial cable connects to the yoke 114 of the trunk cable, such connection shown herein by pin connectors 116, though other types of connectors may be employed. The present-art system configuration shown in FIG. 1 makes evident the ease of frequent contamination of the trunk cable and its yoke connector by the patient, bedclothes, and other personal sundries residing with the patient. The serial cable is generally disposable.

[0040] FIG. 2 depicts a present-art monitoring system for body temperature, showing the patient 201, the perimeter 204 of the bed, and the outer boundary or perimeter 207 of the infectious zone. Electronic monitor console 210 is shown outside the infectious zone and engages input connector 213 on the proximal end of the trunk cable 212. The distal end of the trunk cable possesses connector 214 which couples to connector 216 on the proximal end of serial cable 217, possessing the requisite number of conductors to convey the signal representing body temperature. The distal end of the serial cable connects to the temperature sensor 222, such as thermistor or thermocouple, shown in the axilla of the patient.

FIG. 2, in a manner analogous to FIG. 1, shows the consistent contamination of the trunk cable by the patient and his intimate physical environment.

[0041] FIG. 3 depicts a present-art monitoring system for non-invasive blood pressure measurement, showing the patient 301, the perimeter of the bed 304, and the perimeter 307 of the infectious zone. Electronic monitor console 310 is shown outside the infectious zone and receives pneumatic input connector 313 on the proximal end of the pneumatic trunk cable 312 (tubular trunk line). The distal end of the tubular pneumatic trunk line possesses connector 314, which couples pneumatically to connector 316 on the proximal end of the pneumatic serial cable 317, the serial tubular line to inflatable blood-pressure cuff 323. The electronic console contains an air pump to inflate the cuff, a valve to gradually bleed air from the cuff after adequate inflation, a pressure sensor to measure air pressure within the tubular lines and cuff, and algorithms for controlling the operation of the system and for computing blood pressure from the pulsating pressure fluctuations which occur during deflation of the pressurized cuff. This method is well-known to those skilled in the art, and further details are not herein provided. While disposable blood pressure cuffs are now available, but not always employed, their serial pneumatic line 317 is always short, and connector 316 lies within the infectious zone, as does its mating connector 314; the pneumatic trunk cable 312 extending to the monitor console 310 is extensively within the bed and infectious zone.

[0042] FIG. 4 depicts the first configuration applied to ECG monitoring, showing the patient 401, the perimeter 404 of the bed, and the perimeter 407 of the infectious zone. Electronic monitor console 410 is located outside the infectious zone, and receives connector 413 from the proximal end of trunk cable 426. Trunk cable 426 lies entirely outside the infectious zone, as does the connector or yoke 414 at its distal end. Thus, the trunk cable is not subject to direct contamination by the patient or his intimate environment. Pin connectors 416, affixed to the proximal end of serial cable 418, also lie outside the infectious zone, but serial cable 418 enters the infectious zone and extends to the patient, where ECG electrodes 421 at the distal ends of the serial cable's wires are conductively coupled to the patient. Compared to present art as shown in FIG. 1, the configuration as drawn in FIG. 4 shows the trunk cable to be shorter and the disposable serial cable to be longer than present art.

[0043] FIG. 5 depicts the first configuration applied to monitoring of temperature, showing patient 501, the perimeter 504 of the bed, and the perimeter 507 of the infectious zone. Electronic monitor console 510 is located outside the infectious zone, and receives connector 513 from the proximal end of trunk cable 526. Trunk cable 526 lies entirely outside the infectious zone, as do connector 513 at its proximal end and connector 514 at its distal end. Thus, the trunk cable is not subject to direct contamination by the patient or his intimate environment. Connector 516 at the proximal end of serial cable 518 also lies outside the infectious zone, but serial cable 518 enters the infectious zone and extends to the patient, where temperature sensor 522 at the distal end resides in the patient's axilla. Compared to present art as drawn in FIG. 2, the configuration as drawn in FIG. 5 shows the trunk cable to be shorter and the disposable serial cable to be longer than present art.

[0044] FIG. 6 depicts the first configuration applied to monitoring of blood pressure, showing patient 601, the

perimeter 604 of the bed, and the perimeter 607 of the infectious zone. Electronic monitor console 610 is located outside the infectious zone, and receives connector 613 from the proximal end of pneumatic trunk cable 626. Trunk cable 626 lies entirely outside the infectious zone, as does pneumatic connector 614 at its distal end. Thus, pneumatic trunk cable 626 is not subject to direct contamination by the patient or his intimate environment. Pneumatic connector 616 at the proximal end of serial pneumatic cable 618 also lies outside the infectious zone; serial pneumatic cable 618 enters the infectious zone and extends to the patient, where blood-pressure cuff 623 at the distal end is wrapped around the patient's arm. Compared to present art as drawn in FIG. 3, the configuration as drawn in FIG. 6 shows the pneumatic trunk cable to be shorter and the disposable serial pneumatic cable to be longer than present art.

[0045] FIG. 7 depicts the second configuration applied to ECG monitoring, showing patient 701, the perimeter 704 of the bed, and the perimeter 707 of the infectious zone. Electronic monitor console 710 is located outside the infectious zone, and receives connector 713 from the proximal end of trunk cable 726. Trunk cable 726 lies entirely outside the infectious zone 707, as does yoke connector 714 at its distal end. Thus, trunk cable 726 is not subject to direct contamination by the patient or his intimate environment. Pin connectors 715 are affixed to the proximal end of an intermediate cable 733, and also lie outside the infectious zone, while intermediate cable 733 enters the infectious zone and extends to the proximal end of the serial cable 717. Pin-receptive connectors 734 at the distal end of the intermediate cable mate with pin connectors 716 at the proximal end of the serial cable. The distal ends of wires comprising the serial cable terminate in conductive electrodes 721 which are conductively coupled to the patient. In this second configuration, both the serial cable and the intermediate cable are disposable. This permits use of serial cables as presently manufactured, which are not sufficiently long to reliably extend outside the infectious zone, while the intermediate cable of simple structure and inexpensive serves as an extension line for the serial cable and reaches outside the infectious zone to the yoke connector 714 of the trunk cable 726. Essentially, serial cable 717 linked to intermediate cable 733 replaces serial cable 418 of FIG. 4.

[0046] FIG. 8 depicts the second configuration applied to monitoring of temperature, showing patient 801, the perimeter 804 of the bed, and the perimeter 807 of the infectious zone. Electronic monitor console 810 is located outside the infectious zone, and receives connector 813 from the proximal end of trunk cable 826. Trunk cable 826 lies entirely outside the infectious zone 807, as does connector 814 at its distal end. Thus, trunk cable 826 and its connectors are not subject to direct contamination by the patient or his intimate environment. Mating connector 815 is affixed to the proximal end of an intermediate cable 833, and also lies outside the infectious zone, while intermediate cable 833 enters the infectious zone and extends to the proximal end of the serial cable 817. At the distal end of intermediate cable 833, receptive connector 834 mates with connector 816 at the proximal end of serial cable 817. The distal end of serial cable 817 connects to the temperature sensor, which is shown nestled in the patient's axilla. In this second configuration for temperature monitoring, both serial cable 817 and intermediate cable 833 are disposable. Essentially, serial cable 817 linked to intermediate cable 833 replaces serial cable 518 of FIG. 5.

[0047] FIG. 9 depicts the second configuration applied to monitoring of blood pressure, showing patient 901, the perimeter 904 of the bed, and the perimeter 907 of the infectious zone. Electronic monitor console 910 is located outside the infectious zone, and receives pneumatic connector 913 from the proximal end of pneumatic trunk cable 926. Trunk cable 926 lies entirely outside the infectious zone 907, as does pneumatic connector 914 at its distal end. Thus, pneumatic trunk cable 926 and its connectors are not subject to direct contamination by the patient or his intimate environment. Mating connector 915 is affixed to the proximal end of an intermediate pneumatic cable 933, and also lies outside the infectious zone, while intermediate pneumatic cable 933 enters the infectious zone and extends to the proximal end of the serial cable 917. At the distal end of intermediate pneumatic cable 933, receptive pneumatic connector 934 mates with pneumatic connector 916 at the proximal end of serial pneumatic cable 917. The distal end of pneumatic serial cable 917 connects to the blood pressure cuff 923, which is wrapped around the patient's arm. In this second configuration for monitoring of blood pressure, both serial pneumatic cable 917 and intermediate pneumatic cable 933 are disposable. Essentially, serial pneumatic cable 917 linked to intermediate pneumatic cable 933 replaces serial pneumatic cable 618 of FIG. 6. Present-day disposable blood-pressure cuffs generally possess a short length of pneumatic cable (tubing) permanently affixed thereto, which would serve as the serial pneumatic cable 917 of the present FIG. 9.

[0048] FIGS. 10A-10B depicts sheaths primarily used for encasing the trunk cable of the monitoring system, and could also be used for the other cables as well. FIG. 10A is a longitudinal section along the central axis showing an configuration having a pleated sheath with end-partitions. The pleated sheath 1080 is generally shown, with radially-oriented pleats 1081, end-partition 1082 possessing apertures 1083a and 1083b through both of which the cable is inserted, and then one end-partition is slidably drawn along the entire length of the cable. At the trunk cable's proximal end the connector protrudes slightly to enable connection to the monitor console; at the distal end the trunk cable may protrude sufficiently to allow connection of the serial cable, and the region of such connection may then be inserted inside the sheath so that the trunk cable at its distal end is fully protected by the sheath. As previously described, the distal end of the trunk cable and its mating to the proximal end of the serial cable, or the proximal end of the intermediate cable in the second configuration, are always maintained outside of the infectious zone, and this is maintained during disposition of the sheath around and over said cables.

[0049] FIG. 10B is a longitudinal section along the central axis of another configuration depicting a sheath with a compact telescopic form, which may be drawn along the entire length of the trunk cable and connections made as described above for a pleated sheath. The telescopic sheath 1090 is generally shown, with overlying folds 1091, end-partition 1092 possessing apertures 1093a and 1093b.

[0050] The apertures 1083 and 1093, if true voids in the material of the end-partition, are smaller than the diameter of the cable so that the end-partition snugly surrounds the cable and seals it from the external environment. Alternatively, the aperture may be replaced by a slit which is parted to insert the cable. End-partitions 1082 and 1092 are advantageously elastic or compliant materials to perform the function of a seal around the cable. If the material comprising the end-partition

is sponge-like, it may be impregnated with an antimicrobial, which would be wiped along the cable during insertion as the end-partition is drawn along the entire length of the cable.

[0051] The sheath material may be made of any number of elastomeric materials, and may or may not incorporate an anti-microbial agent. Alternatively, the anti-microbial agent may be applied to the inner and/or outer surfaces of the sheath material.

[0052] While the two configurations of a sheath depicted herein show the sheath material in a folded manner in order to reduce the space needed to package the component, an alternative means of collapsing the sheath may be to simply bundle or bunch the material together.

[0053] Other configurations for the sheath (not shown) may consist of other means for enclosing each end of the sheath to capture it against the cable or the connector. In one configuration an adhesive material may be applied to the end of the sheath, which is then compressed against the cable or connector. Alternatively, the ends may be made with an elastic band or other cinching means which can cinch down against the cable or the connector.

[0054] Yet other configurations of the sheath may provide sufficient material to allow the sheath to extend over multiple cables of the monitoring system. In this configuration the sheath would extend into the infectious zone. It may also be made of sufficient length to reach from the monitor to the patient along the entire length of multiple cables.

[0055] While preferred configurations have been described with particularity and with reference to the drawings, modifications and variations of the foregoing will be apparent to those of skill in the art utilizing the techniques disclosed herein. It is, therefore, to be understood that such configurations are illustrative and not limiting on the scope of the present application and that the application encompasses such modifications and variations.

[0056] 2. The system wherein said serial cable proximal end connects to a wireless transmitter and said trunk cable distal end connects to a wireless receiver.

[0057] The system wherein said serial cable proximal end connects to a wireless transmitter and a wireless receiver is connected to said monitor.

[0058] The system wherein said wireless receiver is contained within said monitor's enclosure.

[0059] The system wherein said intermediate cable proximal end connects to a wireless transmitter and said trunk cable distal end connects to a wireless receiver.

[0060] The system wherein said intermediate cable proximal end connects to a wireless transmitter and a wireless receiver is connected to said monitor.

What is claimed is:

1. A monitoring system for transmission of information from a patient residing within an infectious zone to a monitor apparatus using an assembly, said monitoring system comprising:

A monitor apparatus to process and/or display said information from said patient;

A wireless receiver connected to said monitor apparatus; and

An assembly comprising a serial cable and a wireless transmitter;

Said serial cable being of a second length and comprising a proximal end and a distal end, said proximal end comprising said wireless transmitter, said distal end comprising at least one sensor device adapted to interface

with said patient and capture said information from said patient, said second length defined as the distance from said proximal end to said distal end;
 wherein said wireless transmitter is configured to transmit said information to said wireless receiver, and said wireless receiver is configured to receive said information from said wireless transmitter;
 wherein said assembly and said wireless receiver together are configured to transmit said information from said patient to said monitor apparatus when said sensor device is interfaced with said patient;
 wherein said patient resides within and is surrounded by an infectious zone having an outer boundary demarcated by a perimeter located beyond the reach of any portions of said patient's body;
 wherein said monitor apparatus resides entirely outside said perimeter of said infectious zone, said monitor apparatus being located a distance from said perimeter, said distance being of a first length; and
 wherein said wireless receiver resides entirely outside said perimeter of said infectious zone, such that said wireless receiver cannot contact said perimeter of said infectious zone.

2. The system of claim 1 wherein said sensor device is of a type to capture said information related to at least one of the functions of electrocardiogram, heart rate, respiration, temperature, blood pressure, bio-impedance, blood oxygen, ultrasound, electro-encephalography, pulse-oximetry and generates a signal to be transmitted along said assembly to said monitor.

3. The system of claim 1 wherein said wireless receiver is contained within said monitor apparatus's enclosure.

4. The system of claim 1 further comprising a trunk cable, said trunk cable being of a third length and comprising a proximal end and a distal end, said third length defined as the distance from said proximal end to said distal end, said proximal end adapted to interface with said monitor apparatus, said distal end comprising said wireless receiver, wherein said third length is less than said first length.

5. The system of claim 1 wherein said serial cable is an electrical cable.

6. The system of claim 1 wherein said serial cable is a pneumatic cable.

7. The system of claim 1 wherein said serial cable is a fiber-optic cable.

8. The system of claim 1 wherein said serial cable is a hydraulic cable.

9. The system of claim 1 wherein said serial cable is disposable.

10. The system of claim 1 wherein said at least one sensor device is adapted to couple to said serial cable distal end.

11. The system of claim 1 wherein said sensor is an electrode.

12. The system of claim 1 wherein said wireless transmitter is adapted to couple to said serial cable proximal end.

13. The system of claim 4 wherein said wireless receiver is adapted to couple to said trunk cable distal end.

14. The assembly of claim 1 further comprising a sheath adapted to be disposed over said wireless transmitter such that said wireless transmitter is encased in said sheath.

15. A method of preventing the transfer of infective agents along a series of patients utilizing a monitoring system, said monitoring system to be subsequently used consecutively amongst said series of patients, comprising:

Defining an infectious zone surrounding said patient that is contaminated with infective agents, said infectious zone having an outer boundary demarcated by a perimeter located beyond the reach of any portions of said patient's body and where the location of said perimeter is defined by said patient's caregiver;

Deploying a monitor apparatus configured to process and/or display information conveyed from said patient, and placing said monitor apparatus outside of said perimeter of said infectious zone such that it resides a distance from said perimeter, said distance defined by a first length;

Deploying a first assembly comprising a trunk cable and a wireless receiver, Said trunk cable being of a third length and comprising a proximal end and a distal end, said proximal end adapted to interface with said monitor apparatus, said distal end comprising said wireless receiver, said third length defined as the distance from said proximal end to said distal end;

Deploying a second assembly comprising a serial cable and a wireless transmitter, Said serial cable being of a second length and comprising a proximal end and a distal end, said proximal end comprising said wireless transmitter, said distal end comprising at least one sensor device adapted to interface with said patient and capture said information from said patient, said second length defined as the distance from said proximal end to said distal end;

wherein said wireless transmitter is configured to transmit said information to said wireless receiver, and said wireless receiver is configured to receive said information from said wireless transmitter;

wherein said third length is less than said first length such that when said trunk cable proximal end is interfacing with said monitor apparatus, said wireless receiver cannot contact said perimeter of said infectious zone, and

Connecting said patient to said monitor apparatus through said first assembly and said second assembly;

wherein said connecting said patient comprises the steps of:

(1) Interfacing said trunk cable proximal end to said monitor apparatus and placing the entirety of said trunk cable in a position outside said perimeter of said infectious zone;

(2) Interfacing said sensor device to said patient so that information can be acquired from said patient and transmitted to said monitor apparatus; and

Monitoring said patient for a period of time;

Terminating said monitoring of said patient while maintaining the trunk cable outside said perimeter of said infectious zone, thereby keeping said trunk cable, said wireless receiver, and said monitor apparatus free from contamination and preventing said transfer of said infective agents to a subsequent patient in said series of patients.

16. The method of claim 15 wherein said wireless transmitter is adapted to couple to said serial cable proximal end.

17. The method of claim 16 further comprising a sheath adapted to be disposed over a said wireless transmitter such that said wireless transmitter is encased in said sheath, wherein said step of connecting said patient further comprises the step of disposing said sheath over said wireless transmitter.

18. A method of preventing the transfer of infective agents along a series of patients utilizing a monitoring system, said monitoring system to be subsequently used consecutively amongst said series of patients, comprising:

Defining an infectious zone surrounding said patient that is contaminated with infective agents, said infectious zone having an outer boundary demarcated by a perimeter located beyond the reach of any portions of said patient's body and where the location of said perimeter is defined by said patient's caregiver;

Deploying a monitor apparatus configured to process and/or display information conveyed from said patient, and placing said monitor apparatus outside of said perimeter of said infectious zone such that it resides a distance from said perimeter, said distance defined by a first length;

Said monitor apparatus comprising a wireless receiver contained within said monitor apparatus's enclosure;

Deploying an assembly comprising a serial cable and a wireless transmitter,

Said serial cable being of a second length and comprising a proximal end and a distal end, said proximal end comprising said wireless transmitter, said distal end comprising at least one sensor device adapted to interface with said patient and capture said information from said patient, said second length defined as the distance from said proximal end to said distal end;

wherein said wireless transmitter is configured to transmit said information to said wireless receiver, and said wireless receiver is configured to receive said information from said wireless transmitter;

Connecting said patient to said monitor apparatus through said assembly by interfacing said sensor device to said patient so that information can be acquired from said patient and transmitted to said monitor apparatus;

Monitoring said patient for a period of time;

Terminating said monitoring of said patient while maintaining the trunk cable outside said perimeter of said infectious zone, thereby keeping said wireless receiver and said monitor apparatus free from contamination and preventing said transfer of said infective agents to a subsequent patient in said series of patients.

19. The method of claim **18** wherein said wireless transmitter is adapted to couple to said serial cable proximal end.

20. The method of claim **19** further comprising a sheath adapted to be disposed over a said wireless transmitter such

that said wireless transmitter is encased in said sheath, wherein said step of connecting said patient further comprises the step of disposing said sheath over said wireless transmitter.

21. A monitoring system for transmission of information from a patient residing within an infectious zone to a monitor apparatus using an assembly, said monitoring system comprising:

A monitor apparatus to process and/or display said information from said patient;

A wireless receiver connected to said monitor apparatus; and

An assembly comprising a wireless transmitter and at least one sensor device adapted to interface with said patient and capture said information from said patient;

Said at least one sensor device and said wireless transmitter being connected to one another;

wherein said wireless transmitter is configured to transmit said information to said wireless receiver, and said wireless receiver is configured to receive said information from said wireless transmitter;

wherein said assembly and said wireless receiver together are configured to transmit said information from said patient to said monitor apparatus when said at least one sensor device is interfaced with said patient;

wherein said patient resides within and is surrounded by an infectious zone having an outer boundary demarcated by a perimeter located beyond the reach of any portions of said patient's body;

wherein said monitor apparatus resides entirely outside said perimeter of said infectious zone, said monitor apparatus being located a distance from said perimeter, said distance being of a first length; and

wherein said wireless receiver resides entirely outside said perimeter of said infectious zone, such that said wireless receiver cannot contact said perimeter of said infectious zone.

22. The system of claim **21** wherein said wireless transmitter and said at least one sensor device are integrated together.

23. The system of claim **21** wherein said wireless receiver and said monitor apparatus are integrated together.

24. The system of claim **22** wherein said wireless receiver and said monitor apparatus are integrated together.

* * * * *

专利名称(译)	监控系统的系统配置		
公开(公告)号	US20160183790A1	公开(公告)日	2016-06-30
申请号	US14/836956	申请日	2015-08-26
[标]申请(专利权)人(译)	GRAYZEL JOSEPH GRAYZEL JEFFREY		
申请(专利权)人(译)	GRAYZEL , JOSEPH GRAYZEL , JEFFREY		
当前申请(专利权)人(译)	GRAYZEL , JOSEPH GRAYZEL , JEFFREY		
[标]发明人	GRAYZEL JOSEPH GRAYZEL JEFFREY		
发明人	GRAYZEL, JOSEPH GRAYZEL, JEFFREY		
IPC分类号	A61B5/00 A61B8/00 A61B5/0476 A61B5/0205 A61B5/0402		
CPC分类号	A61B5/002 A61B5/02055 A61B5/0402 A61B2562/224 A61B8/00 A61B2562/222 A61B2562/223 A61B5/0476 A61B5/00 A61B5/021 A61B5/04286 A61B2562/221 A61B2562/225 A61B2562/247		
外部链接	Espacenet USPTO		

摘要(译)

电缆的物理配置和用于将监测设备连接到人类患者的无线通信系统，其中所述患者及其周围环境限定潜在的传染性污染区域。该配置使监测装置和无线接收器位于污染区域之外，并且一条或多条串行电缆与所述感染区内的所述患者接口。无线发射器连接到所述串行电缆近端，并配置成将患者信息无线传输到连接到监视设备的所述无线接收器。该物理配置防止监测设备和无线接收器的污染，因此它们可以在连续的患者上重复使用，并且防止感染剂转移到一系列患者中的后续患者。用于在其污染区域内接触患者的串行电缆可以是一次性的。提供监视各种生理参数的示例以举例说明这种物理配置的通用概念。在某些实施例中，无线发射器可以与附接到患者的传感器设备集成，和/或无线接收器可以与监视设备集成。

