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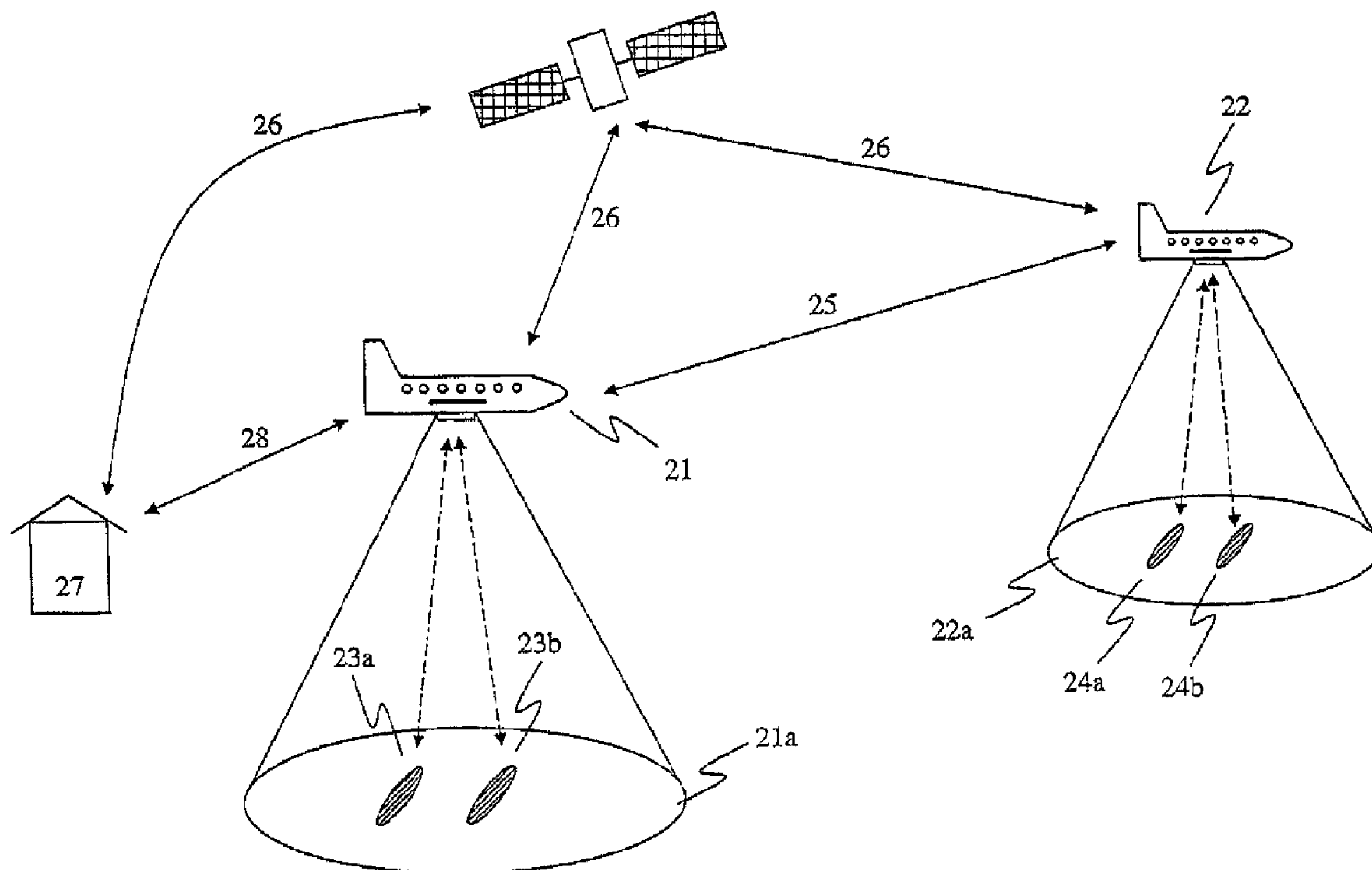
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(54) **Titre : SYSTEME DE SURVEILLANCE DE BATEAU**
(54) **Title: SHIP MONITORING SYSTEM**



(57) **Abrégé/Abstract:**

The present disclosure relates to a monitoring system for monitoring ships in shipping traffic that have AIS ship transmission units and/or AIS ship reception units for sending and/or receiving AIS radio signals that contain shipping traffic data for the shipping traffic, wherein a plurality of AIS transmission units and/or AIS reception units are provided that are arranged on commercial aircraft such that at least a portion of the AIS radio signals transmitted by the AIS ship transmission units in the shipping traffic can be received by at least one of the AIS reception units arranged on a commercial aircraft, and/or the AIS radio signals transmitted by at least one of the AIS transmission units arranged on a commercial aircraft can be received by at least a portion of the AIS ship reception units in the shipping traffic, when the commercial aircraft are flying in the direction of their destinations in the air traffic area.

Abstract

The present disclosure relates to a monitoring system for monitoring ships in shipping traffic that have AIS ship transmission units and/or AIS ship
5 reception units for sending and/or receiving AIS radio signals that contain shipping traffic data for the shipping traffic, wherein a plurality of AIS transmission units and/or AIS reception units are provided that are arranged on commercial aircraft such that

10 at least a portion of the AIS radio signals transmitted by the AIS ship transmission units in the shipping traffic can be received by at least one of the AIS reception units arranged on a commercial aircraft, and/or

15 the AIS radio signals transmitted by at least one of the AIS transmission units arranged on a commercial aircraft can be received by at least a portion of the AIS ship reception units in the shipping traffic,

when the commercial aircraft are flying in the direction of their destinations in the air traffic area.

Ship monitoring system

Technical Field

The disclosure relates to a monitoring system for monitoring ships in shipping traffic that have AIS ship transmission units and/or AIS ship reception units for sending and/or receiving AIS radio signals that contain shipping traffic data for the shipping traffic. The disclosure likewise relates to a method for producing such a monitoring system and to a method for monitoring the shipping traffic in this regard.

10 Background

Today, monitoring of shipping traffic, which is increasing worldwide, is based predominantly on radar monitoring systems, radio telephony and the use of AIS (Automatic Identification System). Since the year 2000, the AIS has been stipulated as an obligatory standard by the International Maritime Organization (IMO) in order to increase the safety of international shipping traffic. This locally bounded radio system is used in this case for the interchange of navigation and other shipping data that are meant to allow the ships to obtain a comprehensive overview of the adjacent shipping traffic. The primary aim in this case is to avoid collisions between ships.

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The AIS alternately transmits on two channels in the VHF marine radio band, namely firstly on 168.975 MHz and secondly on 162.025 MHz. In this case, the individual AIS shipping data items are transmitted in fixed time frames, the use of which is automatically coordinated by the relevant subscribers (what is known as SOTDMA: Self organized time division multiple access). Hence, there are just 2250 time slots per minute available to the individual subscribers for transmitting data.

On the basis of the VHF frequency band used, the radio range of AIS from ship to ship corresponds to approximately 40 to 60 km, which corresponds to little more than normal visibility on the high sea. Coastal stations are able to cover a radius of up to 100 km as a result of their relatively high position. On account
5 of the limited range and also the SOTDMA transmission protocol used, ships that are able to see and receive one another form an AIS radio cell within which the subscribers are able to send and receive without collision.

Hence, the AIS is merely a local radio system that, although it provides
10 sufficient data for a ship on the high sea, is not suitable for worldwide collection of the increasing shipping traffic. For shipping companies, shipping organizations or environmental ministries, however, real-time collection of the AIS shipping traffic data accruing worldwide would be of great interest in order to counteract particularly also illegal practices on the high sea.

15

In the very recent past, attempts have been made to arrange AIS reception
antennas on satellites so as to be able to receive the AIS radio signals transmitted worldwide that are regularly transmitted by the ships. Although this would allow worldwide collection of the shipping traffic data transmitted using
20 the AIS, it has considerable difficulties and disadvantages in practice, since the AIS has not been developed for satellite reception.

On account of the extremely high altitude of the satellite, a reception range with
a diameter of approximately 5000 km is produced. Since the AIS, as a local
25 radio system, automatically organizes itself into individual radio cells that all send on the same frequency bands, such a large reception radius results in a large number of radio cells with identical transmission frequencies being received. The AIS radio signals from the various AIS radio cells are therefore superimposed at the receiver, which means that normal data processing is no
30 longer possible. Instead, the received radio signal needs to be conditioned in a complex and computationally intensive manner in order to be able to ascertain

the individual AIS radio signals from the superimposed AIS radio signals. With such a large reception range, this is no longer possible on the satellite alone, however, which means that the signal processing has to be performed on the earth's surface in large computer centres.

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Furthermore, the AIS radio signals are subjected to severe interference by the atmosphere when received on the satellite, which impairs the signal quality to a considerable extent and hence reduces the number of AIS radio signals that can be received and evaluated.

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Finally, these disadvantages that are conditional upon the satellite system result in only a fraction of the AIS radio signals transmitted worldwide now being able to be received and evaluated using AIS reception antennas arranged on the satellite, which means that this also allows worldwide coverage only to a limited extent. Furthermore, the use of satellites and also the associated complex signal processing are very cost intensive, which means that for economic reasons alone the use of satellites for receiving AIS radio signals appears questionable.

20 Summary

It is therefore an object of selected embodiments to specify a monitoring system that can be used to receive, and to evaluate in real time, at least most AIS radio signals that are transmitted worldwide.

25 The disclosure generally relates to the monitoring system of the type described at the outset in that a plurality of AIS transmission units and/or AIS reception units are provided that are arranged on commercial aircraft such that

- at least a portion of the AIS radio signals transmitted by the AIS ship transmission units in the shipping traffic can be received by at least one of the AIS reception units arranged on a commercial aircraft,
- 30 and/or

- the AIS radio signals transmitted by at least one of the AIS transmission units arranged on a commercial aircraft can be received by at least a portion of the AIS ship reception units in the shipping traffic,
- 5 when the commercial aircraft are flying in the direction of their destinations in the air traffic area.

Accordingly, it is proposed that conventional commercial aircraft are equipped with appropriate AIS transmission units and/or AIS reception units that are then
10 able to receive the AIS radio signals transmitted by the ships, and are also able to transmit appropriate AIS radio signals using the transmission units, on their flight to their respective destinations. Since conventional commercial aircraft usually have a much lower altitude than communication satellites, the possible reception range is much shorter and is up to 350 km, for example. This
15 ultimately results in fewer AIS radio cells being able to be received simultaneously, which reduces the superimposition of the individual AIS radio signals and therefore reduces the complexity of the signal processing following reception of the radio signals. Furthermore, the reception quality is increased on account of the lower altitude of the commercial aircraft. Hence, the
20 reception rate can be increased on account of the shorter reception range. On the other hand, however, a sufficient plurality of AIS radio cells are still covered by a single AIS flying reception unit or AIS flying transmission unit, since the commercial aircraft usually have a cruise altitude of several 1000 metres (in most cases between 8 and 12 km). The number of AIS radio cells that can be
25 received in this case is sufficient in order to be able to derive an appropriate overview.

In this case, the inventors have recognized that a sufficient number of equipped commercial aircraft allows almost uninterrupted monitoring of the
30 highly frequented international shipping routes, since firstly most shipping routes are covered by the flight routes of the commercial aircraft and secondly

the high volume of flights means that there is always a certain number of commercial aircraft in the air that safeguard reception of the AIS radio signals.

Furthermore, equipping commercial aircraft is much less expensive in
5 comparison with the design of a satellite system, since it is possible to resort to known engineering and it is possible for retrofitting to take place inexpensively on the ground.

Advantageously, in addition to the AIS transmission and/or reception units, AIS
10 signal processing units are arranged on the respective commercial aircraft, said AIS signal processing units being set up to ascertain AIS radio signals from superimposed AIS radio signals from various AIS ship transmission cells. The reason is that the lower altitude of the aircraft in comparison with the satellite means that fewer SOTDMA cells are also received, which results in less
15 superimposition of the AIS radio signals from the individual cells. On account of this, the signal conditioning or signal processing is much simpler, which means that it can actually be performed on board the commercial aircraft. Using an AIS signal processing unit, it is therefore possible to calculate the individual AIS radio signals from the superimposed AIS radio signals from the various
20 cells, and hence to take them as a basis for further use, during the actual flight of the commercial aircraft.

Furthermore, it is quite particularly advantageous if the commercial aircraft
contain an AIS data processing unit that is set up to extract the shipping traffic
25 data contained in the AIS radio signals. Hence, the received shipping traffic data can be ascertained from the AIS radio signals during the actual flight of the commercial aircraft, as a result of which they can be taken as a basis for further use. By way of example, the shipping traffic data can now be forwarded to a ground station, sent as AIS radio signals back to the ships or transmitted
30 to the ships using other communication and radio systems.

Advantageously, the commercial aircraft each contain an AIS data memory for storing received shipping traffic data so as to be able to collect the received shipping traffic data in the event of there being no contact with a ground station, for example. In this case, the AIS data memory can either store the AIS
5 radio signals in raw format or can store the shipping traffic data already extracted from the AIS radio signals as data records. It is also possible for shipping traffic data forwarded by other aircraft to be stored in this data memory for further use.

10 Advantageously, the AIS reception units are designed such that they generate a timestamp when receiving shipping traffic data, said timestamp then being stored together with the shipping traffic data in the AIS data memory. This means that the time aspect, particularly the age of the relevant data, can also be taken into account during later use of the shipping traffic data.

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It is quite particularly advantageous if the commercial aircraft have a communication unit that is set up to transmit received and/or stored shipping traffic data to a reception station directly or using intermediate stations. In this case, such a communication unit may be different from the AIS transmission
20 and/or reception units so as, by way of example, to forward received shipping traffic data to other ships, aircraft, satellites or ground stations directly or using intermediate stations. This can advantageously be accomplished by resorting to already existing communication means. Thus, shipping traffic data that have been received by means of the AIS reception unit on the commercial aircraft
25 can also be transmitted to the ships by means of these already existing communication means, so that there is not necessarily a requirement for an AIS transmission unit on the commercial aircraft.

The communication units that are different from the AIS are naturally also set
30 up to receive shipping traffic data from a transmission station, for example in order to be able to receive shipping traffic data from other aircraft, from

satellites or from ground stations. These shipping traffic data that a commercial aircraft receives via the communication unit can then be transmitted to the ships in the shipping traffic in the transmission range of the AIS transmission unit of the commercial aircraft using the AIS transmission units, for example, which increases the consciousness of situation and position for the individual ships within the reception range above their own reception and transmission horizon.

Alternatively, it is conceivable for the AIS transmission units or AIS reception units that are already arranged on the commercial aircraft or for additional AIS transmitters and receivers to be used as communication means for communicating with other stations, such as commercial aircrafts or satellites. By way of example, it is thus possible to use the satellites already equipped with AIS as intermediate stations in order to interchange information via AIS between the commercial aircraft and the satellites.

The large number of civil air movements and the fact that most shipping and aviation routes used are essentially congruent allow real-time AIS signal monitoring to be performed, as a result of which it is possible to ascertain a worldwide consciousness of position for the shipping traffic using a ground station that receives the relevant data, for example. By contrast, the current AIS satellite systems provide only repeated daily contact, the superimposed signal problems meaning that the number of shipping traffic data items that can actually be received is greatly reduced.

The use of commercial aircraft as transmission and/or reception stations for sending and/or receiving AIS radio signals means that the commercial aircraft are used to form an AIS monitoring network or monitoring system having a worldwide span and allowing real-time, worldwide collection of AIS shipping traffic data. The intercommunication between the commercial aircraft and the

interchange of the received shipping traffic data therefore allow a comprehensive consciousness of position.

5 Selected embodiments otherwise achieve this with a method for producing a monitoring system of the above by arrangement of AIS reception units and/or AIS transmission units on a commercial aircraft.

10 Furthermore, selected embodiments also are directed to a method for monitoring ships in shipping traffic that are able to send and/or receive AIS radio signals containing shipping traffic data by means of AIS ship transmission units and/or AIS ship reception units arranged on the ships, wherein

- 15 - reception of AIS radio signals, containing shipping traffic data, that have been transmitted by at least a portion of the AIS ship transmission units in the shipping traffic by means of at least one AIS reception unit arranged on at least one commercial aircraft, and/or
- transmission of AIS radio signals, containing shipping traffic data, that can be received by at least a portion of the AIS ship reception units in the shipping traffic by means of at least one AIS transmission unit arranged on at least one commercial aircraft,

20 when the at least one commercial aircraft is flying in the direction of its destination in air traffic.

Advantageous embodiments of the method are described herein.

25 Brief Description of the Drawings

The disclosure is explained in more detail by way of example with reference to the appended figures, in which:

Figure 1 - shows a block diagram of the AIS aircraft unit;

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Figure 2 - shows an illustration of the manner of operation of the monitoring system;

Figure 3 - shows an illustration of the manner of operation of the monitoring system for a plurality of radio cells that can be received
5 simultaneously.

Detailed Description of Selected Embodiments

Figure 1 shows an AIS aircraft unit 1, as it may be used for arrangement on a commercial aircraft in order to form the monitoring system. The AIS aircraft unit
10 1 has an AIS transmission unit 2 and an AIS reception unit 3. The AIS transmission unit 2 and the AIS reception unit 3 are in this case set up such that they are able to send and receive AIS radio signals.

Furthermore, the AIS aircraft unit 1 has a signal processing unit 4 that is
15 connected to the AIS reception unit 3. In this case, the AIS signal processing unit 4 is set up to process the superimposed AIS radio signals received by the AIS reception unit 3 so as to calculate the superimposed radio signals from various AIS radio cells apart. Hence, even when a plurality of radio cells that send on one and the same frequency band are received, it is possible for the
20 superimposed radio signals to be ascertained individually, which substantially increases the reception rate.

Furthermore, the AIS signal processing unit 4 has a contact connection to an AIS data processing unit 5 that receives, as an input, the AIS radio signals
25 conditioned by the AIS signal processing unit 4. The AIS data processing unit 5 of the AIS aircraft unit 1 then extracts the shipping traffic data that have been transmitted by the ships in the received AIS radio signals. These received shipping traffic data can then be transmitted again by means of the AIS transmission unit 2 to the ships that are situated in the transmission and
30 reception range of the AIS aircraft unit 1, so as to increase the consciousness of position for the ships, since a substantially larger transmission and reception

range is set up for the ships. However, the extracted shipping traffic data can also be supplied to an AIS data memory 6, advantageously together with a reception timestamp, in order to keep them for later use.

- 5 Finally, the AIS aircraft unit 1 also has a communication unit 7 that is different from the AIS radio system, so as to forward the received or stored shipping traffic data to other aircraft or ground stations directly or using intermediate station such as satellites or other flying objects. Furthermore, this communication unit 7 can also be used to receive shipping traffic data from
10 other aircraft from other transmission and reception ranges, as a result of which a common transmission and/or reception range is formed that comprises the individual transmission and reception ranges of the respective AIS transmission units and/or AIS reception units.
- 15 When the commercial aircraft enters the reception range of a ground station, for example, it is entirely advantageous, by way of example, if the shipping traffic data stored in the data memory 6 are then transmitted to the ground station by means of the communication unit 7, so that over time a complete overview of the worldwide shipping traffic can be established.

20

Figure 2 shows the manner of operation of the monitoring system according to the invention. Commercial aircraft 21 and 22 are each equipped with an AIS aircraft unit 1, as shown in Figure 1. Each of these commercial aircraft 21 and 22 uses an AIS aircraft unit 1 to form a transmission and/or reception range
25 21a, 22a within which AIS radio signals can be received from ships 23a, 23b, 24a, 24b and corresponding signals can be transmitted thereto, respectively.

Hence, a plurality of AIS transmission units and/or AIS reception units are provided that are arranged on a multiplicity of commercial aircraft in order to
30 form a common transmission and/or reception range that comprises individual transmission and/or reception ranges of the respective AIS transmission units

and/or AIS reception units. The individual transmission and/or reception ranges 21a and 22a of the respective commercial aircraft 21 and 22 therefore form a common transmission and/or reception range for sending and receiving AIS radio signals when the commercial aircraft are flying on their predetermined trajectories in the air traffic space in the direction of their destinations.

The shipping traffic data ascertained by the commercial aircraft 21 and 22 can be interchanged among one another via a first communication link 25, as a result of which the commercial aircraft 22 receives shipping traffic data from the ships 23a, 23b in the transmission and/or reception range 21a, for example. The commercial aircraft 22 can then make these shipping traffic data available to the ships 24a, 24b in the transmission and/or reception range 22a formed by the commercial aircraft 22 via the AIS radio signals, so that the ships 24a and 24b receive information about the ships 23a and 23b even though the latter are in another radio cell and outside the radio range of the AIS.

In this case, the communication link 25 is a direct communication link between the two commercial aircraft 21 and 22. Alternatively, a communication link 26 that is effected by means of a satellite link is conceivable.

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In proximity to a ground station 27, it is furthermore conceivable for the commercial aircraft 21 to transmit the shipping traffic data received from everyone, whether directly via the AIS radio signals or indirectly via other commercial aircraft 22, to this ground station 27 so that a worldwide overview of the ships and the shipping traffic can be established in said ground station. By way of example, this is accomplished via the communication link 28. Alternatively, it is conceivable in this case for satellite communication 26 to be used for the communication with the ground station 27 so that appropriate data can be transmitted to the ground station 27 even outside the range thereof.

Finally, Figure 3 shows the manner of operation of the monitoring system according to the invention in the case of a commercial aircraft 31 that can receive at least two AIS radio cells 32 and 33. The subscribers in the first radio cell 32 are two ships 32a and 32b, while the subscribers in the second radio cell are two ships 33a and 33b. The subscribers in the radio cells 32 and 33 are unable to see one another and can neither receive nor detect their corresponding transmitted AIS radio signals.

On account of the high altitude of the commercial aircraft 31, the commercial aircraft 31 is able to receive more than one radio cell, as shown by way of example in Figure 3 by the reception of the two radio cells 32 and 33. Since the subscribers in the respective radio cells send on the same frequency band, however, corresponding signal superimpositions arise in the case of reception by the aircraft 31, since the subscribers in the respective radio cell 32 and 33 are sending on the same frequency bands. Therefore, the radio signal received by the commercial aircraft 31 must first of all be conditioned by signal processing in order to be able to individually ascertain the individual AIS radio signals transmitted by the individual subscribers in the radio cells 32 and 33.

Once this has happened, the shipping traffic data from the subscribers 32a, 32b, 33a and 33b can be extracted from the AIS radio signals and are therefore available for further use. By way of example, it is thus possible for the commercial aircraft 31 to now spontaneously transmit AIS radio signals to the transmission and/or reception range 34, so that the subscribers in the first radio cell 32 are able to receive shipping traffic data for the subscribers in the second radio cell 33, even though they would not be able to receive them under normal circumstances. The same also applies to the subscribers in the second radio cell 33, which receive shipping traffic data from the subscribers in the radio cell 32 from the commercial aircraft 31.

It is naturally also conceivable for the shipping traffic data that are intended to be transmitted to the ships also to be transmitted via alternative communication links, as a result of which it is possible to dispense with the AIS flying transmission unit on the satellite, for example.

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This allows the consciousness of situation and position to be increased for every single ship, since there are now much more data and information available than is possible under normal circumstances, since it is normally assumed that data interchange among one another takes place only in visual

10

range.

Claims

1. A monitoring system for monitoring ships in shipping traffic that have AIS ship transmission units and/or AIS ship reception units for sending and/or receiving AIS radio signals that contain shipping traffic data for the shipping traffic, wherein a plurality of AIS transmission units and/or AIS reception units are provided that are arranged on commercial aircraft such that
at least a portion of the AIS radio signals transmitted by the AIS ship transmission units in the shipping traffic can be received by at least one of the AIS reception units arranged on a commercial aircraft, and/or the AIS radio signals transmitted by at least one of the AIS transmission units arranged on a commercial aircraft can be received by at least a portion of the AIS ship reception units in the shipping traffic, when the commercial aircraft are flying in the direction of their destinations in the air traffic area.
2. The monitoring system according to Claim 1, wherein at least one commercial aircraft is provided with an AIS signal processing unit that is set up to ascertain AIS radio signals from superimposed AIS radio signals from various AIS radio cells that have been received by the AIS reception unit arranged on the commercial aircraft.
3. The monitoring system according to Claim 1 or 2, wherein at least one commercial aircraft is provided with an AIS data processing unit that is configured to extract the shipping traffic data contained in the AIS radio signals that have been received by the AIS reception unit arranged on the commercial aircraft.

4. The monitoring system according to Claim 1, 2 or 3, wherein at least one commercial aircraft is provided with an AIS data memory for storing received shipping traffic data.
- 5 5. The monitoring system according to Claim 4, wherein the AIS reception unit arranged on the commercial aircraft is set up to generate a timestamp when receiving the shipping traffic data and the AIS data memory is further configured to store the generated timestamp in conjunction with the relevant shipping traffic data.
- 10 6. The monitoring system according to any one of Claims 1 to 5, wherein at least one commercial aircraft is provided with a communication unit that is configured to transmit shipping traffic data to a reception station directly or using intermediate stations and/or that is set up to receive shipping traffic data from a transmission station.
- 15 7. The monitoring system according to Claim 6, wherein the intermediate, transmission and/or reception stations make up a ground control station for monitoring the shipping traffic, other commercial aircraft that are in the airspace and that have a communication unit and/or satellites.
- 20 8. The monitoring system according to any one of Claims 1 to 7, wherein the AIS transmission unit in each of the aircraft is designed to transmit AIS radio signals that contain at least the shipping traffic data received and/or stored in the respective commercial aircraft.
- 25 9. The method for producing a monitoring system according to any one of Claims 1 to 8, wherein the monitoring system comprises an arrangement of AIS reception units and/or AIS transmission units on a commercial aircraft.
- 30 10. A method for monitoring ships in shipping traffic that are capable of sending and/or receiving AIS radio signals containing shipping traffic data

by means of AIS ship transmission units and/or AIS ship reception units arranged on the ships, the method comprising:

5 receiving AIS radio signals, containing shipping traffic data, that have been transmitted by at least a portion of the AIS ship transmission units in the shipping traffic by means of at least one AIS reception unit arranged on at least one commercial aircraft, and/or
10 transmitting AIS radio signals, containing shipping traffic data, that can be received by at least a portion of the AIS ship reception units in the shipping traffic by means of at least one AIS transmission unit arranged on at least one commercial aircraft,
when the at least one commercial aircraft flies in a direction of its destination in air traffic.

11. The method according to Claim 10, wherein the received shipping traffic
15 data is stored in an AIS data memory arranged on the commercial aircraft and the method comprises forwarding of the stored shipping traffic data by means of a communication unit arranged on the commercial aircraft to a reception station when the reception station comes into radio range of the communication unit.

20

12. The method according to Claim 10 or 11, wherein the shipping traffic data is transmitted by a transmission station by a communication unit arranged on the commercial aircraft and transmitting AIS radio signals that contain
25 at least these shipping traffic data received from the transmission station by means of the AIS transmission unit arranged on the commercial aircraft.

13. The method according to any one of Claims 10 to 12, wherein AIS radio signals are received containing shipping traffic data from a first AIS radio cell by means of the AIS reception unit arranged on the at least one commercial aircraft and shipping traffic data is transmitted from the first AIS radio cell to ships in at least one second AIS radio cell.

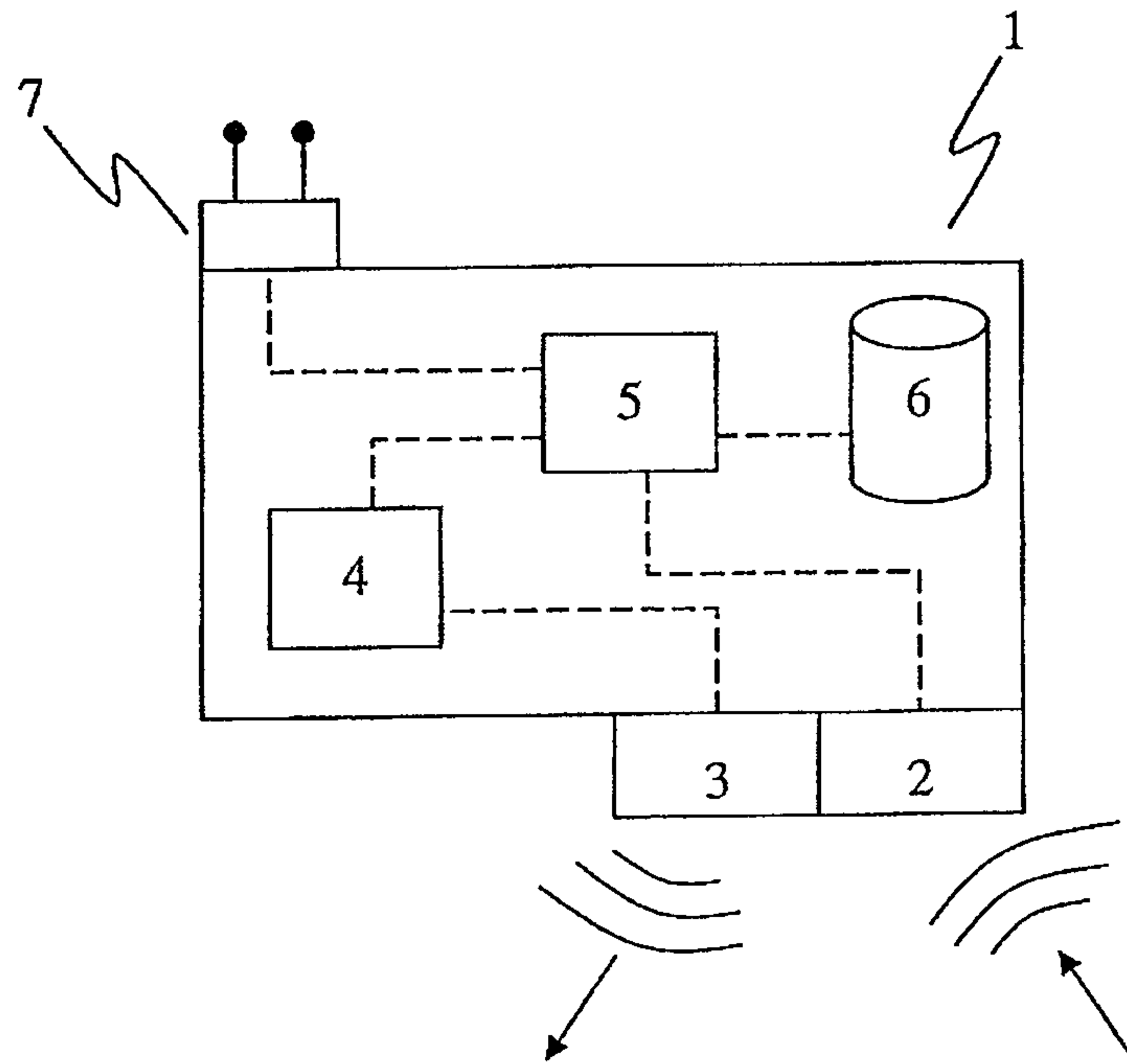


Figure 1

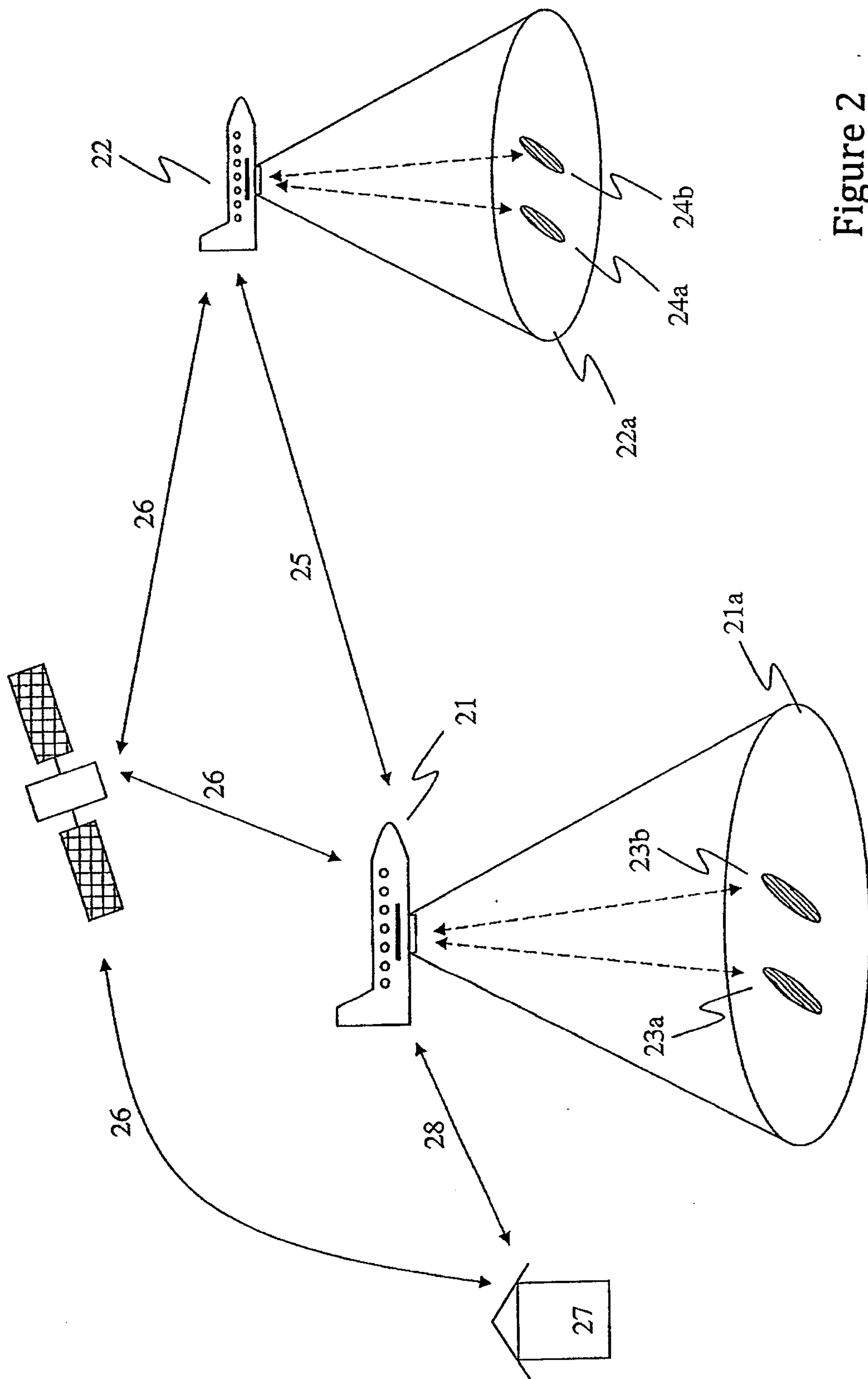


Figure 2

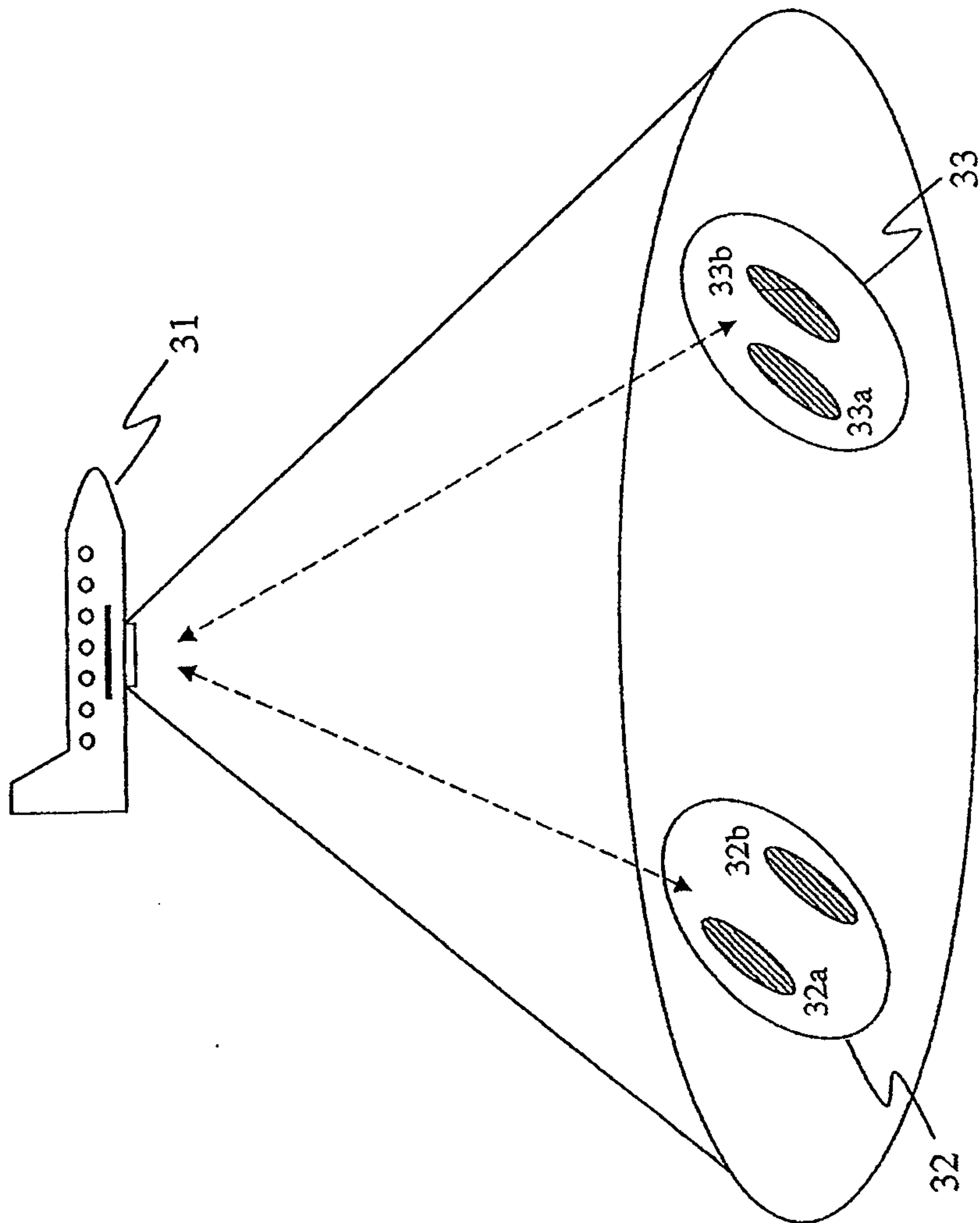


Figure 3

