



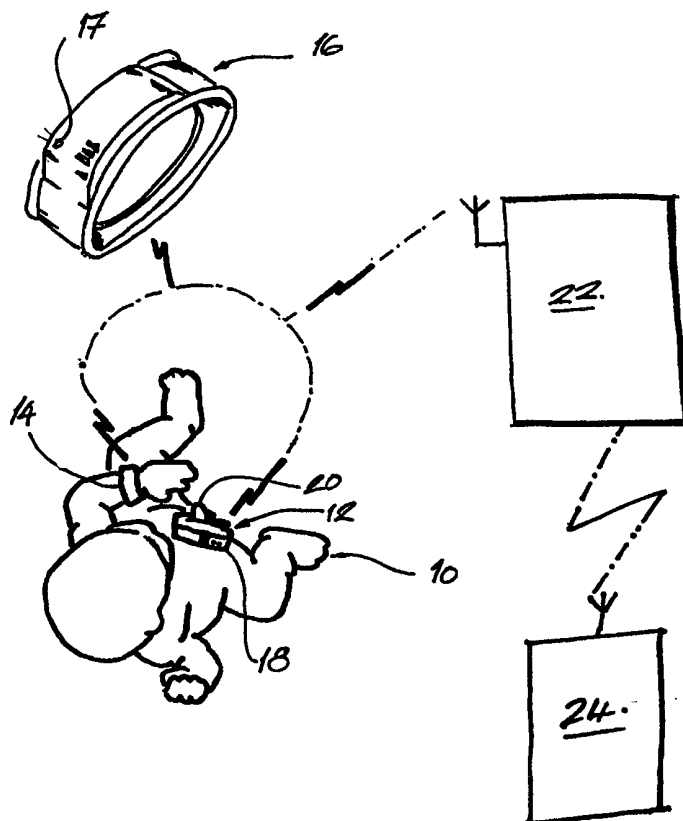
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : G08B 13/14, 21/00, 23/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 99/65004 (43) International Publication Date: 16 December 1999 (16.12.99)</p>
<p>(21) International Application Number: PCT/ZA99/00044 (22) International Filing Date: 11 June 1999 (11.06.99) (30) Priority Data: 98/5058 11 June 1998 (11.06.98) ZA (71) Applicant (for all designated States except US): MUSHROOM BIOMEDICAL SYSTEMS (PROPRIETARY) LIMITED [ZA/ZA]; 7 Buffalo Street, Vygeboom, Durbanville 7550 (ZA). (72) Inventors; and (75) Inventors/Applicants (for US only): FOURIE, Pieter, Rousseau [ZA/ZA]; 7 Buffalo Street, Vygeboom, Durbanville 7550 (ZA). WESSELS, Jacobus, Adriaan [ZA/ZA]; 32 Candelbos Street, Loevenstein, Bellville 7530 (ZA). (74) Agent: ASHBY, Kevin, Peter; Hofmeyr Herbstein Gihwala Cluver & Walker Inc., P.O. Box 12, Stellenbosch 7559 (ZA).</p>		<p>(81) Designated States: AL, AT, AU, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, HR, HU, ID, IL, IN, IS, JP, KE, KP, KR, LC, LK, LR, LT, LU, LV, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SE, SG, SI, SK, TR, TT, UA, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report.</p>

(54) Title: PERSON MONITORING APPARATUS

(57) Abstract

A monitoring system in particular for infants comprises intercommunicating child and mother stations (14, 16), the mother station (16) containing data pertaining to both mother and her infant (10) and the child station (14) being attached to such infant (10) at birth, preferably to its umbilical stump (20) by a monitor (12)/clamp (18) and containing data regarding the infant (10), such that an association is established between the mother and child stations (14, 16). The association may be established by the provision of matching encoded data strings, assisting in guarding against the mismatching of mother and infant (10) after completion of the birthing process. In a preferred embodiment, an alarm is given in the event that the mother and child stations (14, 16) become separated beyond a predetermined distance. Also disclosed are a local control station (22) and a central control station (24) communicable with the system.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

PERSON MONITORING APPARATUS

Field of invention

5

This invention relates to a system of monitoring a person and in particular for guarding an infant and has application particularly during the stay of such person in a healthcare facility such as a clinic, hospital, nursing home or other similar establishment.

10

Background to the invention

Abductions of newborn babies are not frequent occurrences, but when they do occur, the emotional trauma that inevitably results is almost impossible to quantify. In addition, such abductions expose healthcare facilities to potential loss arising out of possible litigation and damage to their public image.

15

This invention provides a simple monitoring system to guard infants during their stay at healthcare facilities and thereafter, since the monitoring system of the invention can be expanded to guard against unauthorised discharge of the mother and child from the healthcare facility. In addition, the system can incorporate means to monitor the vital signs of the child to guard, for instance, against cot death or sudden infant death syndrome (SIDS).

20

Known systems for monitoring and locating objects, animals or articles use monitoring base stations communicating by ID code with portable transponders, which are secured to the objects to be monitored. The transponder responds to signals transmitted by the base, the latter indicating by an alarm the absence of a timely or appropriate response from the transponder. USA patent no. 4,918,425 to Greenberg describes such a system. Such simple systems are insufficient, however, to perform the more complex monitoring functions required to be addressed by this invention.

25

30

It is thus an objective of this invention to provide a monitoring system suited for use in relation to an infant that will assist in guarding against unauthorised removal of such infant from a care-giver's custody. A further object is to provide a monitoring system that will assist in detecting failure of a subject's vital signs.

5

Another object of the invention to provide means for detecting and signalling to a custodian or mother that she does not have the correct subject or infant in her care.

Summary of the invention

10

According to this invention, an infant monitoring system comprises a child station and a remote mother station each having communication means enabling communication between them, the child station including a monitor that is securable to the body of an infant to be monitored, the monitor comprising data storage means for storing data pertaining to the infant, the data including identification means unique to the infant, and the mother station having data storage means for storing data pertaining to the mother, such data collectively being capable of providing positive identification to the mother of such infant.

20 The mother station is intended to be under the control of the authorised nurturer of the infant. In most circumstances, this will be the biological mother of the infant, but it will be appreciated that a broader meaning is implied to include nurturers or care givers other than the child's mother.

25 The data capable of giving positive identification include encoded portions provided at the respective mother and child stations. Preferably, the encoded portions from the respective stations should match each other.

In a preferred form of the invention, the communication means comprises transmitter means for regularly communicating data between stations. Fixed range communication transmitters are preferred.

30

The child station monitor comprises an umbilical stump monitor that includes a housing having secural means for securing it to the infant's umbilical stump. Preferably, the secural means comprises clamping means intended to be clamped around the umbilical cord of the infant during the delivery procedure and remain
5 secured to the remnant umbilical stump thereafter.

The umbilical stump monitor includes sensor means for sensing vital signs of the subject infant, the sensor means including breathing detection means, such as an accelerometer. The monitor may further incorporate replayer means to retrieve and
10 replicate the data upon interrogation from a remote station by an appropriate interrogation mechanism.

The data storage means preferably comprises automatic actuation means adapted for automatic actuation of the said data storage means upon closing of the clamp
15 about the umbilical cord of the infant during delivery of the infant.

The child station may, in addition to the umbilical stump monitor incorporate a limb monitor that is adapted for securement to a limb of the infant, the limb monitor comprising communication means capable of relaying communication between the
20 umbilical stump monitor and the mother station.

In this form of the invention, the infant armband monitor may include one or more monitors adapted to monitor vital signs of the infant and to communicate data pertaining to such vital signs to the mother station. Such vital signs monitors could
25 include an impedance monitor, which can serve as a breathing and heart rate monitor, or a separate heart rate monitor.

Communication means between the limb monitor and the umbilical stump monitor is preferably limited on a fixed range basis.

30

The monitoring system of the invention preferably further includes a local control station that has communication means at least with the child station. The local

control station should preferably communicate with either or both the umbilical stump monitor and the infant limb monitor. Optionally, it may also communicate with the mother station.

5 In the preferred form of the invention, the local control station is adapted to serve as the principal controller of the integrity of the monitoring system, the local control station being adapted to raise an alarm upon the occurrence of one or more of the following alarm conditions:

10 detachment of the umbilical stump monitor from the umbilical stump of the infant;

detachment of the infant armband monitor from the arm or leg of the infant;

15 an abnormal increase in the distance between the umbilical stump monitor and the infant armband monitor;

an abnormal increase in the distance between the local control station and either or both of the umbilical stump monitor and the infant armband monitor;

20 and

an abnormal condition in one or more of the vital signs of the infant monitored by the system.

By utilising fixed range communication systems for the monitors, abnormal distance
25 alarm conditions can be determined distance determining means and by means of out of range signals emitted by the various monitors. Alternatively an abnormal distance signal can be generated by means of signal strength monitors set to respond to substrength signals.

30 The mother station can be constituted by a portable transceiver that is adapted to communicate with the child station. In a preferred form of the invention, the station comprises a securement means such as an armband that is adapted for securement

to the arm of the mother. Alternatively, the securement means may comprise a strap or an expansible bracelet.

In a further preferred form of the invention, the mother's armband is adapted to be securable to the mother during delivery of the infant, with data entry into the children's subsystem being enabled conditional on proximity of a mother armband that, for better security, may only be activated by securement of the mother's armband to the arm of the mother, for example through the provision of suitable switching means.

10

The mother and child stations preferably include programmable identification means comprising instructions for determining a match, during communication with one another, and providing positive identification of the child, for instance by means of a discernable signal. Such signal may be an audible or visible signal such as a light-emitting diode (LED) that lights up on the mother's armband when the matching child station is brought into communication proximity with the mother's armband.

15

Alternatively, warning signal emitting means may be provided to be activated responsive to a mismatch of mother and infant data.

20

The system may be supplemented by area monitors, such as door post monitors, adapted to raise an alarm within the monitoring system or (for instance by alerting the mother) or externally of the monitoring system (for instance by raising an alarm in the healthcare facility) upon the unauthorised movement of any one of the umbilical stump monitor, the infant limb monitor or the local control station through a monitored checkpoint at the boundary to the monitored area, such as a door post.

25

In addition, the infant monitoring system may include a central control station adapted for operation by the healthcare facility, having communication means with the local control station and into which central control station data may be transferred, through use of such means, for storage or action in the event of an alarm condition arising in the system.

30

The system includes an infant abdomen monitor that has means for securement to the abdomen of the infant by means of an adhesive cover, the abdomen monitor serving to replace the umbilical stump monitor, when, in the normal course of development of the infant, the umbilical clamp falls off.

The system also includes an apnoea monitor that is adapted to replace the local control station when the infant leaves the healthcare facility, the apnoea monitor being the functional equivalent of the local control station.

All communications within the system may be rendered secure by means of data encryption.

Brief description of the drawings

Figure 1 illustrates the infant monitoring system of the invention in block diagram form.

Figure 2 is a perspective view of an exemplary umbilical clamp monitor incorporating an umbilical cord clamp, according to the invention.

Figure 3 illustrates in perspective view an armband mother station exemplary of an embodiment of the invention.

Description of embodiments of the invention

The infant monitoring system of this invention comprises child and mother stations that are enabled to communicate with one another through the provision at each one of communication means. Such means are suitable for the transmission of data between the stations by electromagnetic radiation means, such as radio waves, as is known in the art.

At each station are means for storing data pertaining respectively to the infant and to the mother. The data includes a first portion identifying the respective party and a second portion that matches data stored at the other station, or a positive identification criterion relating to such data, enabling testing and authentication thereof on receipt. The matching data is preferably encoded, further preferably by an encryption algorithm or engine and preprogrammed to be stored in the respective stations prior to delivery of the infant from the mother. Where encoded data transmitted from the child station match encoded data from the mother station, an association is established between the mother and her baby that may be used to identify the infant positively as belonging to the mother and may further be used to alert third parties should the mother and her infant become separated by more than a predetermined maximum distance.

A transmitter contained in the child station regularly transmits encoded data that is receivable by the mother station receiver for confirmation of the identity and proximity of the infant station and thus of the infant to which it is secured. In a preferred embodiment, the child station transmitter transmits a fixed range signal and if the mother station receiver fails to receive it or determines it to be substrength, an "out- of-range" condition is signalled, setting off an alarm to alert the mother or care giver.

In a further preferred embodiment of the invention, the child station comprises at least one, but preferably two sensors capable of monitoring vital signs of the infant to which it is attached for monitoring. The sensors may be attached to limbs and or abdomen or torso of the child. Preferably, attachment is initially accomplished at birth by securement to the infant's umbilical cord and subsequent umbilical stump by suitable clamping means. An example of such clamping means is described below with reference to figure 3.

In figure 3 the umbilical cord monitor comprises a housing in two hingedly attached jaw-like halves, attached by a tensioned hinge connector. Opposed gripping means in the form of tooth-like formations provide means for securely

gripping the umbilical cord or stump of the infant when the jaws are moved together into closed position. The protruding end portions 36, 38 on closing of the jaws locate into receiving sockets 40, 42 located in the opposed jaw portion.

5 Within the housing, rendered sufficiently water- and tamper-proof, are located electronic circuitry comprising the communication means, being a transceiver and data storage chip and appropriate processor means capable of responding to interrogatory instructions received via the transceiver. In response to such instructions, the processor is programmed to cause retrieval of stored data and
10 onward communication to the interrogating station.

Such station would typically be the mother station, but may also or alternatively be a control station as will be elaborated on below, with reference to figure 1.

15 The stored data comprises identification code pertaining to the infant, but may additionally include data relating to the infant's vital signs, such data being collected periodically or continuously from appropriate sensors mounted in the housing.

The sensors thus may comprise one or both of a heart beat or pulse and a breathing
20 sensor means – for example an accelerometer or an impedance sensor and the like.

The invention will be further described with reference to figure 1, in which a non-limiting embodiment is illustrated schematically by way of example only.

25 Referring to figure 1, the child station is shown to be made up of a pair of monitors that are adapted for securement to a born infant 10, the monitors being respectively an umbilical stump monitor 12 and an armband monitor 14.

The mother station is made up of an armband 16 that is adapted for securement to
30 the arm of the child's mother.

The umbilical stump monitor 12 is incorporated in a modified umbilical cord clamp 18. The umbilical cord clamp 18 is used to clamp off the umbilical cord of the infant and the remaining umbilical stump 20 during the delivery procedure.

- 5 The umbilical stump monitor incorporates a radio transceiver and an accelerometer as well as programmable logic means in the form of electronic data storage circuitry.

The umbilical stump monitor 12 is actuated when the umbilical cord clamp 18 is clamped around the umbilical stump 20 during the delivery procedure. A non-
10 contact data writing device, such as an induction coil, is then used to write data specific to the infant into the data storage means. To enhance the security of the system, the umbilical stump monitor is programmable to require a specific initialisation procedure that requires the presence or initialisation of one or more of
15 the subsystems of the infant monitoring system of the invention. For instance, the initialisation procedure may optionally be designed to require the proximity of the mother's armband 16 in order to enable programming of the umbilical stump monitor
12.

20 The accelerometer in the umbilical stump monitor 12 is used to detect the breathing rhythm of the infant 10.

The child station includes an infant armband monitor 14 that is secured to a limb - either a leg or arm - of the infant during its. The armband monitor 14 incorporates a radio transceiver that relays communications between the umbilical stump monitor
25 12 and the mother's armband 16.

In addition, the infant's armband monitor 14 includes sensors or monitors adapted to monitor vital signs of the infant 10. For instance, the infant's armband monitor 14 includes an impedance monitor which senses and monitors the infant's breathing
30 and heart rates.

The mother station is constituted by the mother's armband 16.

In its simplest form, the infant monitoring system of the invention permits positive identification of the child 10. This is done through radio communications between the mother and child stations with the mother's armband 16 containing an indicator such as a light emitting diode (LED) 17 that lights up when the mother's armband 16 identifies the child station through identification of either or both of the umbilical stump monitor 12 and the infant's armband 14. Identification is preferably by means of receiving an unique code transmitted from the child station components that matches a code stored at the mother station. This will confirm, to the mother, that the child being presented to her really is her's. As an alternative to the LED 17, an indicator comprising an audible alarm or some other attention drawing means, such as a vibrating device, may be used.

With the incorporation of the monitors and sensors referred to above, however, the system of the invention is capable of performing substantially more complex monitoring functions. To exploit these functions, the system incorporates a local control station 22.

The local control station 22 can either be attached to the infant's cot or pram or carried around by the mother. By incorporating the local control station 22 in the cot of the infant 10, a radio communication link can be established between the components (12, 14) of the child station and the local control station 22. The control station 22 can then be used to receive data from the monitors and sensors forming part of the child station to monitor data such as heart rate, breathing and the integrity of the system.

The latter function will monitor against abduction of the child. Should the integrity of the system be compromised by one or more alarm conditions, the local control station 22 can be used to raise an alarm. The most obvious alarm condition is constituted by an abnormal increase in the distance between the local control station and either or both of the umbilical stump monitor 12 and the infant's armband monitor 14 such as might arise when the infant 10 is removed from her cot or the

vicinity of the mother (the vicinity of the local control station 22) without authorisation.

5 The umbilical stump monitor 12 and the infant's armband monitor 14 could also be programmed to signal an alarm condition should there be any attempt at detaching either or both of the two monitors, 12 or 14 from the infant 10. If the umbilical stump monitor 12 and the infant's armband monitor 14 should become separated from one another by more than a predetermined distance, this could, in itself, constitute an alarm condition.

10

All of these alarm signals can be created with the use of fixed range transceivers and circuitry adapted to poll the transceivers periodically and to output an out-of-range signal whenever a transceiver poll yields a negative result or a weak signal result. In addition, the local control station 22 can be programmed to raise an alarm on receipt of an alarm signal output by one or more of the vital signs sensors incorporated in the umbilical stump monitor 12 or the infant's armband 14. By programming the local control station 22 to read the cessation of the infant's breathing or heartbeat as alarm conditions, the local control station acts as an apnoea or heart arrest monitor.

15

20 In order to increase the efficacy of the system in guarding against abduction, the system may include vicinity monitors, such as door post monitors, that are adapted to raise an alarm upon the unauthorised movement of any one of the umbilical stump monitor 12, the infant's armband monitor 14 or the local control station 22 through a monitored doorpost.

25

In this form of the invention, the alarm could be raised locally - that is by an audible or visible alarm signal output - by one or all of the umbilical stump monitor 12, the infant's armband 14 or the local control station 22. Alternatively or in addition, the alarm signal could also be used to alert the mother by means of an audible or visible alarm signal output by the mother's armband 16. The alarm signal can be supplemented by an alarm that is raised within the healthcare facility itself.

30

Another level of security could be added by programming the system to ensure that the mother always accompanies the infant through a monitored doorpost. This can be done by requiring the simultaneous detection of both the mother's armband 16 and one or both of the umbilical stump monitor 12 and the infant's armband 14 by the door post monitor. If only one of these items passes a doorpost monitor unaccompanied by the other, an alarm will be raised.

In order to raise an appropriate alarm, the healthcare facility can be equipped with a central control station 24 that is adapted for operation by the healthcare facility. The central control station may serve as a collector of data and as a central monitoring station for alarm conditions detected by the infant monitoring system of the invention.

In the event that the local control station 22 is incorporated in the cot of the infant, the healthcare facility will normally retain the local control station for reuse when the infant 10 and her mother are discharged from the healthcare facility. To replace the local control station 22, the system may incorporate an apnoea monitor that is essentially the functional equivalent of the local control station 22. The apnoea monitor may be sold or lent to the mother to monitor the vital signs of the infant 10 at home through signals output by the components 12, 14 of the child station.

The umbilical cord clamp 18 will fall off in the normal course of development of the infant 10. When this should occur, the umbilical stump monitor 12 can be replaced by an abdomen monitor constituted by sensors and circuitry equivalent to the sensors and circuitry found in the umbilical stump monitor 12, the exception being that they are contained in a monitor that is taped to the abdomen of the infant 10 by an adhesive cover. The abdomen monitor could also be located in a vest that accommodates the monitor circuitry and that fits snugly around the abdomen of the infant 10.

During certain deliveries, such as with some premature infants, babies delivered by Caesarian section or infants intended for more intensive care, the umbilical stump is often removed immediately to permit intubation of the infant through the navel. In these situations, the infant may also be fitted with an abdomen monitor immediately
5 upon removal of the umbilical stump.

Figure 2 illustrates an alternative embodiment of an armband wearable by the mother or care-giver and constituting the mother station of the system. Here the armband is in a wristwatch-like configuration comprising a housing 50 to which is
10 attached connectable strap portions 52, 54 of conventional design. A display 56 provides output relating selectively to infant's pulse, breathing rate and temperature and a loudspeaker 58 provides audible alarm signals when activated by an alarm condition.

15 The housing contains the transceiver device that emits regular signals, so that when, for example, the mother passes a door post checkpoint, the receiver at such checkpoint records MOTHER. In the event such mother passes the checkpoint with an infant, the receiver will receive signals from both the mother station and infant
20 station. Should the coded portion of the signal match, an OK condition is recorded, failing which BABY alone is detected, an alarm signal is generated and this is communicated to the control room of the establishment and or to the matching mother station and, optionally, to the control station as well.

To enhance the security of the system, the data communicated within the infant
25 monitoring system may be rendered secure by means of secure data encryption.

CLAIMS

- 1 An infant monitoring system comprising a child station and a remote mother
station each having communication means enabling data communication
5 between them, the child station including a monitor that is securable to the
body of an infant to be monitored, the monitor comprising data storage means
for storing data pertaining to the said infant, such data including identification
means unique to said infant and the mother station having data storage
means for storing data pertaining to the infant's mother, such data collectively
10 being capable of providing positive identification to the mother of such infant.
- 2 An infant monitoring system according to claim 1 wherein the positive
identification data include encoded portions provided at the respective mother
and child stations.
- 15 3 An infant monitoring system according to claim 2 wherein the encoded data
portion from the child station matches the encoded portion from the mother
station.
- 20 4 An infant monitoring system according to any one of the preceding claims
wherein the communication means comprises transmitter means for regularly
communicating the data between stations.
- 5 An infant monitoring system according to claim 4 wherein the communication
25 means is a fixed range communication means.
- 6 An infant monitoring system according to any one of the preceding claims
wherein the child station monitor comprises an umbilical stump monitor
including a housing having secural means for securing it to the infant's
30 umbilical stump.

- 7 An infant monitoring system according to claim 6 wherein the securing means comprises clamping means for clamping around the umbilical cord of said infant.
- 5 8 An infant monitoring system according to claim 7 wherein the umbilical stump monitor comprises vital signs sensing means sensitive to detect vital signs of the infant.
- 9 An infant monitoring system according to claim 8 wherein the vital signs
10 sensing means comprises breathing detection means.
- 10 An infant monitoring system according to claim 9 wherein the breathing detection means comprises an accelerometer.
- 15 11 An infant monitoring system according to any one of the preceding claims wherein the child station includes replayer means to retrieve and replicate the data upon interrogation from a remote station.
- 12 An infant monitoring system according to claim 11 wherein the data storage
20 means comprises automatic actuation means for automatically actuating said data storage means upon closing of the clamp about the umbilical cord of the infant.
- 13 An infant monitoring system according to any one of the preceding claims
25 wherein the child station further comprises a limb monitor that is securable to a limb of said infant, the limb monitor comprising communication means capable of relaying communication between the umbilical stump monitor and the mother station.
- 30 14 An infant monitoring system according to claim 13 wherein the limb monitor includes one or more vital signs monitors capable of monitoring vital signs of

the infant and of communicating data pertaining to such vital signs to the mother station.

- 5 15 An infant monitoring system according to claim 14 wherein at least one vital signs monitor is a heart rate monitor.
- 16 An infant monitoring system according to claim 15 wherein at least one vital signs monitor comprises a breathing monitor.
- 10 17 An infant monitoring system according to any one of claims 14 to 16 wherein at least one vital signs monitor comprises an impedance monitor.
- 18 An infant monitoring system according to any one of the preceding claims comprising fixed range communication means providing communication
15 between the umbilical stump monitor and the infant limb monitor.
- 19 An infant monitoring system according to any one of the preceding claims further including a local control station having means of communication with the child station.
20
- 20 An infant monitoring system according to claim 19 wherein the local control station has means of communication with at least one of the umbilical stump monitor and the infant limb monitor.
- 25 21 An infant monitoring system according to claim 19 or claim 20 wherein the local control station has means of communication with the mother station.
- 22 An infant monitoring system according to any one of claims 19 to 21 wherein the local control station is adapted to function as principal controller of the integrity of the monitoring system, and comprises alarm raising means
30 adapted to raise an alarm responsive to occurrence of at least one of the following alarm conditions:

- detachment of the umbilical stump monitor from the umbilical stump of the infant;
- detachment of the infant armband monitor from the arm or leg of the infant;
- 5 • an abnormal increase in distance between the umbilical stump monitor and the infant armband monitor;
- an abnormal increase in distance between the local control station and at least one of the umbilical stump monitor and the infant armband monitor; and
- 10 • an abnormal condition in one or more of the vital signs of the infant.

23 An infant monitoring system according to claim 22 wherein the alarm raising means comprises distance determining means and signalling means for emitting an out of range signal on determination by the distance determining means of any one of the abnormal distance increase alarm conditions.

15

24 An infant monitoring system according to claim 22 comprising signal strength monitoring means, means connected thereto for generating an alarm signal in response to detecting a substrength signal indicative of said abnormal distance increase.

20

25 An infant monitoring system according to any one of the preceding claims wherein the mother station comprises securement means for rendering it securable to the arm of the care giver or mother of the infant.

25

26 An infant monitoring system according to claim 25 wherein the securement means is selected from an arm band, a strap and an expansible bracelet.

27 An infant monitoring system according to claim 25 or claim 26 wherein the mother station is adapted to be secured to the mother during delivery of the infant.

30

- 28 An infant monitoring system according to claim 27 wherein the mother station includes input means enabling data entry into the child station, such data entry being rendered conditional on proximity of such mother station during such delivery.
- 5
- 29 An infant monitoring system according to claim 28 comprising activation means responsive to securement of the mother station to the arm of the mother.
- 10
- 30 An infant monitoring system according to claim 29 wherein the mother station includes programmable identification means comprising instructions for determining whether the encoded data from the child station matches data at the mother station and signalling means capable of emitting a discernable signal in the event of failure to determine a match.
- 15
- 31 An infant monitoring system according to claim 30 wherein the emitted signal is audible.
- 32 An infant monitoring system according to claim 30 wherein the emitted signal is visible.
- 20
- 33 An infant monitoring system according to claim 30 wherein the signalling means comprises a light-emitting diode (LED) that lights up responsive to a match being determined.
- 25
- 34 An infant monitoring system according to any one of claims 6 to 33 further comprising at least one area monitor having alarm raising means adapted to raise an alarm upon the unauthorised movement of any one of the umbilical stump monitor, the infant limb monitor or the local control station beyond a predefined, monitored area.
- 30

- 35 An infant monitoring system according to claim 34 wherein the area monitor comprises a door post monitor.
- 36 An infant monitoring system according to claim 34 or 35 wherein the alarm raising means is operable within the monitoring system to alert the mother.
- 37 An infant monitoring system according to claim 34 or 35 wherein the alarm raising means is operable externally of the monitoring system to raise an alarm at a remote location.
- 38 An infant monitoring system according to any one of the preceding claims further comprising a central control station for operation by a healthcare facility and having communication means capable of establishing communication between it and the control station, into which central control station data may be transferred, using such means, for storage or action in the event of an alarm condition arising in the system.
- 39 An infant monitoring system according to any one of the preceding claims further including an infant abdomen monitor having securement means to the abdomen of the infant, the abdomen monitor serving to replace the umbilical stump monitor, when in the normal course of development of the infant the umbilical clamp becomes detached from the infant.
- 40 An infant monitoring system according to claim 39 wherein the abdomen monitor securement means comprises an adhesive cover.
- 41 An infant monitoring system according to any one of claims 19 to 40 including a replacement station for the local control station when the infant is ready to leave the healthcare facility, the replacement station being an apnoea monitor and a functional equivalent of the local control station.

- 42 An infant monitoring system according to any one of the preceding claims comprising data encryption means for encrypting communications within the system.
- 5 43 An infant monitoring system substantially as described herein with reference to any one of the accompanying drawings.

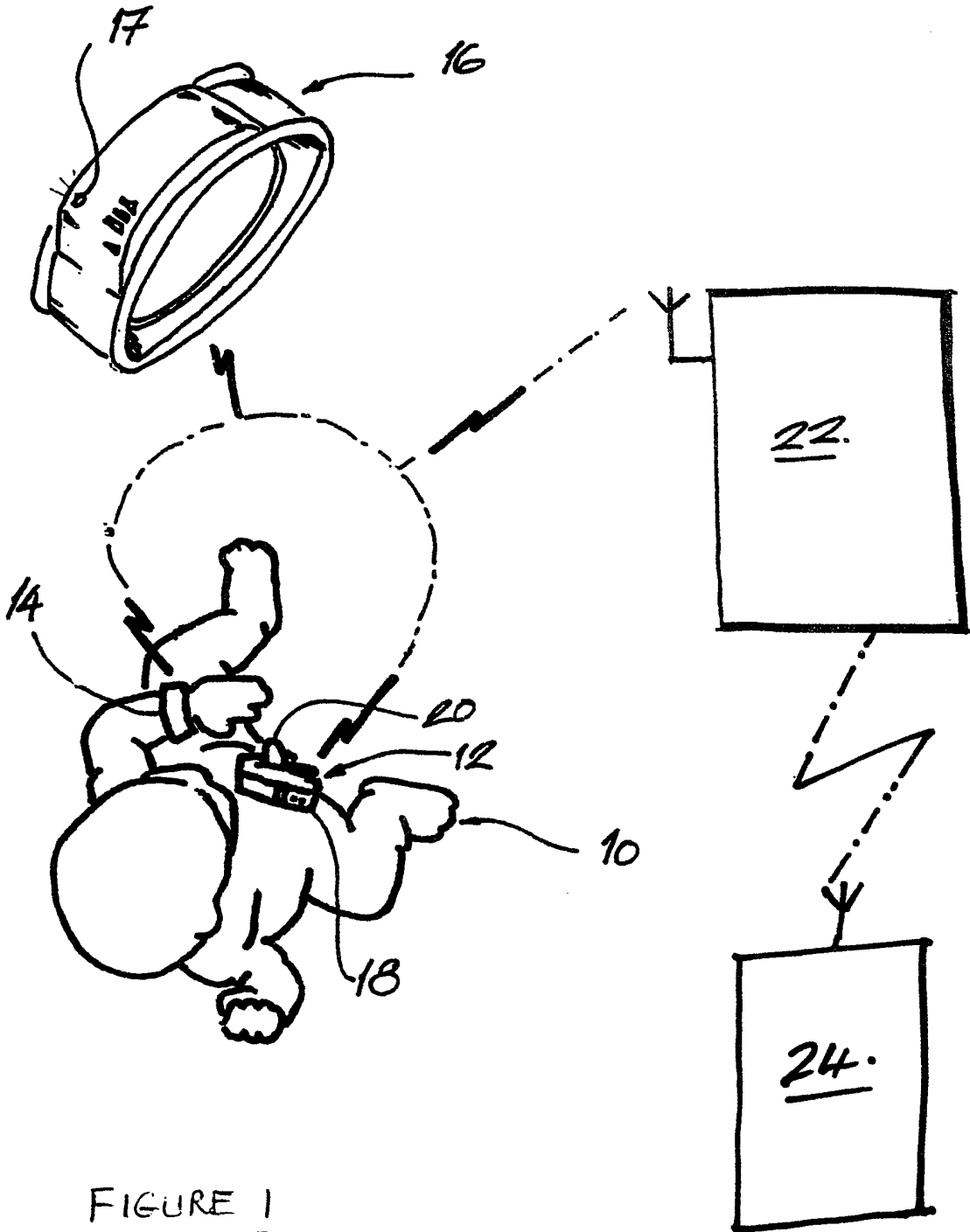


FIGURE 1

FIGURE 2

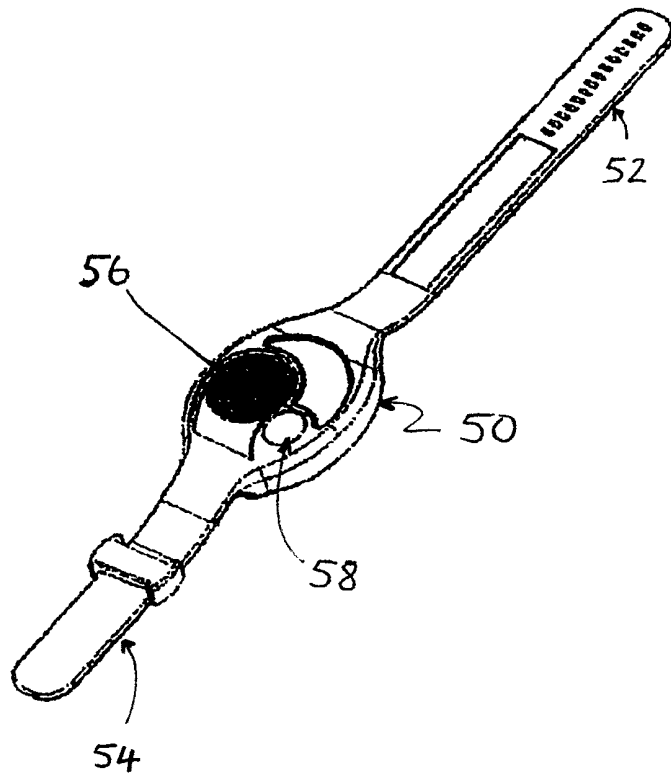
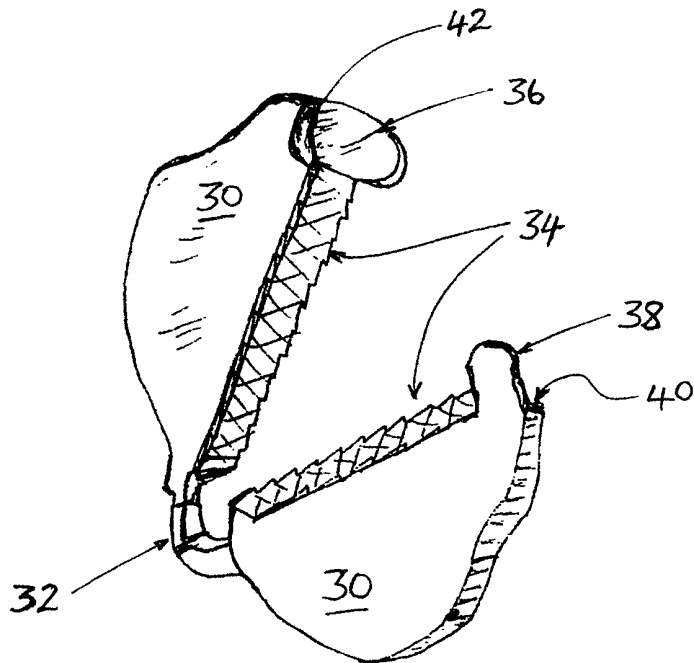


FIGURE 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/ZA 99/00044

A. CLASSIFICATION OF SUBJECT MATTER																						
Int Cl ⁶ : G08B 13/14, 21/00, 23/00																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols) IPC: G08B 13/14, 21/00, 23/00; A61B 5/113, 5/024																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: IPC as above																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT: MONITOR: OR ALARM: ID OR IDENTIF.; RANGE OR PROXIM: OR LOCAT.; DISTANCE OR SEPARAT.; TRANSMISSION OR TRANSMIT: OR REMOTE: OR RADIO OR WIRELESS; INFANT# OR CHILD: OR BABY OR PATIENT#																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X	US 5714932 A (CASTELLON et al) 3 February 1998 Abstract, column 1 to column 14 line 5, column 23 line 63 to column 24 line 2, and drawings	1-5, 42																				
Y	Entire document	6-41																				
X	US 5646593 A (HUGHES et al) 8 July 1997 Entire document	1-5, 42																				
Y		25, 26																				
X	WO 9618913 A (SECURE TECHNOLOGIES, INC) 20 June 1996 Entire document	1-5, 42																				
Y	Entire document	6-26, 34																				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A"</td> <td>Document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>Earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>Document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>Document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>Document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	Document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	Earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	Document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	Document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	Document published prior to the international filing date but later than the priority date claimed		
"A"	Document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																			
"E"	Earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																			
"L"	Document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
"O"	Document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	Document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search 10 August 1999		Date of mailing of the international search report 13 AUG 1999																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer C BERKO Telephone No.: (02) 6283 2169																				

INTERNATIONAL SEARCH REPORT

International application No.

PCT/ZA 99/00044

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 800054 A (CZERNY et al) 24 January 1980 Abstract, and drawings	6-22, 27
Y	EP 602459 A (SIEMENS MEDICAL SYSTEMS, INC) 22 April 1994 Entire document	9-17, 22
Y	GB 2261290 A (REMY) 5 December 1993 Entire document	6-26, 39-41
Y	US 4918425 A (GREENBERG et al) 17 April 1990 Abstract, and drawings	38
Y	US 5615688 A (O'DWYER) 1 April 1997 Abstract, claims, and drawings	41
A	US 5484060 A (MIDDLE et al.) 16 January 1996 Entire document	6-41

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/ZA 99/00044

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member				
WO	9618913	EP	800653	US	5589821	US561460
WO	8000054	DE	2826391	EP	16052	
EP	602459	US	5458123			
GB	2261290	US	5749365	WO	9308734	

END OF ANNEX