

CLAIMS

1. A navigation message reception device comprising:

5 a satellite receiver~~(330)~~ for receiving a navigation message from an artificial satellite used for a satellite positioning system;

a satellite information acquisition portion~~(S31, S61)~~ for acquiring authenticated satellite information from a positioning device~~(200)~~ that performs authentication by receiving authentication information corresponding to a navigation message received from the artificial satellite, wherein the authenticated
10 satellite information is information about the artificial satellite that is a source of the successfully authenticated navigation message; and

a simplified determination portion ~~(S33 to S35, S66, S67, S95, S96, S106, S107, S113, S114, S125, S126)~~ for determining whether the navigation message received by the satellite receiver is authentic, by using the authenticated
15 satellite information acquired by the satellite information acquisition portion.

2. The navigation message reception device according to claim 1, wherein:

the navigation message contains identification information for identifying
20 the artificial satellite;

the authenticated satellite information contains identification information for identifying the artificial satellite that is a source of the successfully authenticated navigation message;

the simplified determination portion~~(S33 to S35)~~ determines that the
25 navigation message received by the satellite receiver is authentic when the identification information contained in the navigation message received by the

satellite receiver matches the identification information contained in the authenticated satellite information acquired by the satellite information acquisition portion-(S31); and

the simplified determination portion does not determine that the navigation message received by the satellite receiver is authentic when the identification information contained in the navigation message received by the satellite receiver does not match the identification information contained in the authenticated satellite information acquired by the satellite information acquisition portion.

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3. The navigation message reception device according to claim 1, wherein:

the authenticated satellite information contains a transmission time at which the artificial satellite originates the successfully authenticated navigation message, and a reception time at which the positioning device receives the successfully authenticated navigation message,

the navigation message reception device further comprising:

a first continuity determination portion-(S65) for determining whether the transmission time contained in the authenticated satellite information acquired by the satellite information acquisition portion-(S64) and the transmission time contained in the navigation message received by the satellite receiver from the artificial satellite that is the source of the successfully authenticated navigation message have therebetween continuity that corresponds to a reception time difference which is a difference between a navigation message reception time contained in the authenticated satellite information and a reception time of the navigation message by the satellite receiver from the artificial satellite that is the

source of the successfully authenticated navigation message,

wherein:

when the first continuity determination portion determines that there is the continuity, the simplified determination portion ~~(S66, S67)~~ determines that the navigation message received by the satellite receiver is authentic; and

when the first continuity determination portion determines that there is no continuity, the simplified determination portion does not determine that the navigation message received by the satellite receiver is authentic.

4. The navigation message reception device according to claim 1 or 2, further comprising:

an authentication information receiver ~~(S75)~~ for receiving the authentication information from the authentication center;

a center usage authentication portion ~~(S79 to S81)~~ for authenticating the navigation message received by the satellite receiver using the authentication information received by the authentication information receiver; and

a second continuity determination portion ~~(S94, S105)~~ for determining whether there is continuity between the navigation message successfully authenticated by the center usage authentication portion and a new navigation message that the satellite receiver receives from the artificial satellite that is the source of the navigation message successfully authenticated by the center usage authentication portion,

wherein:

when the second continuity determination portion determines that there is the continuity, the simplified determination portion ~~(S95, S96, S106, S107)~~ determines that the navigation message received by the satellite receiver is

authentic; and

when the second continuity determination portion determines that there is no continuity, the simplified determination portion does not determine that the navigation message received by the satellite receiver is authentic.

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5. The navigation message reception device according to claim 4, wherein:

the navigation message contains a transmission time thereof; and

the second continuity determination portion determines whether a
10 transmission time contained in the navigation message successfully authenticated by the center usage authentication portion and a transmission time contained in the new navigation message have therebetween continuity that corresponds to a reception time difference between a reception time of the successfully authenticated navigation message and a reception time of the new navigation
15 message.

6. The navigation message reception device according to claim 4, wherein:

the navigation message contains a transmission time thereof;

20 the new navigation message is the navigation message that the satellite receiver receives within a specified time period from a reception time of the navigation message successfully authenticated by the center usage authentication portion; and

the second continuity determination portion-(S105) determines that there
25 is the continuity between the navigation message successfully authenticated by the center usage authentication portion and the new navigation message when a

difference between a pseudo-distance determined from the transmission time and the reception time of the navigation message successfully authenticated by the center usage authentication portion and a pseudo-distance determined from the transmission time and the reception time of the new navigation message is
5 smaller than a threshold value.

7. The navigation message reception device according to claim 1 or 2, wherein:

the navigation message contains consistency information ensuring
10 consistency between a plurality of the artificial satellites,

the navigation message reception device further comprising:

an authentication information receiver ~~(S75)~~ for receiving, from an authentication center, the authentication information corresponding to the navigation message received from the artificial satellite;

15 a center usage authentication portion ~~(S79 through S81)~~ for authenticating the navigation message received by the satellite receiver using the authentication information received by the authentication information receiver according to the navigation message; and

a consistency determination portion ~~(S112, S124)~~ for determining
20 whether information ensuring consistency with the consistency information contained in the navigation message successfully authenticated by the center usage authentication portion is contained in a navigation message received by the satellite receiver from an unauthenticated satellite, wherein the unauthenticated satellite is the artificial satellite other than the source of the navigation message
25 successfully authenticated by the center usage authentication portion,

wherein:

when the consistency determination portion determines that the information ensuring the consistency is contained in the navigation message received from the unauthenticated satellite, the simplified determination portion (~~S113, S114, S125, S126~~) determines that the navigation message received by the satellite receiver is authentic; and

when the consistency determination portion determines that the information ensuring the consistency is not contained in the navigation message received from the unauthenticated satellite, the simplified determination portion does not determine that the navigation message received by the satellite receiver is authentic.

8. The navigation message reception device according to claim 7, wherein:

the consistency information is a transmission time thereof; and

based on whether there is a match between a transmission time contained in the navigation message successfully authenticated by the center usage authentication portion and a transmission time contained in the navigation message received by the satellite receiver from the unauthenticated satellite, the consistency determination portion (~~S112~~) determines whether the information ensuring the consistency is contained.

9. The navigation message reception device according to claim 7, wherein:

the navigation message contains satellite position calculation information enabling to calculate satellite positions of not only the artificial satellite that is a source of the navigation message but also another artificial satellite;

the consistency information is the satellite position calculation information; and

based on whether there is a match between a satellite position of the unauthenticated satellite calculated from the satellite position calculation information contained in the navigation message successfully authenticated by the center usage authentication portion and a satellite position of the unauthenticated satellite calculated from the satellite position calculation information contained in a navigation message received by the satellite receiver from the unauthenticated satellite, the consistency determination portion-(S124) determines whether the information ensuring the consistency is contained.

10. A simplified authentication system comprising:

a first navigation message reception device-(200) used for a first mobile object;

15 a roadside device-(400) arranged to a road; and

a second navigation message reception device-(300) used for a second mobile object,

wherein the first navigation message reception device includes:

a first satellite receiver-(230) for receiving a navigation message from an artificial satellite used for a satellite positioning system;

an authentication information receiver-(S5) for receiving, from an authentication center, authentication information corresponding to the navigation message received by the first satellite receiver;

a center usage authentication portion-(S9 to S11) for authenticating whether the navigation message received by the first satellite receiver is authentic, by using the authentication information received by the authentication information

receiver; and

a satellite information transmitter~~-(S22)~~ for transmitting authenticated satellite information, wherein the authenticated satellite information is information about the artificial satellite that is a source of the navigation message
5 successfully authenticated by the center usage authentication portion,

wherein the roadside device includes:

a satellite information receiver~~-(S41)~~ for receiving the authenticated satellite information transmitted from the satellite information transmitter;

an accumulation portion~~-(430)~~ for accumulating the authenticated
10 satellite information received by the satellite information receiver; and

a delivery portion~~-(S52)~~ for delivering information accumulated in the accumulation portion,

wherein the second navigation message reception device includes:

a second satellite receiver~~-(330)~~ for receiving a navigation message from
15 an artificial satellite used for the satellite positioning system;

a satellite information acquisition portion~~-(S31, S61)~~ for acquiring the authenticated satellite information by receiving the authenticated satellite information delivered from the delivery portion of the roadside device; and

a simplified determination portion ~~(S33 to S35, S66, S67, S95, S96, S106, S107, S113, S114, S125, S126)~~ for determining whether the navigation
20 message received by the satellite receiver is authentic, by using the authenticated satellite information acquired by the satellite information acquisition portion.