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US 6629285 B **US 6222484 B1**
US 4833477 B **US 20040217900 A**

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INT CL **G01S, G08B, G08C, H04L**
Other: **WPI, EPODOC**

(54) Abstract Title**: Communicating vessel location information**

(57) Techniques for communicating with a vessel are disclosed. A method of communicating with a vessel comprises the steps of: transmitting at predetermined intervals a position information message from the vessel over a return communications channel; monitoring the return communications channel; in the event that the position information message is not received over the return communications channel within a predetermined period encompassing the predetermined interval, transmitting a position request message to the vessel over an outgoing communications channel; monitoring the outgoing communications channel; and in response to receipt of the position request message at the vessel, transmitting a position response message from the vessel over the return communications channel. It will be appreciated that this approach improves the reliability of the communications link. Also disclosed is a personal safety device worn by crew members which communicates with an on-board transceiver and activates an alarm in emergency situations.

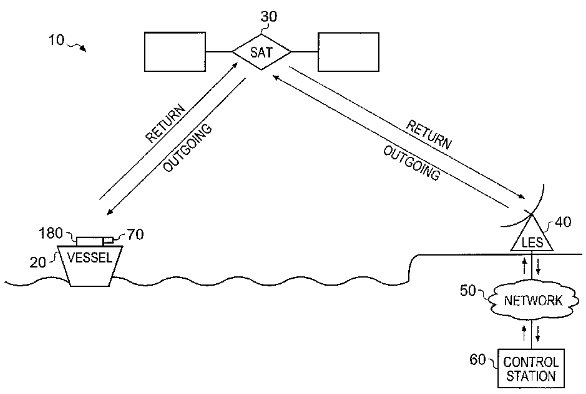


Fig. 1

GB 2 430 112 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

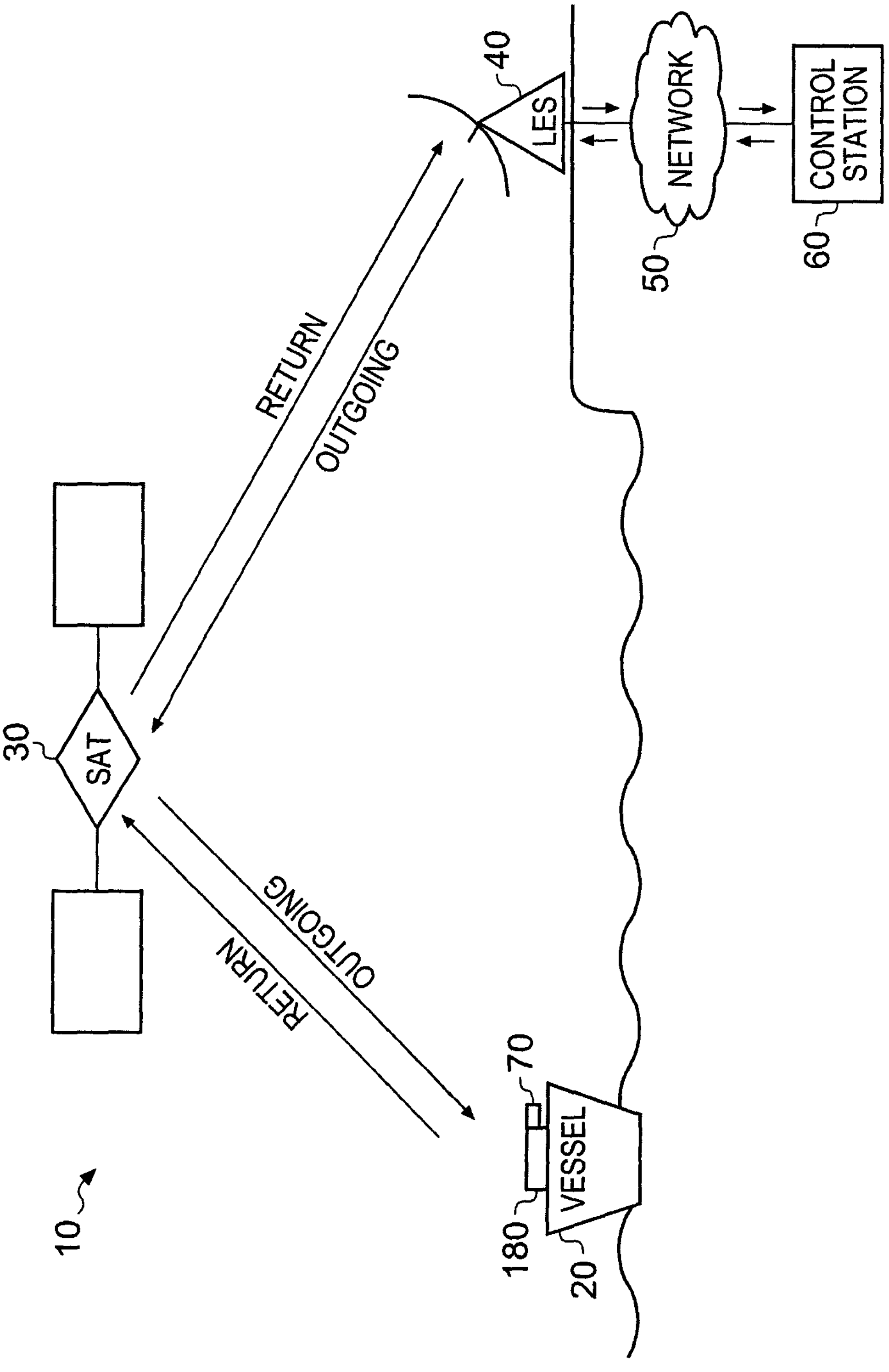

10
SAT
30
RETURN
OUTGOING
LES
40
NETWORK
50
CONTROL STATION
60
VESSEL
20
70
180

Fig. 1

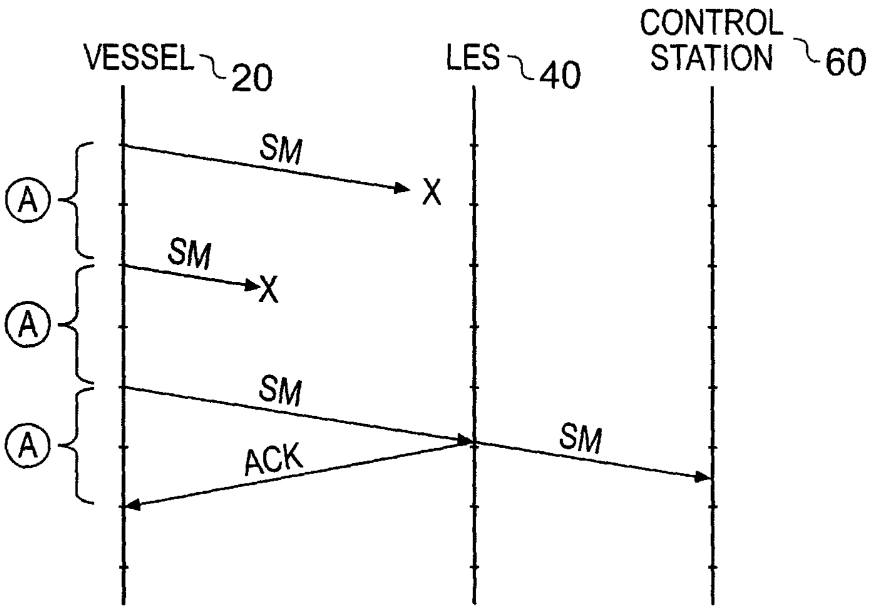

VESSEL
20
LES
40
CONTROL STATION
60
SM
X
SM
X
SM
SM
ACK
A
A
A

Fig. 2

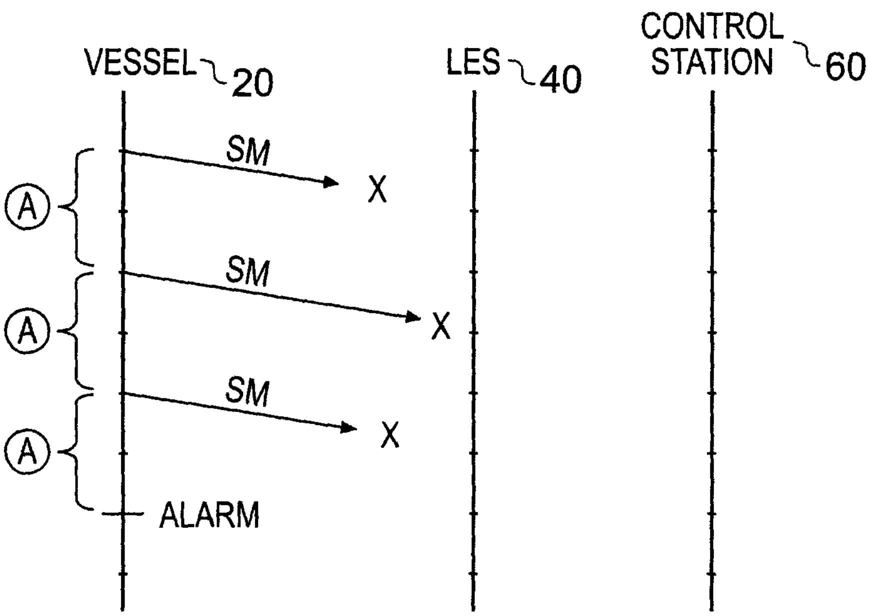
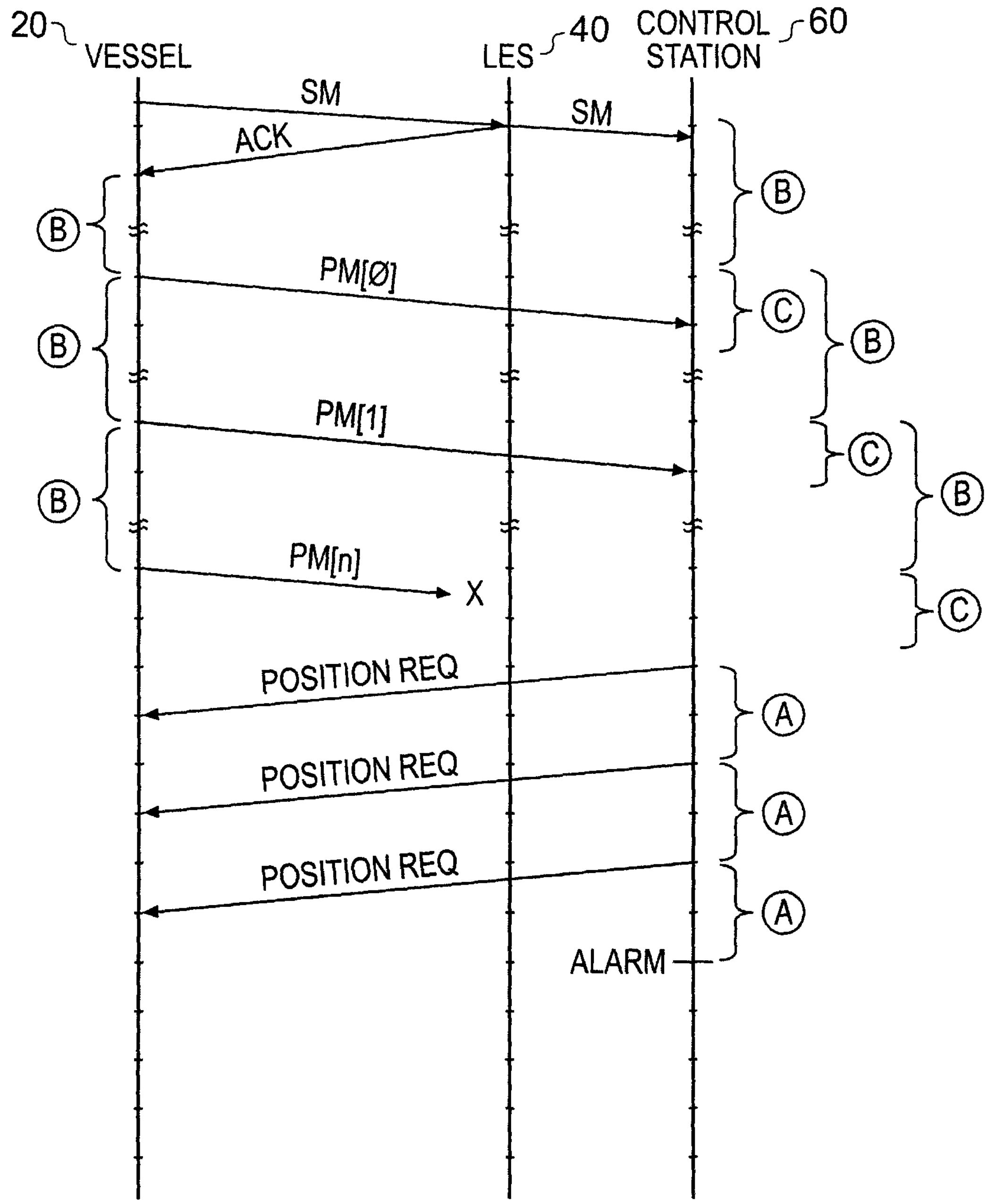

VESSEL
20
LES
40
CONTROL STATION
60
SM
X
SM
X
SM
X
ALARM
A
A
A

Fig. 3



20
VESSEL
LES
40
CONTROL STATION
60
SM
SM
ACK
B
B
PM[Ø]
C
B
B
PM[1]
C
B
B
PM[n]
X
C
POSITION REQ
A
POSITION REQ
A
POSITION REQ
A
ALARM

Fig. 4

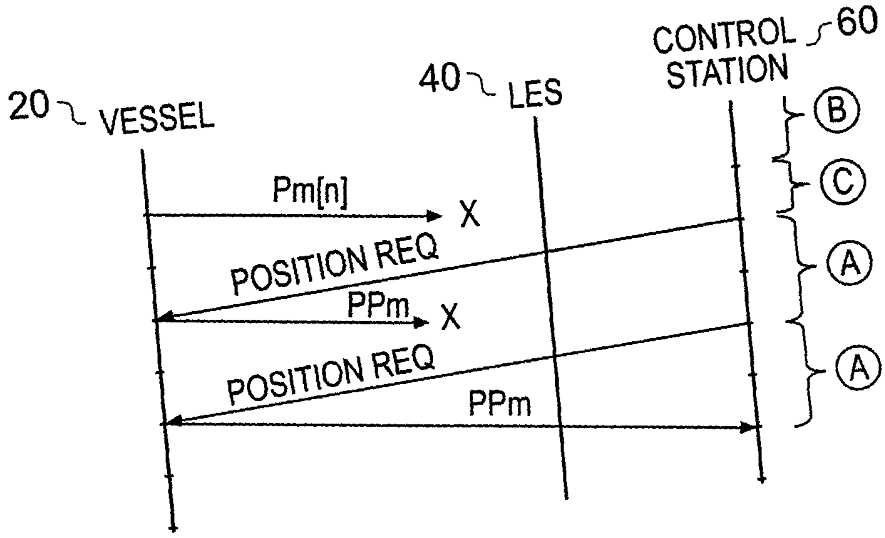

20 VESSEL
40 LES
CONTROL STATION 60
B
C
A
A
Pm[n]
X
POSITION REQ
PPm
X
POSITION REQ
PPm

Fig. 5

Message	Description	Ack[1]	Ctrl (4 bits)	Dest (8 bits)			Desc (8 bits)	Data (64 bits)
				Priority	Type	Data		
Poll Response	Position Report in response to a poll request	N	0x09	0	00	00000	0x01	<Maritime Position Data>
Stop Monitoring	Notification that automated periodic position reporting has stopped	Y	0x09	0	00	00001	0x01	<Maritime Position Data>
Start Monitoring	Notification that automated periodic position reporting has started	Y	0x09	0	00	00011	0x01	<Maritime Position Data>
External Power On	The SAT101 is now running on external power	N	0x09	0	00	00101	0x01	<Maritime Position Data>
External Power Off (Switched to battery)	The external power to the SAT101 has been cut, and the unit is now running on battery	N	0x09	0	00	00100	0x01	<Maritime Position Data>
All clear (formerly entitled Cancel)	All previously signaled alerts are now cancelled	Y	0x09	1	00	00010	0x01	<Maritime Position Data>
Panic Alert	On board panic button has been pressed	Y	0x09	1	00	01000	0x01	<Maritime Position Data>
Periodic Position Report	An automated, periodic position report	N	0x09	0	01	<Seq Number>	0x01	<Maritime Position Data>
PSD Alert	A Personal Safety Device has been activated	Y	0x09	1	10	0<Device Identifier>	0x01	<Maritime Position Data>
MOB Alert	A Man Overboard device has been activated	Y	0x09	1	10	1<Device Identifier>	0x01	<Maritime Position Data>
External Input	Signal from IO Port	N	0x09	0	11	<Input Identifier>	0x01	<Maritime Position Data>
External Alert	Alert Signal from IO Port	Y	0x09	1	11	<Input Identifier>	0x01	<Maritime Position Data>

[1] 'Y' denotes an important message, which should be sent with frame randomisation set to zero to ensure near-immediate transmission; also multiple times, or with an LES acknowledgement request.

Fig. 6

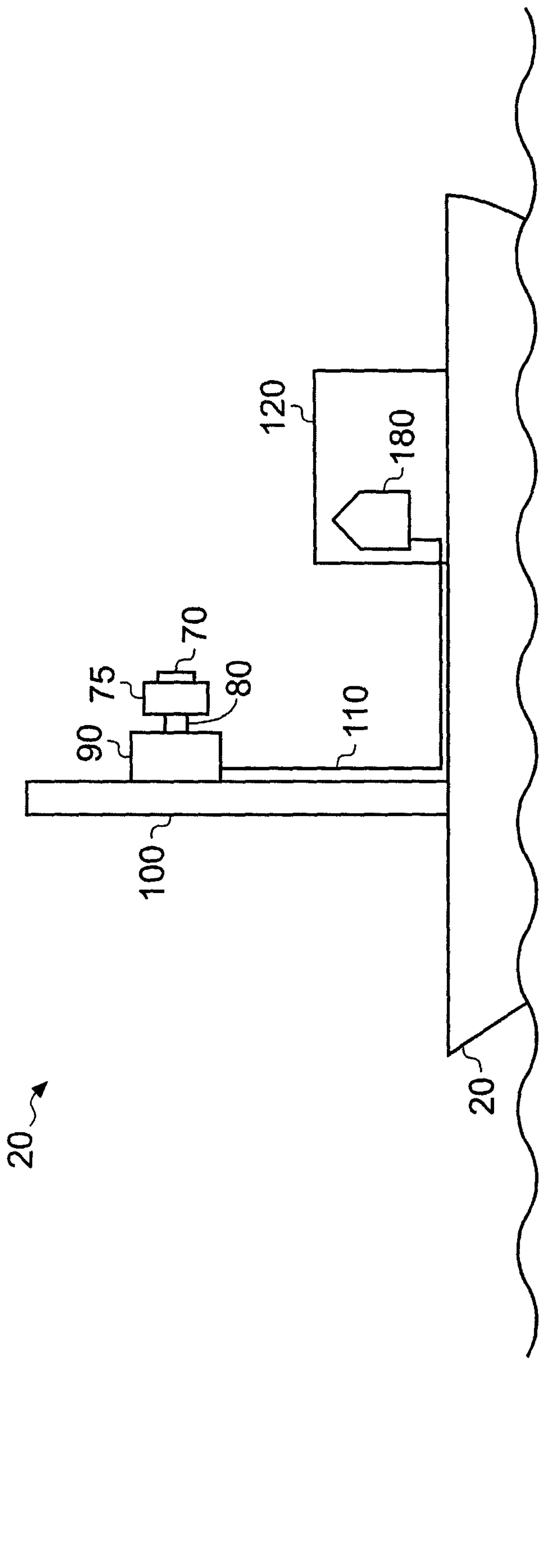


Fig. 7

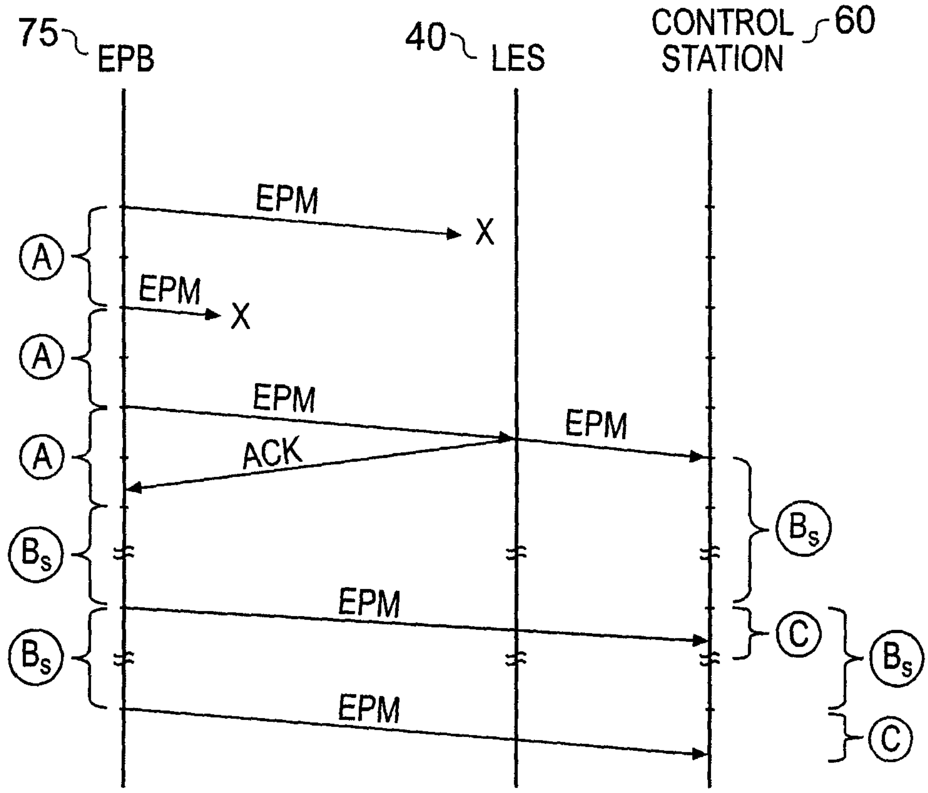

75
EPB
40
LES
CONTROL STATION
60
EPM
X
A
EPM
X
A
EPM
EPM
A
ACK
Bs
Bs
EPM
Bs
C
Bs
EPM
C

Fig. 8

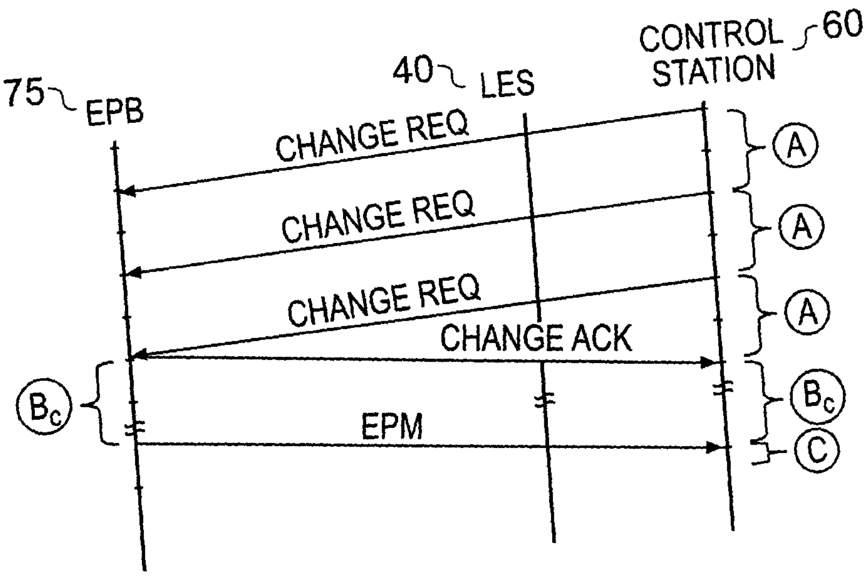

75
EPB
40
LES
CONTROL STATION
60
CHANGE REQ
CHANGE REQ
CHANGE REQ
CHANGE ACK
EPM
A
A
A
Bc
Bc
C

Fig. 9

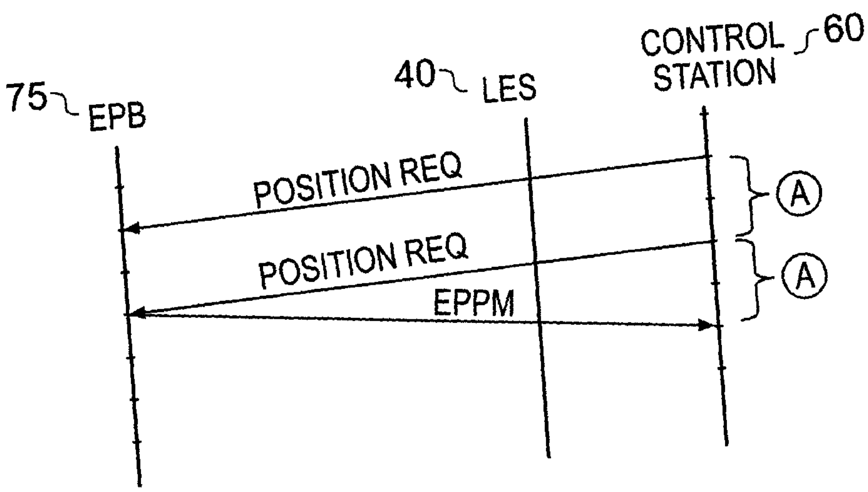

75
EPB
40
LES
CONTROL STATION
60
POSITION REQ
POSITION REQ
EPPM
A
A

Fig. 10

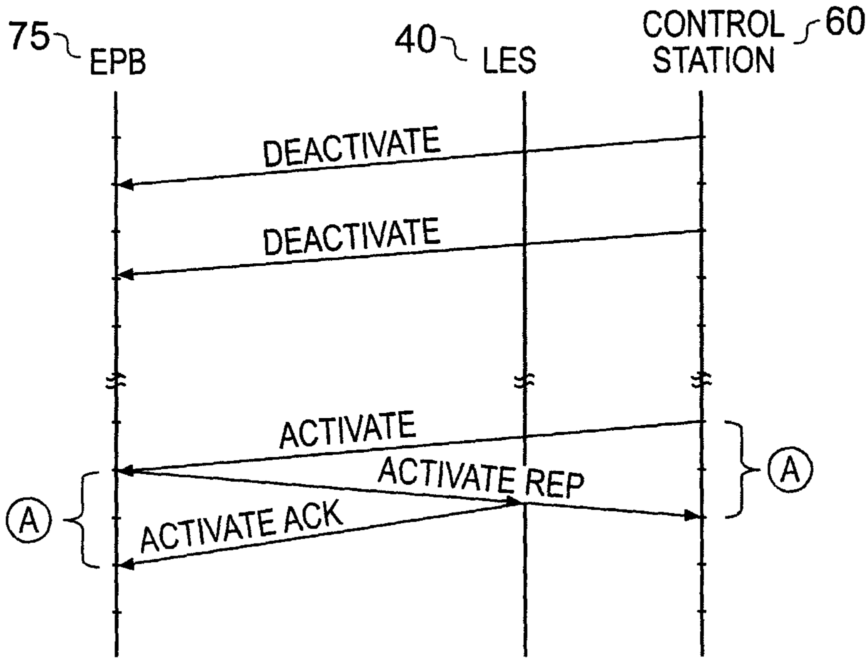
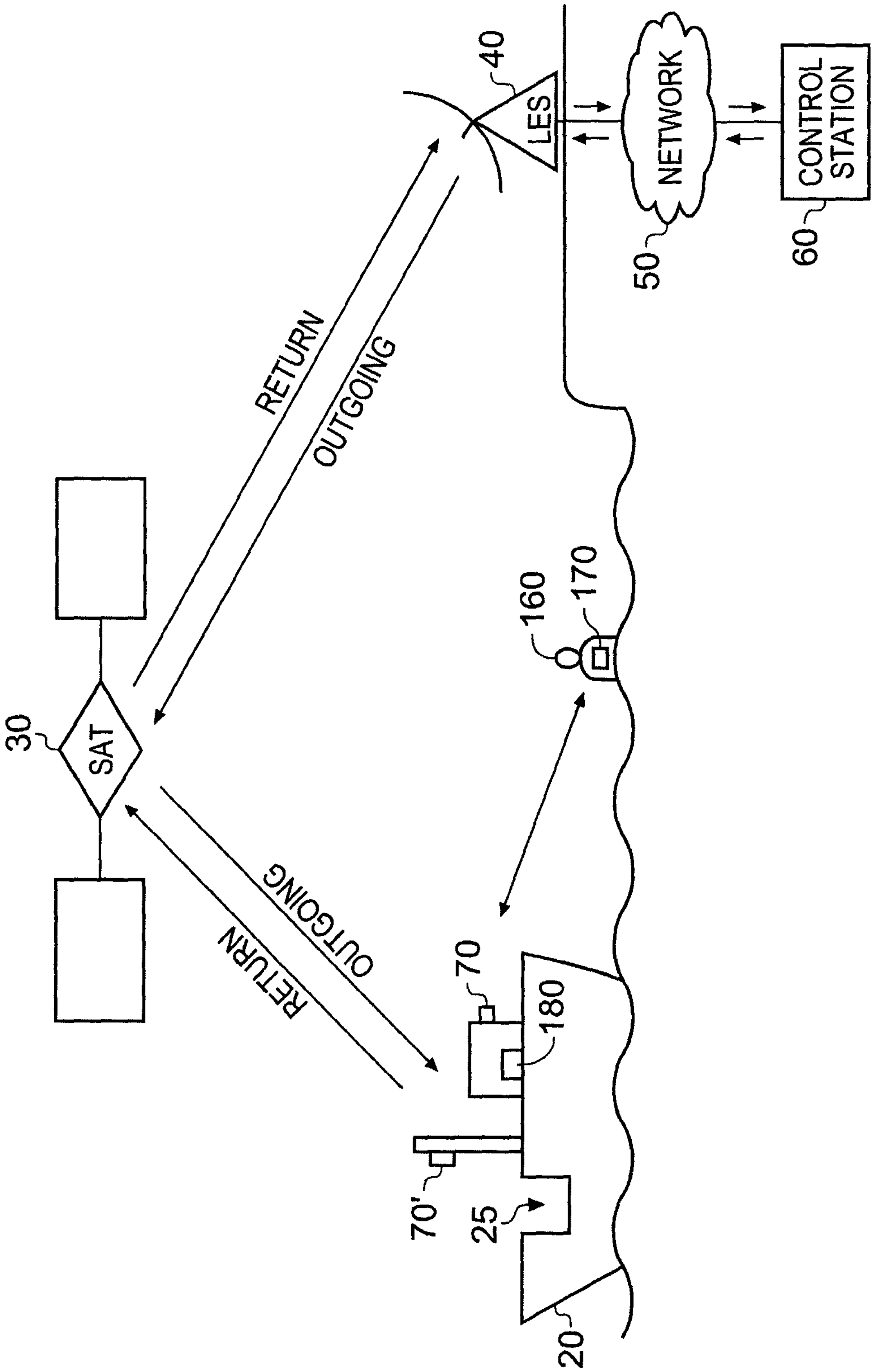

75
EPB
40
LES
CONTROL
STATION
60
DEACTIVATE
DEACTIVATE
ACTIVATE
ACTIVATE REP
ACTIVATE ACK
A
A

Fig. 11



SAT
30
RETURN
OUTGOING
RETURN
OUTGOING
LES
40
NETWORK
50
CONTROL STATION
60
160
170
70
180
70'
25
20

Fig. 12

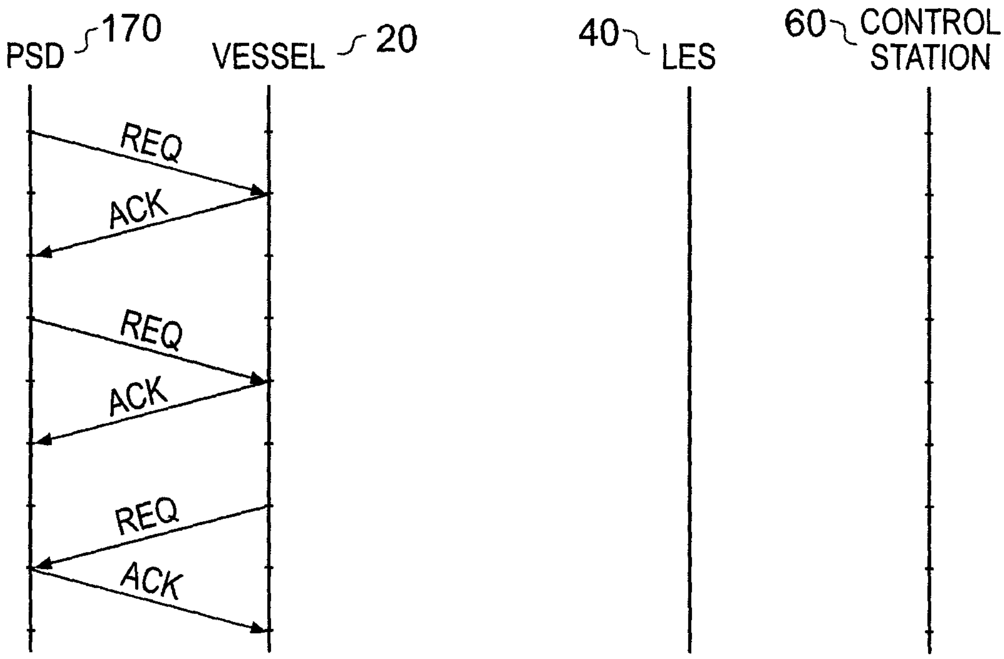

PSD 170
VESSEL 20
40 LES
60 CONTROL STATION
REQ
ACK
REQ
ACK
REQ
ACK

Fig. 13

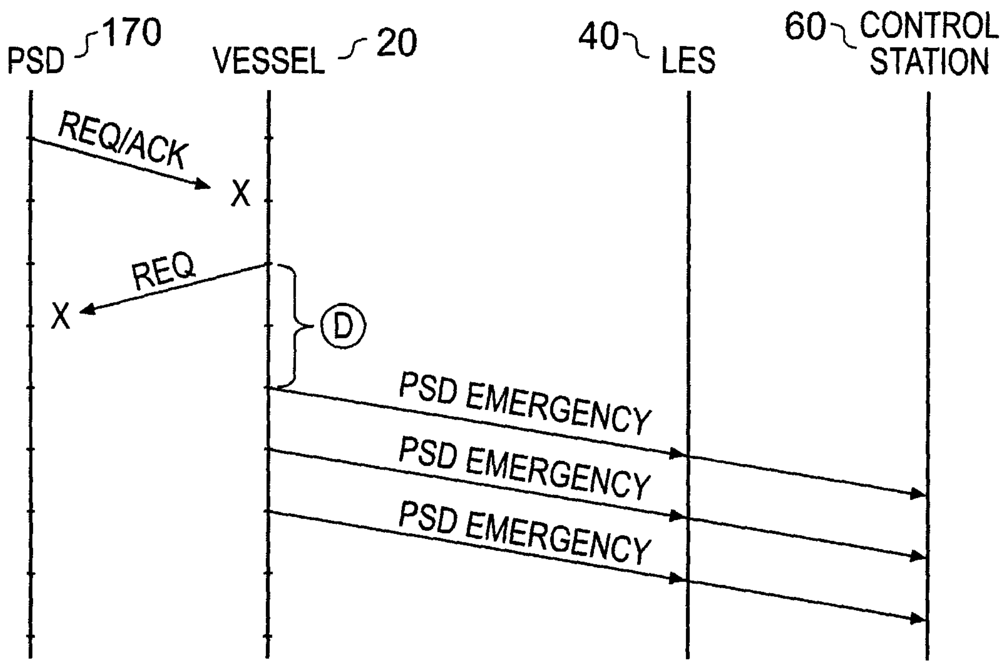

PSD 170
VESSEL 20
40 LES
60 CONTROL STATION
REQ/ACK
X
REQ
X
D
PSD EMERGENCY
PSD EMERGENCY
PSD EMERGENCY

Fig. 14

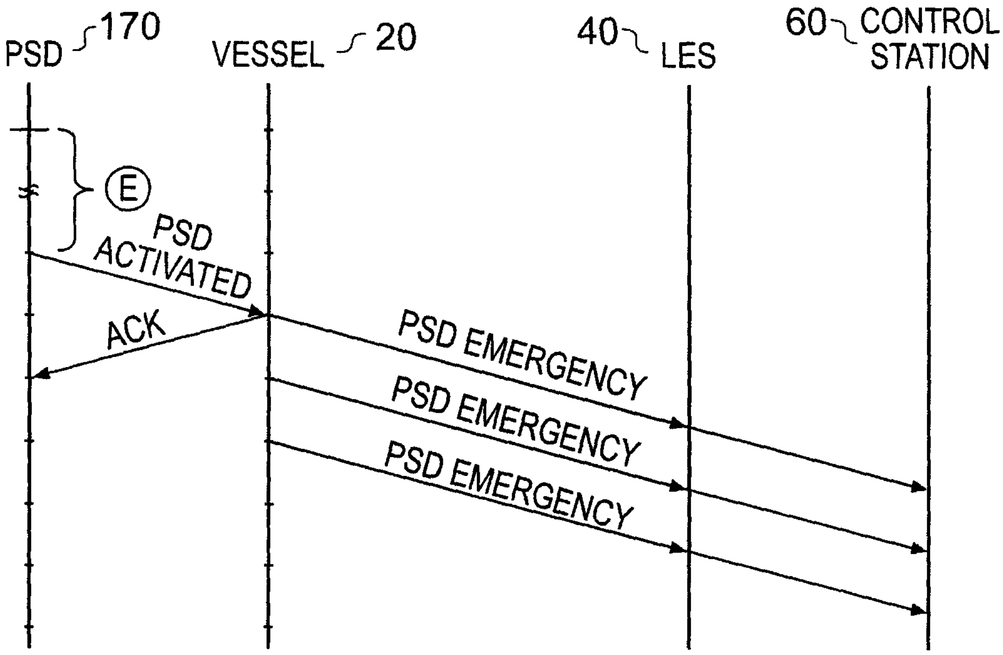

PSD 170
VESSEL 20
40 LES
60 CONTROL STATION
E
PSD ACTIVATED
ACK
PSD EMERGENCY
PSD EMERGENCY
PSD EMERGENCY

Fig. 15

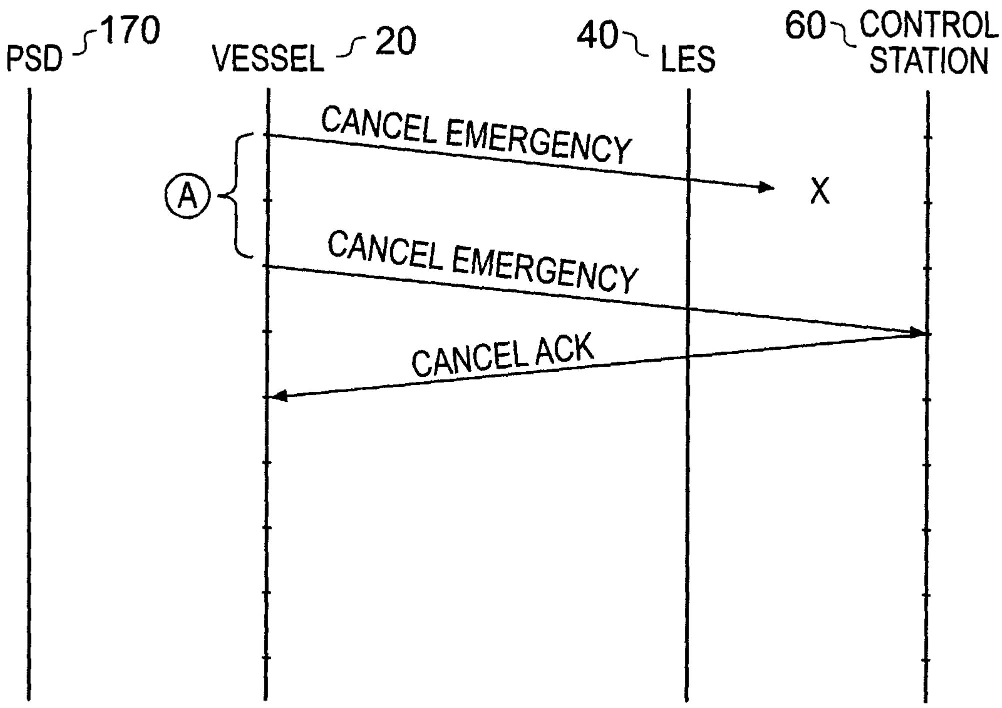

PSD 170
VESSEL 20
40 LES
60 CONTROL STATION
CANCEL EMERGENCY
A
X
CANCEL EMERGENCY
CANCEL ACK

Fig. 16

COMMUNICATING WITH A VESSEL

Field of the Invention

The present invention relates to techniques for communicating with a vessel.

Background of the Invention

Techniques for communicating with a vessel are known. Such techniques typically enable information to be transferred from a vessel when, for example, it is at sea either to another vessel or to a control station ashore. Such communication systems will typically have a low data rate and their global coverage may be intermittent.

In the field of vessel search and rescue operations, it is typically the case that many lives are lost because a vessel which is in an emergency situation is unable to alert the relevant rescue authorities rapidly enough to enable a realistic rescue operation to be launched quickly and prevent life being lost. Similarly, many rescue operations are initiated because a particular vessel is not contactable and so an assumption will be made that the vessel is in an emergency situation.

Hence, there exist a need to provide a reliable technique for communicating with a vessel.

Summary of the Invention

According to one aspect of the present invention there is provided a method of communicating with a vessel, the method comprising the steps of: transmitting at predetermined intervals a position information message from the vessel over a return communications channel; monitoring the return communications channel; in the event that the position information message is not received over the return communications channel within a predetermined period encompassing the predetermined interval, transmitting a position request message to the vessel over an outgoing communications channel; monitoring the outgoing communications channel; and in response to receipt of the position request message at the vessel, transmitting a position response message from the vessel over the return communications channel.

The present invention recognises that the communications systems used for communicating with a vessel are inherently unreliable. This unreliability can occur for a variety of reasons. For example, the vessel may temporarily list to a position which does not enable information to be transmitted at the particular moment when a data transmission is due to occur. Alternatively, geographical features or meteorological conditions may temporarily reduce the communications coverage.

Accordingly, position information messages are transmitted at predetermined intervals by the vessel over the return communications channel, which is monitored. Hence, the vessel can simply continue to transmit position information messages one way for receipt over the return communications channel. Should a position information message not be received over the return communications channel within a predetermined period for whatever reason then a position request message is transmitted to the vessel. However, in normal operation, no regular messages need be sent back to the vessel to indicate that the position information message has been received, the vessel can simply assume that this is the case. It will be appreciated that by only transmitting position request messages when the position information message is not received when expected ensures that the number of messages transmitted is reduced, which in turn reduces the communications bandwidth required and also reduces the cost of operating the system. Should the vessel receive the position request message then this indicates to the vessel that a previous position information message was not received.

In this way, when communication with the vessel is lost, a rapid assessment can be made to determine whether the lack of communication is due to a temporary unreliability in the communications channel or whether the vessel is likely to be in some form of an emergency situation. It will be appreciated that this approach improves the reliability of the communications link.

In embodiments, the return communications channel has a transmission latency and the method further comprises the steps of: embedding a sequence identifier to each position information message; and ordering the information messages received over the return communications channel using the sequence identifiers.

It is recognised that the communications channel may suffer from a degree of transmission latency. This latency can sometimes result in some messages being stored and then received out of order. It will be appreciated that receiving position information which is out of order can lead to some doubt as to which of the received position information messages are the most up to date. Accordingly, each position information message is provided with a sequence identifier. The sequence identifier of the position information message can be reviewed to determine the correct ordering of the position information messages, thereby enabling the most recently received position information message and an accurate plot of the vessel position over time to be made.

In embodiments, the method further comprises the step of: varying the predetermined interval in order to vary the data bandwidth used by position information messages transmitted over the return communications channel.

It will be appreciated that varying the predetermined time interval between position information messages being transmitted directly affects the quantity of position information provided. Increasing the frequency at which position information messages are transmitted will clearly increase the amount of traffic over the return communications channel and therefore decrease the available bandwidth. Conversely, reducing the frequency at which position information messages are transmitted will decrease the amount of traffic transmitted over the return communications channel, thereby increasing the available bandwidth on that channel but will necessarily reduce the amount of position information provided for any particular vessel. Hence, altering the rate at which position information messages are transmitted can assist in managing the transmission load of the return communications channel.

In one embodiment, the method further comprises the step of: varying the predetermined interval in order to vary a maximum emergency identification reporting period.

It will be appreciated that by varying the frequency at which position information is generated will directly affect the potential size of any search area, should the vessel subsequently need to be located. It will be appreciated also that the predetermined interval could be varied also in dependence on the likely speed and activities of the vessel in order to provide an acceptably sized search area.

In embodiments, the return communications channel has a transmission latency and the method further comprises the step of: setting the predetermined period to be no shorter than the transmission latency.

By setting the predetermined period to be no shorter than the transmission latency it can be ensured that a position request message will not be sent for position information messages which have been properly transmitted by the vessel but which may still be being transmitted over the return communications channel.

In embodiments, the method further comprises the step of: setting the predetermined period to be no longer than the predetermined interval.

In embodiments, the method further comprises the steps of: in the event that the position response message is not received over the return communications channel within a predetermined response period, retransmitting the position request message to the vessel over the outgoing communications channel.

Hence, should a position request message not result in a position response being received then the position request message is once again transmitted to the vessel.

In embodiments, the return communications channel and the outgoing communications channel have a combined transmission latency and the method further comprises the step of: setting the predetermined response period to be no shorter than the combined transmission latency.

As before, the period before which any subsequent position request messages are transmitted to the vessel is set to be no less than the combined latency period required to transmit the original position request message to the vessel and to receive a response from the vessel.

In embodiments, the method further comprises the steps of: determining the number of position request messages that have been retransmitted; and in the event that greater than a predetermined number of position request messages have been retransmitted, activating an alarm to indicate that communication with the vessel could not be established.

Hence, in the event that the position request message does not illicit a response from the vessel then an alarm is activated which indicates that the vessel could not be contacted. Also, by retransmitting the position request messages a number of times, the number of false alarms which occur due to temporary communications loss is reduced.

In embodiments, the method further comprises the steps of: in response to the alarm, causing an alarm mechanism to issue a position request message.

Hence, when an alarm initially is activated the alarm mechanism or a system operator may attempt to contact the vessel by issuing a further position request message.

In embodiments, the method further comprises the steps of: in response to the alarm, contacting the vessel using predetermined vessel contact information.

Hence, when the alarm activates contact with the vessel using other communications mechanisms will be attempted. It will be appreciated that should contact be made with the vessel then this will also reduce the number of false alarms.

In embodiments, the method further comprises the steps of: in response to the alarm, reviewing the most recently received position information message to determine whether or not the vessel is likely to be in distress.

Hence, should the alarm be activated then most recently received position information message is reviewed and a determination made as to whether the vessel is likely or not to be in an emergency situation. It will be appreciated that this determination could be performed by checking whether the position information indicates that the vessel is at a location at which it is likely to be moored or alongside in port.

In embodiments, the method further comprises the steps of: in the event the vessel is likely to be in distress, transmitting at least the most recently received position information message for that vessel to a search and rescue organisation.

Accordingly, should the vessel be likely to be in an emergency situation then the latest position information message is transmitted to an organisation to enable a search and rescue operation to be instigated. Vessel ID, vessel description and/or owner contact details may also be included.

In embodiments, the method further comprises the steps of: transmitting a stop monitoring message from the vessel over the return communications channel; monitoring the return communications channel; on receipt of the stop monitoring message over the return communications channel, transmitting a stop monitoring acknowledgement message over the outgoing communications channel; and in the event that the stop monitoring acknowledgement message is not received over the return communications channel within a predetermined stop monitoring response period, retransmitting the stop monitoring message.

By transmitting a stop monitoring message the monitoring of the vessel can be terminated. Hence, transmission of position information messages by the vessel can be ceased without causing an alarm to activate.

In embodiments, the method further comprises the steps of: determining the number of stop monitoring messages that have been retransmitted; and in the event that greater than a predetermined number of stop monitoring messages have been retransmitted, activating an alarm to indicate to the vessel that monitoring by the control station could not be terminated.

In the event that monitoring of the vessel cannot be deactivated then an alarm will activate on the vessel to indicate that deactivation has not occurred.

In embodiments, the method further comprises the steps of: transmitting a start monitoring message from the vessel over the return communications channel; monitoring the return communications channel; on receipt of the start monitoring message over the return communications channel, transmitting a start monitoring acknowledgement message over the outgoing communications channel; and in the event that a start monitoring acknowledgement message is not received over the outgoing communications channel within a predetermined start monitoring period, retransmitting the start monitoring message.

In embodiments, the method further comprises the steps of: determining the number of start monitoring messages that have been retransmitted; and in the event that greater than a predetermined number of start monitoring messages have been retransmitted, activating an alarm to indicate to the vessel that communication could not be established.

Hence, an alarm will activate on the vessel in the event that communication cannot be established. It will be appreciated that this will provide an indication to the vessel that its position is not being monitored.

In embodiments, the position information message includes vessel ID and position data.

According to a second aspect of the present invention there is provided a system for communicating with a vessel, the system comprising: vessel transmission logic operable to transmit at predetermined intervals a position information message from the vessel over a return communications channel; return channel monitoring logic operable to monitor the return communications channel; transmission logic operable, in the event that the return channel monitoring logic indicates that the position information message is not received over the return communications channel within a predetermined period encompassing the predetermined interval, to transmit a position request message to the vessel over an outgoing communications channel; and outgoing channel monitoring logic operable to monitor the outgoing communications channel, wherein the vessel transmission logic is further operable, in response to the outgoing channel monitoring logic indicates receipt of the position request message at the vessel, to transmit a position response message from the vessel over the return communications channel.

According to a third aspect of the present invention there is provided a position transmission apparatus for a vessel, the apparatus comprising: transmission logic operable to transmit at predetermined intervals a position information message over a return communications channel; and outgoing channel monitoring logic operable to monitor an outgoing communications channel, wherein the transmission logic is further operable, in response to the outgoing channel monitoring logic indicating receipt of a position request message, to transmit a position response message over the return communications channel.

Embodiments of the position transmission apparatus include features of the system for communicating with a vessel of the second aspect of the present invention.

According to a fourth aspect of the present invention there is provided a vessel position receiving apparatus, the apparatus comprising: return channel monitoring logic operable to monitor the return communications channel; and transmission logic operable, in the event that the return channel monitoring logic indicates that a position information message is not received over the return communications channel within a predetermined period, to transmit a position request message to a vessel over an outgoing communications channel.

Embodiments of the system for communicating with a vessel include features of the system for communicating with a vessel of the second aspect of the present invention.

Brief Description of the Drawings

The present invention will be described further, by way of example only, with reference to preferred embodiments thereof as illustrated in the accompanying drawings, in which:

Figure 1 illustrates a system for communicating with a vessel according to one embodiment;

Figure 2 illustrates messaging between the vessel and control station illustrated in Figure 1 when activating and deactivating position monitoring;

Figure 3 illustrates failure in messaging between the vessel and control station illustrated in Figure 1 when activating and deactivating position monitoring;

Figures 4 and 5 illustrate messaging between the vessel and control station illustrated in Figure 1 during position monitoring;

Figure 6 illustrates the structure and content of messages transmitted;

Figure 7 illustrates in more detail an arrangement of the vessel shown in Figure 1;

Figure 8 illustrates messaging between the emergency positioning beacon and the control station when an emergency incident occurs;

Figure 9 illustrates messaging between the emergency positioning beacon and the control station when varying the interval at which position messages are generated;

Figure 10 illustrates messaging between the control station and the emergency positioning beacon when requesting updated position information;

Figure 11 illustrates messaging between the emergency positioning beacon and the control station when the electronic positioning beacon is requested to cease transmission;

Figure 12 illustrates an arrangement of a personal safety system according to one embodiment;

Figure 13 illustrates messaging between the personal safety device and the base unit during start up and normal operation;

Figure 14 illustrates messaging when the personal safety device goes out of range such as may occur when a crewmember falls off the vessel;

Figure 15 illustrates messaging when an alarm is activated on the personal safety device; and

Figure 16 illustrates messaging used to cancel an emergency alarm.

Description of the Preferred Embodiments

Figure 1 illustrates a communication system according to an embodiment of the present invention. The communication system links a vessel 20 via a satellite 30 with a land earth station 40 using a communication link. The land earth station 40 is coupled via a network (for example, the internet) with a control station 60. Messages are transmitted over the communications link to provide an indication to the control station 60 of whether or not the vessel 20 is likely to be in an emergency situation.

In this example, the communication link is provided by the Inmarsat (trademark) D+ satellite network, which provides a low cost time division multiplexed bearer for transmission of data at a low bit rate. However, it will be appreciated that any suitable satellite (such as Iridium (trademark)) or other communications link (such as GSM) having an appropriate antenna arrangement could be utilised.

The Inmarsat (trademark) D+ satellite network provides a relatively high power outgoing channel linking the land earth station 40 via the satellite 30 with the vessel 20. The reliability of the outgoing channel is reasonably high due to the comparatively high power transmission performed by the land earth station 40.

The return channel from the vessel 20 via the satellite 30 to the land earth station 40 provides a comparatively less reliable transmission path due, in the main, to the comparatively low power of the transmission from the vessel 20. Accordingly, it will be appreciated that the reliability of messages transmitted over the outgoing channel will be generally higher than the reliability of the messages transmitted over the return channel.

A transceiver 70 is provided on the vessel 20 which, in accordance with one known technique, registers with the land earth station 40 using a bulletin board system to reserve a particular time slot in the return channel. The transceiver 70 is coupled with a base station 180. Data transmissions from the vessel 20 will then occur, as required, on the time slot allocated to the transceiver 70 on the vessel 20. In a typical Inmarsat (trademark) D+ arrangement, the transceiver 70 on the vessel 20 will be provided with a time slot at around every 2 minutes. Accordingly, it will be appreciated that a delay can occur of up to 2 minutes from when the vessel 20 may require to transmit a message to when an available time slot is available. Hence, messages to be transmitted over the return channel will typically be placed in a buffer until transmission can occur. For an

Iridium (trademark) arrangement no two minute time slots exist and instead the data can be transmitted almost immediately. Therefore, transmission delays are significantly reduced.

Similarly, a time slot in the outgoing channel will be reserved for use by the land earth station 40 for transmitting data to the vessel 20. Hence, a latency of up to 2 minutes will also exist in any transmissions originating from the land earth station 40 for transmission to the vessel 20.

Accordingly, an end-to-end latency of around 4 minutes may occur following transmission of a message from the vessel 20 to the land earth station 40 to the time when a response from the land earth station 40 is received at the vessel 20, and vice versa. Also, further latency can occur should any buffering occur in the vessel 20, the satellite 30, the land earth station 40, the network 50 or the control station 60 the prior to transmitting or passing on received messages. For example, should the land earth station 40 not be able to forward messages via the network 50 to the control station 60 for whatever reason then these messages may also be buffered by the land earth station 40 until those messages can be forwarded.

In order to save power, the transceiver 70 on the vessel 20 may be deactivated during the periods outside its allocated time slots.

Data is transmitted over the Inmarsat (trademark) D+ satellite network in form of small packets. More detail on the contents of the packets will be described later with reference to Figure 6.

As mentioned above, the reliability of the return channel is relatively low and the probability of a message not reaching its destination over the return channel is between 2% and 5% (this means that around one in 20 messages transmitted over the return channel will never be received). The absence of a message may be for two typical reasons. Firstly, the message may have been transmitted by the transceiver 70 but simply never received. Alternatively, the vessel 20 may be in an emergency situation and unable to transmit a message. However, in the absence of any mechanism to differentiate between these two events the safest assumption that the vessel 20 may be in an emergency situation. Accordingly, attempting to utilise the Inmarsat (trademark) D+ communications system to provide an indication to the control station 60 of whether or not the vessel 20 is likely to be in an emergency situation is likely to result in a large number of false alarms occurring due to the unreliability of the Inmarsat (trademark) D+ communications system, making the system unusable.

Hence, techniques are provided to effectively improve the reliability of the return communications channel, thereby decreasing the occurrence of false alarms. Figures 2 to 5 illustrate techniques employed by the communications system 10 in order to reduce the occurrence of false alarms.

Figure 2 illustrates the communication between the vessel 20, land earth station 40 and the control station 50 when attempting to initiate vessel position monitoring.

In the example shown in Figure 2, the crew of the vessel 20 firstly switches on the position monitoring system by activating an "at sea" switch on the base station 180. Following a number of system checks and registration with the satellite 30, a start monitoring message is transmitted from the vessel 20 via the satellite 30 to the land earth station 40.

As illustrated in this example, the start monitoring message fails to reach the land earth station 40. This may be due to, for example, the vessel transmitter being obscured within a port or rough conditions causing the transceiver 70 to be in an incorrect orientation with respect to the satellite 30. The vessel 20 monitors the outgoing channel in order to determine whether a start monitoring acknowledgement signal has been received. After a time period A (which is a predetermined time period representative of the longest possible latency between the start monitoring message being transmitted by the vessel 20 and an acknowledgement message being received, in this case around 4 minutes), the vessel 20 will retransmit the start monitoring message.

Once again, in this example, the start monitoring message fails to reach the land earth station 40. Accordingly, after time period A, the vessel 20 will once again retransmit the start monitoring message.

In this example, the start monitoring message is received by the land earth station 40 and is forwarded via the network 50 to the control station 60. The control station 60 will register that the vessel 20 has requested that position monitoring be activated and registers the vessel 20 as a vessel to be monitored. The start monitoring message includes a bit field which, when decoded by the land earth station 40, automatically generates an acknowledgement message which is transmitted via the satellite 30 to the vessel 20.

On receipt of the acknowledgement message, the base station 180 will indicate to the crew of the vessel 20 that position monitoring has been activated. Thereafter, as will be explained in more detail with reference to Figure 4 below, the transceiver 70 will transmit periodic position information messages.

Figure 3 illustrates the sequence of events when the start monitoring request fails. As with Figure 2, the first and second start monitoring messages fail to reach the land earth station 40. However, in this example, the third start monitoring message also fails to reach the land earth station 40.

Accordingly, after the predetermined time period A, an alarm will be activated on the base station 180 to indicate to the crew of the vessel 20 that the request to initiate vessel position monitoring has failed to complete. On the occurrence of the alarm, the crew have the option of either restarting the request to initiate position monitoring, contacting the control station 60 for assistance or aborting the voyage.

Whilst in this example the start monitoring message is only transmitted twice, it will be appreciated that this message may be repeated any number of times. Also, whilst the predetermined time period A is set to be the maximum latency period of a transmission between the vessel 20 and the control station 60 and a return transmission, it will be appreciated that the time period A could be any other time period which is typically longer than this.

Figure 4 illustrates in more detail the messages transmitted during position monitoring of the vessel 20.

As shown in Figure 4, a start monitoring message transmitted by the vessel 20 is received by the land earth station 40, which issues a land earth station acknowledgment signal back to the vessel 20 and forwards the start monitoring message to the control station 60. Thereafter, the vessel 20 transmits position messages over the return channel at periodic intervals B.

The periodic interval B may be either preset within the base station 180 or can be set dynamically in response to control message sent by the control station 60 to the vessel 20. In a typical arrangement, the predetermined interval B may be anything from 5 minutes to 3 hours, but most commonly around 1 hour. It will be appreciated that by having a short periodic interval B, the likelihood of position information being received in any particular time period will be higher than for position messages having a longer periodic interval B. However, this increase is at the cost of increasing the bandwidth used on the return channel. Providing less frequent position information introduces a greater degree of uncertainty regarding the exact location of a vessel should that vessel fail to provide further position information and subsequently trigger an alarm.

After the periodic interval B following receipt of the land earth station acknowledgement message, the vessel 20 will transmit a first position message. The position message contains information on the position of the vessel 20 (as will be described in more detail with reference to Figure 6). The position messages also contain a sequence number. In this example, the first position message is embedded with a sequence number "0", with subsequent messages being numbered consecutively.

Meanwhile, the control station 60 will wait the periodic interval B following receipt of the start monitoring message after which receipt of the first position message is expected. The control station 50 will monitor the return channel during a window of time C following the periodic interval B. The control station 50 will expect to receive the first position message within this time window. The time window C is set to reflect the maximum possible latency between the vessel 20 requiring to transmit a position message and that position message actually being received by the control station 50. By setting this window, it will be appreciated that the incident of false alarms occurring due to transmission latency in the return channel is reduced.

Following transmission of the first position message, the vessel 20 waits during the periodic interval B prior to transmitting the next position message (position message 1) on the return channel.

Similarly, the control station 50 will wait during the periodic interval B prior to monitoring the return channel (within the time window C) for the receipt of the next position message, and so on.

However, in the event that, for whatever reason, a position message fails to be received by the land earth station 40, it will be appreciated that no position message will be provided to the control station 50 within the time window C.

Accordingly, following expiry of time period C, the control station 60 will realize that the expected position message from the vessel 20 has not been received. However, instead of simply activating an alarm at this point, the control station 60 will generate a position request message for transmission to the vessel 20. Because the position request message is transmitted on the outgoing channel, its transmission strength will be significantly higher than any position message transmitted on the return channel. Accordingly, there is a higher likelihood that the position request message will reach the vessel 20 in comparison with the position message being received by the land earth station 40.

The control station 60 will wait the predetermined period A for a position message to be received from the vessel 20. After the elapse of the time period A, the control station 60 will retransmit the position request message. Again, should a position message not be received from the vessel 20 within the allotted time period, then the position request message will be retransmitted once again to the vessel 20.

Should the transmission of three position request messages by the control station 60 not result in a position message being returned from the vessel 20 then it can be assumed that there is a high likelihood that the vessel 20 may be in an emergency situation. Although, in this example, three position request messages are transmitted, it will be appreciated that the optimal number of position request messages required to be transmitted will vary dependent upon the reliability of the particular implementation. Accordingly, an alarm will be activated in the control station 60. At this point, an alarm mechanism will issue a further position request message. Alternatively, an operator may issue the further position request message. Alternatively, or additionally, the alarm mechanism may attempt to automatically contact the vessel using predetermined contact information stored at the control station 60 and associated with the vessel 20. For example, a mobile telephone or a satellite telephone associated with the vessel 20 may be automatically dialled and a recorded message played indicating that it is believed that the vessel 20 may be in an emergency situation and asking that the control station 60 be contacted. Similarly, the vessel owners may be contacted. It will be appreciated that this process could either be automated or handled by an operator. Alternatively, or additionally, the most recent position information received by the control station 60 associated with the vessel 20, together with any previous position information can then be analysed in order to determine a probable location of the vessel 20. In the event that analysis of the position information leads to the likely conclusion that the vessel may be in a safe location (such as in port, moored, at a buoy or in a known area of poor reception) then the decision to progress the incident further may be deferred.

Should the vessel 20 prove not to be contactable and the position information not indicate that the vessel 20 is unlikely to be in an emergency situation then the control station 60 will transmit the position information together with any relevant details of the vessel 20 stored by the control station 60 to a search and rescue organisation, such as the Coastguard.

Hence, it will be appreciated that through this approach, various mechanisms are provided to reduce the likelihood of a false alarm occurring due to the poor reliability of the return data channel and that only in the event that there is a high likelihood that a real incident has occurred will the incident data be passed to a search and rescue organisation and a search and search and rescue operation initiated.

Figure 5 illustrates a temporary loss of communication between the vessel 20 and the land earth station 40.

In a similar manner to Figure 4, the vessel 20 transmits a number of position messages to the land earth station 40. However, one such message fails to be received by the land earth station 40. Hence, the control station 60 will fail to receive a position message within the time window C. Accordingly, the control station 60 will transmit a position request message to the vessel 20. In this example, the position request message is received by the vessel 20 which, in response, transmits a position response message over the return channel.

However, in this example, the position response message also fails to be received by the land earth station 40. Hence, following the time period A, the control station 60 will note that no position response message has been received. At that time, the position request message will be retransmitted to the vessel 20.

Once again, the position request message is received by the vessel 20 which retransmits the position response message. In this example, the position response message is received by the land earth station 40 and forwarded to the control station 60.

Now that the control station 60 has received a position response message from the vessel 20 no further incident action need occur and the position information is recorded. Thereafter, the vessel 20 will continue to transmit position messages at predetermined intervals B and the control station 60 will expect to receive these subsequent position messages within the time window C following the predetermined period B.

As mentioned above, in a typical arrangement, the predetermined period B will be anything from 5 minutes to 3 hours, the outgoing and return transmission latency A may be typically around 4½ minutes, whereas the time window C will typically be half that value, namely, just over 2 minutes.

Figure 2 also illustrates the communication between the vessel 20, land earth station 40 and the control station 50 when attempting to terminate vessel position monitoring.

In the example shown in Figure 2, the crew of the vessel 20 attempts to deactivate the position monitoring system by activating an "in port" switch on the base station 180. A stop monitoring message is transmitted from the vessel 20 via the satellite 30 to the land earth station 40.

As illustrated in this example, the stop monitoring message fails to reach the land earth station 40. This may be due to, for example, the vessel transmitter being obscured within a port or rough conditions causing the transceiver 70 to be in an incorrect orientation with respect to the satellite 30. The vessel 20 monitors the outgoing channel in order to determine whether a stop monitoring acknowledgement signal has been received. After the time period A, the vessel 20 will retransmit the stop monitoring message.

Once again, in this example, the stop monitoring message fails to reach the land earth station 40. Accordingly, after time period A, the vessel 20 will once again retransmit the stop monitoring message.

In this example, the stop monitoring message is received by the land earth station 40 and is forwarded via the network 50 to the control station 60. The control station 60 will register that the vessel 20 has requested that position monitoring be terminated and deregisters the vessel 20 as a vessel to be monitored. The stop monitoring message includes a bit field which, when decoded by the land earth station 40, automatically generates an acknowledgement message which is transmitted via the satellite 30 to the vessel 20.

On receipt of the acknowledgement message, the base station 180 will indicate to the crew of the vessel 20 that position monitoring has been deactivated and the base station will close down.

Figure 3 illustrates the sequence of events when the stop monitoring request fails. As with Figure 2, the first and second stop monitoring messages fail to reach the land earth station 40. However, in this example, the third stop monitoring message also fails to reach the land earth station 40.

Accordingly, after the predetermined time period A, an alarm will be activated on the base station 180 to indicate to the crew of the vessel 20 that the request to terminate vessel position monitoring has failed to complete. On the occurrence of the alarm, the crew have the option of either restarting the request to terminate position monitoring or contacting the control station 60 for assistance.

Whilst in this example the stop monitoring message is only transmitted twice, it will be appreciated that this message may be repeated any number of times. Also, whilst the predetermined time period A is set to be the maximum latency period of a transmission between the vessel 20 and the control station 60 and a return transmission, it will be appreciated that the time period A could be any other time period which is typically longer than this.

In this way, it will be appreciated that the vessel 20 is provided with a positive confirmation that the monitoring has been terminated and, hence, the base station 180 may be deactivated without the risk of such deactivation resulting in a false alarm occurring.

Hence, the present technique provides a reliable messaging solution which enables an unreliable (but low cost) message bearers to be utilised. This is because the major disadvantage of the unreliability can be overcome, whilst retaining the advantage of low cost. Hence, it is possible to provide the same reliability of messaging as would be provided with a higher reliability message bearer but without the penalty of significantly higher equipment and operating costs.

To illustrate this, in the present technique, when the vessel 20 starts its journey a start monitoring message is sent. Under normal circumstances this message would have a probability of being delivered of approximately 95%. Following receipt of the acknowledgement message, the vessel 20 can guarantee that the start monitoring message has been received. As the vessel 20 continues its journey, it sends periodic position messages. Each message is sequence numbered (for example 0 to 31) so that the control station 50 can determine if a message has been lost due to channel unreliability or has simply been delayed. In the event that the control station 60 does not receive an expected position message, it sends a position request message to the vessel 20 to try to obtain the vessel position. This process in repeated typically, up to three times. This approach increases the likelihood that a position message is received by the control station from around 95% to around 99.8%. It will be appreciated that this provides a similar level of reliability to that of transmitting the acknowledgement message, but without the additional cost of having to transmit such a message every time a position message has been transmitted from the vessel 20. At then end of the vessel journey, the stop monitoring message is acknowledged with an acknowledgement message. Thus, only the start monitoring message and the stop monitoring message routinely incur the additional costs of transmitting an acknowledgement message over the outgoing channel. Accordingly, the vast majority of messages will not need to be acknowledged. It will be appreciated that this significantly reduces the operating costs. However, in the event that any of those messages suffer unreliability, a message will be generated to cause retransmission in an effort to increase the likelihood that the message will be received correctly.

Figure 6 illustrates the structure and content of messages transmitted in the communication system. Any return long burst messages are interpreted by the application according to the Satamatics (trademark) Application Message Registry [GDN-0051]. The message format conforms with the standards laid out in [GDN-0051] but adopts an application-specific interpretation of the Destination bits, so that:

- Bit 1 represents the message **Priority**
- Bits 2 and 3 determine the **Message type**:
  - **00** - Standard Message
  - **01** - Periodic Position Report
  - **10** - Personal Safety Device (PSD) / Man Overboard (MOB) Alert
  - **11** - External Input
- Bits 4 to 8 are **data**, to be interpreted according to the Message Type:
  - **Message Number** - A number allowing the standard message to be identified.

- **Sequence Number** - Periodic position report messages are marked with a sequence number to allow the control station to distinguish between lost messages and delayed messages.
- **PSD/MOB Identifier** -Personal Safety Device (PSD) and Man Overboard (MOB) alert messages are marked with an Identifier to allow the control station to distinguish between one of 16 available PSD and 16 available MOB devices.
- **Input Identifier** -The input identifier allows the control station to distinguish which one of up to 32 external input signals has been activated.

The Maritime Position Data format is described in the Satamatics (trademark) Application Message Registry [GDN-0051] as set out below. There is no acknowledgement.

S Bit	E Bit	Length	Field Name	Usage	Range	Present	Information
1		1	Control Flag	1 : Other			Unique Identifier (with Application Identifier)
2	4	3	Application Identifier	01 : ITA			Unique Identifier (with Control Flag)
		1	Priority Flag				
		7	Canned Message Number				
		8	ITA Message Identifier	0x01 : Marine Position Report (JRC Format)			
		1	Hemisphere (N/S)	0 : Northern 1 : Southern			
		7	Latitude degrees		0 - 90		
		6	Latitude minutes		0 - 59		
		7	Latitude		0 -		

			minutes/100		99		
		1	Hemisphere (E/W)	0 : Eastern 1 : Western			
		8	Longitude degrees		0 - 180		
		6	Longitude minutes		0 - 59		
		7	Longitude minutes/100		0 - 99		
		8	Speed		0 - 255		Kilometres per hour
		9	Course		0 - 359		Degrees
		1	Status	0 : GPS Fix Not Available 1 : GPS Fix Valid			
		3	Time since last GPS fix		0 - 7		Hours since last valid GPS reading

Alphanumeric return channel messages can be sent using 6 bit encoding. The message structure is defined in "Return: User - Alphanumeric" in [GDN-0051] Satamatics (trademark) Application Message Registry. There is no acknowledgement.

The following messages are reserved to have a special meaning:

Special Text Message	**Notes**	**Description**
POB *n*	*n* is the textual representation of a positive integer. The canned message number should be set to 0	Used for signalling the number of persons on board.
PSDIU *n*	*n* is the textual representation of a positive	Used for signalling the number of PSD devices in

	integer The canned message number should be set to 0	use.

Canned messages can be supported by setting the canned message number to a value between 1 and 128 inclusive (0 is reserved for system messages, such as those defined in the table above). Under these circumstances, the 12 alphanumeric characters in the Message Data field are assumed to be comma separated values to be substituted into the canned message. For example, a canned message "*Sailing to $1, estimated time of arrival $2 00 UTC*" with data "*Ramsgate,14*" would yield "*Sailing to Ramsgate, estimated time of arrival 14 00 UTC*".

Dictionary encoded messages can be sent using the message structure defined in "Return: User - Dictionary" in [GDN-0051] Satamatics (trademark) Application Message Registry. There is no acknowledgement.

Figure 7 illustrates in more detail a configuration of the vessel 20 shown in Figure 1. The vessel 20 comprises a hull 140, a cabin 120 and a mast 100. Coupled with the mast 100 is a mount 90 for holding a release device 80 which is coupled with the emergency positioning beacon 75 housing the transceiver 70. The emergency positioning beacon 75 is coupled via the cable 110 to the base station 180 in the cabin 120. The transceiver 70 contains a transmitter for transmitting messages over the return channel and a receiver for receiving messages over the outgoing channel.

In normal operation of the vessel 20, the emergency positioning beacon 75 is retained on the mast. It will be appreciated that in this arrangement, the emergency position beacon 75 need not necessarily be arranged to transmit whenever the vessel 20 is at sea, but may simply begin transmissions when an emergency occurs, as will be described in more detail below.

Should an incident occur then the emergency positioning beacon 75 is detached from the vessel 20 either manually or automatically by the release device 80. When the emergency position beacon 75 is detached from the vessel 20 then a self-righting float mechanism deploys which causes the emergency positioning beacon 75 to deploy away from the vessel 20 and to float in the water in an orientation which enables communication over the outgoing channel and the return channel to be achieved. The activation of the release device 80 may occur due to, for example, the activation of a hydrostatic switch should the vessel 20 capsize.

Figure 8 illustrates the operation of the emergency positioning beacon 75 following activation in response to an emergency event. Once the emergency positioning beacon 75 has detected that an emergency event has occurred, due to, for example, a loss of connection to the base station 180 and/or the activation of a water sensing switch on the emergency position beacon 75 indicating that the emergency positioning beacon 75 is in contact with water, the emergency positioning beacon 75 will activate and, following system initialisation, will attempt to transmit an emergency position message during the next available time slot allocated to the emergency positioning beacon 75 by the communications system.

In the example shown, the first emergency positioning message fails to reach the land earth station 40 which may be due, for example, to an obstruction of the transceiver 70 during deployment. Hence, after time period A, the emergency positioning beacon 75 will retransmit the emergency position message. In this example, the message once again fails to reach the land earth station 40. Accordingly, after another time period A, the emergency positioning message will be retransmitted once again. In this example, the emergency positioning message now reaches land earth station 40 and is forwarded on to the control station 60. In the meantime, the land earth station 40 transmits an emergency position acknowledgement message to the emergency positioning beacon 75. When the acknowledgement message is received by the emergency positioning beacon 75, an indication can be made on the beacon 75 that the land earth station 40 has received the emergency positioning message. It will be appreciated that this indication could take a variety of forms such as, for example, an intermittent flashing light on the emergency positioning beacon 75 itself. This indication will provide assurance to the crew that the emergency positioning beacon 75 is operating correctly and that an emergency positioning message has been successfully transmitted to the land earth station 40.

Thereafter, the emergency positioning beacon 70 will transmit periodic emergency position messages indicating the current position of the emergency position beacon 75. The rate at which these initial emergency positioning messages are transmitted may be relatively high such as, for example, every two minutes.

Thereafter, either following a predetermined length of time or in response to a periodic interval change request message the emergency positioning beacon 75 may switch to transmitting emergency position messages at a less frequent rate in order to conserve power.

When utilising an Iridium (trademark) link between the emergency positioning beacon 75 and the control station 60, voice data may also be transmitted between the emergency positioning beacon 75 and the control station 60.

Figure 9 illustrates controlling the emergency position beacon 75 remotely in order to adjust the rate at which emergency position messages are transmitted. The control station 60 will generate a change periodic interval request message which contains information indicating the required time which should elapse between transmitting each emergency position message.

The change periodic interval request message is transmitted to the emergency positioning beacon 75. In the event that the control station 60 fails to receive, within the time interval A, an acknowledgement from the emergency positioning beacon 75 that the change periodic interval request message has been received, the control station 60 will retransmit the change periodic interval request message once more. The control station 60 will continue to retransmit these messages until an acknowledgement from the emergency positioning beacon 75 is received. Thereafter, the electronic positioning beacon 75 will transmit emergency position messages at a rate indicated within the change periodic interval request message. Similarly, the control station 60 will expect to receive the next emergency position message shortly after the expiry of the new periodic interval. It will be appreciated that varying the interval at which the emergency positioning messages are transmitted will affect the power consumption of the emergency positioning beacon 75. Also, varying the rates at which these messages are transmitted will vary the accuracy by which the emergency position beacon 75 may be located and, accordingly, affect the likely search and rescue area.

Figure 10 illustrates the messaging required to perform an on-demand position request. The control station 60 will generate an on-demand positioning request message which is transmitted to the emergency positioning beacon 75 on the appropriate timeslot. Should an emergency position message not being received by the control station within the time period A, the on-demand position request message will be retransmitted. These messages will continue to be retransmitted until a response is received.

On receipt of an on-demand position request message, the emergency positioning beacon 75 will generate an emergency position message indicating its current position. This emergency position message will be transmitted using the return channel to the control station 60. Accordingly, it can be seen that as well as periodic position information being provided by the emergency position beacon 75, it is possible to remotely interrogate the electronic position beacon 75 and force it to provide a current position status, independent of any periodic position messages. It will be appreciated that this provides a significant benefit to any search and rescue organisation when conducting its search and rescue operations.

Figure 11 illustrates the messaging required to support shutdown of the emergency positioning beacon 75. It is often the case that following the completion of a search and rescue operation, it is either not operationally possible or not economically justified to recover the emergency positioning beacon 75 itself. Hence, following the conclusion of the search and rescue operation, the beacon 75 may continue to transmit emergency messages. It will be appreciated that this is undesirable.

Accordingly, a shut down message may be transmitted from the control station 60 via the outgoing channel to the emergency positioning beacon 75. This shut down message will be continued to be transmitted until no further messages are received from the emergency positioning beacon 75.

On receipt of the shut down message, the emergency positioning beacon 75 will cease to transmit any further messages. Also, the emergency positioning beacon 75 may provide an indication that the transmission from this beacon has been deactivated by the control station 60. The electronic positioning beacon 75 may continue to monitor the outgoing channel for any subsequent control messages requesting that, for example, the beacon 75 be reactivated. Also, a mechanism may be provided on the electronic positioning beacon 75 to enable transmission to be manually reactivated.

It will be appreciated that by simply putting the electronic positioning beacon 75 into a monitoring state, rather than shutting down completely, it would be possible to recover from an erroneous stop transmitting message being received. Also, by enabling transmission to be manually reactivated it would be possible to alert the search and rescue organisation to the fact that a real incident has occurred should that organisation have discounted the transmission of emergency positioning messages as being a false alarm.

Figure 12 illustrates an arrangement of a personal safety system according to an embodiment. The personal safety system comprises a personal safety device 170, worn by a crewmember 160, which communicates with the vessel 20 using either the transceiver 70 or the repeater transceiver 70'. One or more repeater transceivers 70' may be provided in order to provide communications coverage in particular communications blackspot areas of the vessel 20 such as, for example, a hold or in a habitation area. For the purposes of clarity, the following embodiments describes communication with the transceiver 70, however, it will be appreciated that communication could be instead with any of the repeater transceivers 70' providing additional communications coverage.

Each crewmember onboard the vessel 20 carries a personal safety device 170. The personal safety device 170 is designed to be lightweight and easily wearable, either on a key fob, attached to a lifejacket or on a necklace cord. Each personal safety device 170 incorporates a battery and a bluetooth transceiver. The base unit 180 also includes a blue tooth transceiver.

Each personal safety device 170 is paired with the base unit 180. It will be appreciated that by providing the facility to pair different personal safety devices 170 with different base units 180 enables a crewmember 160 to retain a personal safety device 170 of their own and still operate on different vessels.

When removed from the base unit 180 the personal safety device 170 transmits at frequent regular intervals. The request message includes a unique identifier for that personal safety device. Typically, a personal safety device 170 is provided for each member of the crew.

The personal safety device 170 maintains a two-way communication link with the transceiver 70. This two-way communications maintains proximity detection of the crewmember 160. Should communications between the personal safety device 170 and the transceiver 70 be broken then this may indicate that the crewmember 160 is in an emergency situation. For example, communication may be lost due to the crewmember 160 falling overboard and drifting out of range, or due to water immersion of the personal safety device 170 blocking transmission.

Also, the personal safety device 170 is provided with an emergency actuator which, once activated, causes an emergency message to be transmitted from the personal safety device to the transceiver 70.

In either event, an alarm will sound on the vessel 20 to indicate that a crewmember 160 may be in an emergency situation. In addition, should communication with the transceiver 70 be lost then the personal safety device 170 will activate an audio visual alarm which indicates to the crewmember 160 that an alarm will have been activated on the vessel 20. Should an alarm occur on the vessel 20 then, as will be explained in more detail below, an emergency message is transmitted over the return channel via the satellite 30, the land earth station 40 and the network 50 to the control station 60. The emergency message will indicate the nature of the emergency (a man-overboard alert or a self-activated alarm) together with the position of the vessel 20 when the alarm occurred. Further information such as a vessel identifier, the number of crewmembers and which crewmember is in an emergency situation may also be provided.

Figure 13 illustrates the proximity-detecting feature of the personal safety device 170. In normal operation, once enabled, the personal safety device 170 periodically communicates with the transceiver 70. A request message is transmitted between the personal safety device 170 and the transceiver 70, when received an acknowledgement signal is sent in reply.

Communication between the personal safety device 170 and the transceiver 70 or the repeater transceiver 70' occurs using a bluetooth link. In accordance with normal bluetooth protocols, it will be appreciated that either the personal safety device 170 or the transceiver 70 can initiate a request message. Should either the personal safety device 170 or the transceiver 70 not receive a request or an acknowledgement for a predetermined period of time then a request message may be transmitted. Hence, it would be appreciated that in this way, the personal safety device 170 and the transceiver 70 continually handshake to provide an assurance that these devices are in range of each other. As long as the personal safety device 170 continues to communicate with the transceiver 70 a visual confidence light flashes, typically every eight seconds, on the personal safety device 170 to provide an indication to the crew member 160 that the personal safety device 170 is communicating correctly with the transceiver 70. Similarly, a visual indicator is provided on the base unit 180 to indicate that communication is established with that crewmember 160.

Figure 14 illustrates in more detail the flow of messages which occurs should the personal safety device 170 and the transceiver 70 fail to communicate with each other. In this example, a request or acknowledgement message sent from the personal safety device 170 to the transceiver 70 fails to reach the transceiver 70.

After a predetermined period of time, the transceiver 70 detects that no message has been received from the personal safety device 170 for that predetermined period of time and, accordingly, transmits a request message to the personal safety device 170. Once again, in this example, the request message fails to be received by the personal safety device 170. This failure in the communications link may be due to, for example, the crew member 160 falling overboard, the crew member 160 leaving the vessel 20 but not deregistering the personal safety device 170 with the base station 180 first, or the crew member 160 simply being in a poor communications location on the vessel 20.

Should the transceiver 70 fail to establish communication with the personal safety device 170 for the predetermined period of time D then the transceiver 70 causes the position of the vessel 20 to be determined and transmits a PSD emergency message which contains this position information, together with an indication that a crew member may be in the water over the return channel to the land earth station 40 and onto the control station 60. In this example, the PSD emergency message is typically transmitted three times. Further information such as a vessel identifier, the number of crewmembers and which crewmember is in an emergency situation may also be provided.

Meanwhile, the personal safety device 170 also detects that communication with the base station 180 has been lost and will activate an audio-visual alarm to provide an indication to the crew member 160 that the PSD emergency message will have been transmitted by the transceiver 70.

On receipt of the PSD emergency message, the control station 60 will forward relevant information to a search and rescue organisation. In conjunction with this, the control station 60 may review the position information received and also attempt to contact the vessel 20 in order to determine whether or not the PSD emergency message is likely to be a false alarm. Assuming that a false alarm is unlikely then the control station 60 may periodically pole the vessel 20 in order to obtain updated position information as required. Meanwhile, the position information recorded by the base station 180 will be stored and displayed in order to provide the remaining crew members with the position of the vessel when the crew member 160 may have been in an emergency situation.

Figure 15 illustrates the signalling which occurs when the crewmember 160 activates an emergency button on the personal safety device 170. Should the crew member 160 press and hold the emergency button for a predetermined period such as, for example, five seconds then the personal safety device 170 will transmit a PSD activated message to the transceiver 70. Depressing the button allows the crewmember 160 to raise an alarm under any circumstances, including an onboard emergency such as when trapped by machinery.

The transceiver 70 will transmit an acknowledgement message back to the personal safety device 170. On receipt of the acknowledgement message, the personal safety device 170 will activate an audio-visual alarm to provide an indication to the crew member 160 that the PSD activated message has been received by the transceiver 70. Meanwhile, an alarm will sound on the vessel 20 and an indication that a personal safety device has been activated will be displayed on the base station 180.

Upon receipt of the PSD activated message, the transceiver 70 will transmit a PSD emergency message over the return channel to the manned earth station 40 and onto the control station 60. The PSD emergency message will provide an indication that a PSD alarm button has been activated and also provide position information of the vessel 20. Further information such as a vessel identifier, the number of crewmembers and which crewmember is in an emergency situation may also be provided. In this example, the PSD emergency message is also typically transmitted three times.

Upon receipt of the PSD emergency message, the control station 60 will forward position information of the vessel 20 to a search and rescue organisation. Meanwhile, personnel at the control station 60 may attempt to contact the vessel in order to determine whether or not the PSD emergency message is a false alarm.

Figure 16 illustrates which occurs in order to cancel a PSD emergency message. Should the emergency onboard the vessel 20 be resolved or should it be determined by the vessel 20 that a false alarm occurred then a cancel emergency message is transmitted over the return channel to the land earth station and onto the control station 60. The cancel emergency message is retransmitted periodically until a cancel acknowledgement message is received in return. In this way, it will be appreciated that the vessel 20 can safely and reliably cancel an emergency message when appropriate to do so in order to prevent a false alarm from occurring and causing an unnecessary search and rescue operation from being launched.

Hence, in a man overboard situation, the personal safety device 170 may become immersed in water and the bluetooth radio signal is attenuated. This prevents the regular transmission between the personal safety device 170 and the transceiver 70. When an emergency is detected, the base station 180 can raise the alarm by sounding a buzzer, or klaxon or similar audio device and also provide a visual indication by means of a flashing light or a display message. When a emergency is detected, the base unit 180 accurately records the current geographical position using a global positioning system, making it easier for the vessel 20 to turn around and steer a course back to where the man overboard is likely to be. This information is also routed to the search and rescue services, if required. This is particularly beneficial for single handed vessels. Also, using the Inmarsat (trademark) D+ system, the speed of the notification is significantly faster than those using emergency position beacons to transmit an alert to an earth orbiting satellite in order to relay the man overboard incident to the search and rescue organisation. Using such an emergency position indicating radio beacon can take around 20 minutes, whereas when using the Inmarsat (trademark) D+ communications channel, a notification can be routinely transmitted in less than two minutes. Other satellite bearers, such as Iridium (trademark) do not employ transmission data slots as in Inmarsat (trademark) D+ and can, therefore, provide even faster notification. When a person is in the water, this time saving from the personal safety device 70 can make the difference between life and death. Also, by using the D+ or Iridium (trademark) system, two-way communications is supported.

It will be appreciated that using the bluetooth communications protocol provides an extremely robust transmission link between the personal safety device 170 and the transceiver 70. The transmission also has a low susceptibility to interference, which helps to reduce the number of false alarms.

On the occurrence of an emergency alarm at the base station 180, a stop vessel switch is activated to cut out any engines in order to reduce the distance between the vessel 20 and the crewmember 160 who may be overboard. This stop vessel switch could also take the form of an auto-helm deactivator on a yacht. It will be appreciated that these features are particular advantageous for single-crewed vessels.

The personnel safety device 70 also transmits routinely battery level information to the transceiver 70. It is important that the personnel safety device 170 maintains a particular level of charge in its battery in order to prevent false alarms occurring. Hence, the battery level can be monitored and an indication can be provided on the base station 180 when an individual battery level reaches a predetermined level. At that point, the crewmember 160 can be informed that his batteries need to be recharged and a low battery alarm on the personnel safety device 170 will be activated. Should the batteries not be recharged and the battery levels in the personal safety device 170 reach a critically low level then the personal safety device 170 will transmit a deactivation message to the transceiver 70 to inform the base station 180 that the personal safety device 170 will cease to continue transmitting. On receipt of a deactivation acknowledgement message from the transceiver 70 the personal safety device will cease transmitting and the confidence indicator will be deactivated.

The personnel safety device 170 may also be provided with a simple display and data input device which would enable, for example, text messages to be transmitted between the base station 180 and the personnel safety device 170. Text messages can also be provided from the control station 60 and routed to the personal safety device 170. Likewise, the base station 180 may also be provided with a simple display and data input device which would enable, for example, text messages to be transmitted between the base station 180, the control station 60 and the personal safety device 170. It will be appreciated that these text messages may either be freeform or pre-programmed templates.

Although illustrative embodiments of the invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications can be affected therein by one scope in the art without departing from the scope of the invention as defined by the appended claims.

CLAIMS

1. A method of communicating with a vessel, said method comprising the steps of:

transmitting at predetermined intervals a position information message from said vessel over a return communications channel;

monitoring said return communications channel;

in the event that said position information message is not received over said return communications channel within a predetermined period encompassing said predetermined interval, transmitting a position request message to said vessel over an outgoing communications channel;

monitoring said outgoing communications channel; and

in response to receipt of said position request message at said vessel, transmitting a position response message from said vessel over said return communications channel.

2. The method of claim 1, wherein said return communications channel has a transmission latency and said method further comprises the steps of:

embedding a sequence identifier to each position information message; and

ordering said information messages received over said return communications channel using said sequence identifiers.

3. The method of any preceding claim, further comprising the step of:

varying said predetermined interval in order to vary the data bandwidth used by position information messages transmitted over said return communications channel.

4. The method of any one of claims 1 and 2, further comprising the step of:

varying said predetermined interval in order to vary a maximum emergency identification reporting period.

5. The method of any preceding claim, wherein said return communications channel has a transmission latency and said method further comprises the step of:

setting said predetermined period to be no shorter than said transmission latency.

6. The method of any preceding claim, further comprising the step of:

setting said predetermined period to be no longer than said predetermined interval.

7. The method of any preceding claim, further comprising the steps of:

in the event that said position response message is not received over said return communications channel within a predetermined response period, retransmitting said position request message to said vessel over said outgoing communications channel.

8. The method of claim 7, wherein said return communications channel and said outgoing communications channel have a combined transmission latency, said method further comprising the step of:

setting said predetermined response period to be no shorter than said combined transmission latency.

9. The method of claim 7 or 8, further comprising the steps of:

determining the number of position request messages that have been retransmitted; and

in the event that greater than a predetermined number of position request messages have been retransmitted, activating an alarm to indicate that communication with the vessel could not be established.

10. The method of claim 9, further comprising the steps of:

in response to the alarm, causing an alarm mechanism to issue a position request message.

11. The method of claim 9 or 10, further comprising the steps of:

in response to the alarm, contacting said vessel using predetermined vessel contact information.

12. The method of any one of claims 9 to 11, further comprising the steps of:

in response to the alarm, reviewing the most recently received position information message to determine whether or not the vessel is likely to be in distress.

13. The method of claim 12, further comprising the steps of:

in the event the vessel is likely to be in distress, transmitting at least the most recently received position information message for that vessel to a search and rescue organisation.

14. The method of any preceding claim, further comprising the steps of:

transmitting a stop monitoring message from said vessel over said return communications channel;

monitoring said return communications channel;

on receipt of said stop monitoring message over said return communications channel, transmitting a stop monitoring acknowledgement message over said outgoing communications channel; and

in the event that said stop monitoring acknowledgement message is not received over said return communications channel within a predetermined stop monitoring response period, retransmitting said stop monitoring message.

15. The method of claim 14, further comprising the steps of:

determining the number of stop monitoring messages that have been retransmitted; and

in the event that greater than a predetermined number of stop monitoring messages have been retransmitted, activating an alarm to indicate to said vessel that monitoring by said control station could not be terminated.

16. The method of any preceding claim, further comprising the steps of:

transmitting a start monitoring message from said vessel over said return communications channel;

monitoring said return communications channel;

on receipt of said start monitoring message over said return communications channel, transmitting a start monitoring acknowledgement message over said outgoing communications channel; and

in the event that a start monitoring acknowledgement message is not received over said outgoing communications channel within a predetermined start monitoring period, retransmitting said start monitoring message.

17. The method of claim 16, further comprising the steps of:

determining the number of start monitoring messages that have been retransmitted; and

in the event that greater than a predetermined number of start monitoring messages have been retransmitted, activating an alarm to indicate to the vessel that communication could not be established.

18. The method of any preceding claim, wherein said position information message includes vessel ID and position data.

19. A system for communicating with a vessel, said system comprising:

vessel transmission logic operable to transmit at predetermined intervals a position information message from said vessel over a return communications channel;

return channel monitoring logic operable to monitor said return communications channel;

transmission logic operable, in the event that said return channel monitoring logic indicates that said position information message is not received over said return communications channel within a predetermined period encompassing said predetermined interval, to transmit a position request message to said vessel over an outgoing communications channel; and

outgoing channel monitoring logic operable to monitor said outgoing communications channel, wherein said vessel transmission logic is further operable, in response to said outgoing channel monitoring logic indicates receipt of said position request message at said vessel, to transmit a position response message from said vessel over said return communications channel.

20. The system of claim 19, wherein said return communications channel has a transmission latency, said vessel transmission logic is further operable to embed a sequence identifier to each position information message and said return channel monitoring logic is operable to order said information messages received over said return communications channel using said sequence identifiers.

21. The system of claim 19 or 20, wherein said predetermined interval is variable in order to vary the data bandwidth used by position information messages transmitted over said return communications channel.

22. The system of claim 19 or 20, wherein said predetermined interval is variable in order to vary a maximum emergency identification reporting period.

23. The system of any one of claims 19 to 22, wherein said return communications channel has a transmission latency and said predetermined period is set to be no shorter than said transmission latency.

24. The system of any one of claims 19 to 23, wherein said predetermined period is set to be no longer than said predetermined interval.

25. The system of any one of claims 19 to 24, wherein said return channel monitoring logic is operable in the event that said position response message is not received over said return communications channel within a predetermined response period to cause said transmission logic to retransmit said position request message to said vessel over said outgoing communications channel.

26. The system of claim 25, wherein said return communications channel and said outgoing communications channel have a combined transmission latency and said predetermined response period is set to be no shorter than said combined transmission latency.

27. The system of claim 25 or 26, wherein said transmission logic is operable to determine the number of position request messages that have been retransmitted and, in the event that greater than a predetermined number of position request messages have been retransmitted, to activate an alarm to indicate that communication with said vessel could not be established.

28. The system of claim 27, wherein said transmission logic is operable to activate said alarm and to cause an alarm mechanism to issue a position request message.

29. The system of claim 27 or 28, wherein said transmission logic is operable to activate said alarm and to cause said vessel to be contacted using predetermined vessel contact information.

30. The system of any one of claims 27 to 29, wherein said transmission logic is operable to activate said alarm and to cause the most recently received position information message to be reviewed to determine whether or not said vessel is likely to be in distress.

31. The system of claim 30, further comprising emergency forwarding logic operable, in the event that said vessel is likely to be in distress, transmitting at least the most recently received position information message for that vessel to a search and rescue organisation.

32. The system of any one of claims 19 to 31, wherein said vessel transmission logic is operable to transmit a stop monitoring message from said vessel over said return communications channel, said transmission logic is operable on receipt of said stop monitoring message over said return communications channel to transmit a stop monitoring acknowledgement message over said outgoing communications channel and said vessel transmission logic is further operable, in the event that said stop monitoring acknowledgement message is not received over said return communications channel within a predetermined stop monitoring response period, to retransmit said stop monitoring message.

33. The system of claim 32, wherein said vessel transmission logic is further operable to determine the number of stop monitoring messages that have been retransmitted and, in the event that greater than a predetermined number of stop monitoring messages have been retransmitted, to activate an alarm to indicate to said vessel that monitoring by said control station could not be terminated.

34. The system of any one of claims 19 to 33, wherein said vessel transmission logic is operable to transmit a start monitoring message from said vessel over said return communications channel, said transmission logic is operable on receipt of said start monitoring message over said return communications channel to transmit a start monitoring acknowledgement message over said outgoing communications channel and said vessel transmission logic is further operable, in the event that said start monitoring acknowledgement message is not received over said return communications channel within a predetermined start monitoring response period, to retransmit said start monitoring message.

35. The system of claim 34, wherein said vessel transmission logic is further operable to determine the number of start monitoring messages that have been retransmitted and, in the event that greater than a predetermined number of start monitoring messages have been retransmitted, to activate an alarm to indicate to said vessel that monitoring by said control station could not be established.

36. The system of claim 19, wherein said position information message includes vessel ID and position data.

37. A position transmission apparatus for a vessel, said apparatus comprising:

transmission logic operable to transmit at predetermined intervals a position information message over a return communications channel; and

outgoing channel monitoring logic operable to monitor an outgoing communications channel, wherein said transmission logic is further operable, in response to said outgoing channel monitoring logic indicating receipt of a position request message, to transmit a position response message over said return communications channel.

38. A vessel position receiving apparatus, said apparatus comprising:

return channel monitoring logic operable to monitor said return communications channel; and

transmission logic operable, in the event that said return channel monitoring logic indicates that a position information message is not received over said return communications channel within a predetermined period, to transmit a position request message to a vessel over an outgoing communications channel.

39. A method of communicating with a vessel as hereinbefore described with reference to the accompanying drawings.

40. A system for communicating with a vessel as hereinbefore described with reference to the accompanying drawings.

41. A position transmission apparatus for a vessel as hereinbefore described with reference to the accompanying drawings.

42. A vessel position receiving apparatus as hereinbefore described with reference to the accompanying drawings.

40

Application No: GB0518444.5 **Examiner:** Gareth Griffiths

Claims searched: 1, 19, 37 & 38 **Date of search:** 19 January 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	EP0509776 A2 (PIONEER)
A	-	US6222484 B1 (SEIPLE)
Y	1-38	US4833477 B (TENDLER) whole document
A	-	GB2409778 A (EDWARDS)
Y	1-38	US2004/0217900 A (MARTIN) whole document
Y	1-38	US6629285 B (NOKIA) abstract

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

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

H4L

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

G01S; G08B; G08C; H04L

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

WPI, EPODOC