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(54) Title: METHOD AND SYSTEM FOR THE OPTIMISED LOADING OF A MEANS OF TRANSPORT

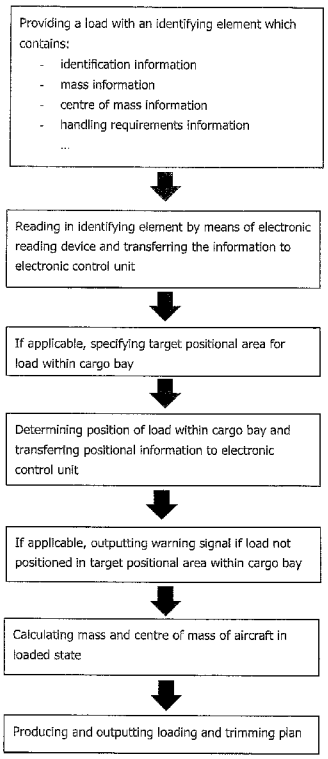

Fig. 3

(57) Abstract: A method of loading a means of transport (100) comprises the steps of providing a load (12) which is scheduled to be conveyed by the means of transport (100) with an identifying element (14) which contains at least information which is characteristic of the identification of the load (12), the mass of said load (12) and the centre of mass of said load (12), reading in the identifying element (14) by means of an electronic reading device (16) and transferring the information contained in said identifying element (14) to an electronic control unit (18), determining the position of the load (12) within a cargo bay (104) of the means of transport (100) by means of a position-detecting apparatus (20) and transferring information which is characteristic of the position of said load (12) within the cargo bay (104) of the means of transport (100) to the electronic control unit (18), and calculating the mass and centre of mass of the means of transport (100) in the loaded state by means of the electronic control unit (18) on the basis of the information transferred to said electronic control unit (18).

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Method and system for the optimised loading of a means of transport

The invention relates to a method and system for loading a means of transport, in particular an aircraft.

The operation of a modern means of transport which is used for conveying loads is usually affected by the mass and centre of mass of said means of transport in the loaded state. Particularly in the case of ships and aircraft, these parameters have a considerable effect on the operating characteristics to be controlled. In order to identify the mass and centre of mass of the means of transport in the loaded state, it is first of all necessary to determine the mass and centre of mass of the individual loads which are to be conveyed by the means of transport. From these data, it is then possible to calculate the mass and centre of mass of the means of transport in the loaded state, while taking into account the position of the loads within said means of transport.

The invention is directed to the object to make available a method and a system for loading a means of transport, in particular an aircraft, which permit automated identification of the mass and centre of mass of said means of transport in the loaded state.

This object is achieved by means of a method having the features in Claim 1 and a system having the features in Claim 8.

In a method of loading a means of transport, a load which is scheduled to be conveyed by said means of transport is provided with an identifying element which contains information which is characteristic of at least the identification of the load, the mass of said load and the centre of mass of said load. The equipping of the load, which may be, for example, in the form of a freight container or the like, with the identifying element preferably takes place outside the means of transport, that is to say before said means of transport is loaded with the load. For example, the identifying element may be fastened to an outer face of the load. If a means of transport is to be loaded with a plurality of loads, for example a plurality of freight containers, it is sensible to always fasten the identifying elements associated with the individual loads to said loads at the same point, for example in a predetermined area of the outer face of the loads.

The identifying element is read in by means of an electronic reading device. The configuration of said electronic reading device is adapted to the configuration of the identifying element in order to ensure that the electronic reading device is capable of reading in and processing the information contained in the identifying element. The information read in by the electronic reading device, which information permits at least identification of the load and also indicates the mass of said load and the centre of mass of said load, is transferred by the electronic reading device to an electronic control unit. As soon as the data read in by the reading device has been transferred to the electronic control unit, said electronic control unit is therefore provided with information as to the load with which the means of transport is to be loaded or has already been loaded, the mass of the said load and where the centre of mass of the said load is located.

In addition, the method of loading a means of transport makes provision for determining the position of the load within a cargo bay of said means of transport. For this purpose, use is made of a position-detecting apparatus which also brings about the transfer of information which is characteristic of the position of the load within the cargo bay of the means of transport to the electronic control unit. As soon as the positional data determined by the position-detecting apparatus have been transferred to the electronic control unit, said electronic control unit is therefore also provided with information as to where a particular load is positioned within the cargo bay of the means of transport.

On the basis of the information transferred to the electronic control unit by the electronic reading device and the position-detecting apparatus, said electronic control unit calculates the mass and centre of mass of the means of transport in the loaded state. When calculating the mass and centre of mass of the means of transport in the loaded state, the control unit is also able to draw upon data which are characteristic of the mass and centre of mass of the means of transport in the non-loaded state, and also other data, for example data which are characteristic of the amount of fuel which is present in a tank belonging to said means of transport. These data may be stored in a memory of the control unit, inputted manually into said control unit or transmitted to said control unit by suitable sensors or the like.

The method of loading a means of transport permits fully electronic calculation of the mass and centre of mass of the means of transport in the loaded state. No manual inputting of data is necessary. This makes it possible to speed up the loading

operation. In addition, inputting errors in the course of manual inputting of data are avoided. Furthermore, it is no longer necessary to subdivide a cargo compartment of the means of transport into compartments which each have to be loaded with loads having the same centre of mass. On the contrary, the loads can be positioned within the cargo compartment of the means of transport as required, and the mass and centre of mass of the individual loads can be taken into account when calculating the mass and centre of mass of the means of transport in the loaded state. As a result, the mass and centre of mass of the individual loads can be transferred more accurately, and the accuracy of calculation of the mass and centre of mass of the means of transport in the loaded state is consequently improved. This increased accuracy of calculation permits an improvement in the efficiency of operation of the means of transport and, in particular, the achieving of a lower fuel consumption.

In principle, it is conceivable to read in the identifying element by means of an electronic reading device which is installed outside the means of transport. For example, said electronic reading device may be positioned in an area in front of a cargo bay door belonging to the means of transport. The identifying elements fastened to the loads which are to be loaded into the means of transport can then be conveniently read in before said loads are finally loaded into said means of transport. However, the reading in of the identifying element preferably takes place by means of an electronic reading device which is installed in the means of transport. For example, said electronic reading device may be installed in a door area of the means of transport, particularly in the area of a cargo bay door belonging to said means of transport. If the electronic reading device is installed in the means of transport, this ensures that only identifying elements which are fastened to loads that are actually loaded into said means of transport are read in.

In the method of loading a means of transport, the information which is transmitted by the position-detecting apparatus to the electronic control unit and which is characteristic of the position of a load within the cargo bay of said means of transport is preferably linked to the information which is contained in the identifying element and which is characteristic of the identification of the load. This makes it possible to associate the information which is likewise contained in the identifying element and which is characteristic of the mass and centre of mass of the load with the positional information which is transmitted by the position-detecting apparatus to the electronic control unit and which is characteristic of the position of the load within the cargo bay of the means of transport.

This may be brought about, for example, through the fact that the arrangement of the loads within the cargo compartment of the means of transport is specified and stored in a memory of the electronic control unit prior to the loading of said means of transport. Said electronic control unit is then able to link the information which is contained in the identifying element of a load and which is characteristic of the identification of the load, the mass of said load and the centre of mass of said load, with a corresponding item of positional information as soon as the data which are characteristic of the identification of the load, the mass of said load and the centre of mass of said load have been transmitted to the control unit by the electronic reading device and, in addition, the position-detecting apparatus reports to the electronic control unit that a position scheduled for the load within the cargo compartment of the means of transport is occupied by a load. This may be brought about, for example, by scanning the position of bolts which are used for locking the load within the cargo compartment of the means of transport.

As an alternative or in addition to this, however, the reading in of the identifying element may also take place by means of an electronic reading device which is installed in the means of transport, is coupled to the position-detecting apparatus or is constructed in a manner integrated with said position-detecting apparatus. This permits direct and error-free linking of the data which are transmitted to the electronic control unit by the electronic reading device and which are characteristic of the identification of the load, the mass of said load and the centre of mass of said load, with the positional information which is transmitted to the electronic control unit by the position-detecting apparatus.

The position of the load within the cargo bay of the means of transport may be detected by means of a position-detecting apparatus which comprises at least one security gate and/or at least one light barrier.

The identifying element may also contain information which is characteristic of handling requirements for the load. For example, said identifying element may contain the item of information to the effect that the load must be cooled or particularly carefully handled. In addition, any other information, for example information regarding the onward transport of the load etc., may be contained in the identifying element if applicable.

The identifying element may, for example, comprise a bar-code marking. Said identifying element can then be produced particularly easily and cost-effectively and fastened to the load in a simple manner. An electronic reading device which is suitable for interacting with an identifying element comprising a bar-code marking comprises, for example, a bar-code scanner.

As an alternative or in addition to this, the identifying element may also comprise a transponder which is constructed, for example, in the form of an RFID (radio frequency identification) chip. An electronic reading device which is suitable for interacting with an identifying element comprising a transponder comprises, for example, a suitable transmitting/receiving unit which is set up for the purpose of reading in the signals outputted by the transponder and of transferring them to the electronic control unit. The transmitting/receiving unit may be designed, for example, as an RFID antenna.

In a preferred embodiment of the method of loading a means of transport, the electronic control unit produces, on the basis of the data regarding the mass and centre of mass of the means of transport in the loaded state which are identified by said electronic control unit, a loading and trimming plan for said means of transport. The electronic control unit may output the loading and trimming plan for the means of transport on an output unit. Said output unit may comprise a display screen and/or a printer.

As an alternative or in addition to this, the electronic control unit may also transmit the data it identifies regarding the mass and centre of mass of the means of transport in the loaded state to a superordinate control unit, for example a flight management system of an aircraft. Said superordinate control unit may then, in turn, produce, and output on an output unit, a loading and trimming plan for the means of transport on the basis of the data identified by the electronic control unit regarding the mass and centre of mass of the means of transport in the loaded state.

The electronic control unit may identify a target positional area for the positioning of the load within the cargo bay of the means of transport on the basis of the information contained in the identifying element and transferred to the electronic control unit. For example, said electronic control unit may specify that the load must be positioned in a particular area of the cargo bay of the means of transport if the mass of said load lies within a predetermined range of mass values. As a further

example, it is conceivable for the electronic control unit to specify that the load must be positioned in a cooled area of the cargo bay of the means of transport if it emerges, from the information contained in the identifying element and transferred to said electronic control unit, that the load must be cooled. Suitable algorithms for identifying a target positional area for positioning a load within the cargo bay of the means of transport may be stored in a memory of the electronic control unit.

The electronic control unit may output a warning signal if said control unit establishes, with the aid of the information transmitted to it by the position-detecting apparatus, that the load is positioned in an area within the cargo bay of the means of transport that lies outside the target positional area. It is thereby possible to check, in a simple manner, whether a load is correctly positioned within a particular area of the cargo bay of the means of transport, and to carry out repositioning of the load if applicable.

A system for loading a means of transport comprises an identifying element which is attachable to a load which is scheduled to be conveyed by said means of transport, and which identifying element contains at least information which is characteristic of the identification of the load, the mass of said load and the centre of mass of said load. An electronic reading device belonging to the system is adapted to read in the identifying element and to transfer the information contained in said identifying element to an electronic control unit. The system for loading a means of transport further comprises a position-detecting apparatus which is adapted to determine the position of the load within a cargo bay of said means of transport and to transmit to the electronic control unit information which is characteristic of said position of the load within the cargo bay of the means of transport. The electronic control unit is adapted to calculate the mass and centre of mass of the means of transport in the loaded state on the basis of the information transferred to said electronic control unit.

The electronic reading device may be installed in the means of transport, particularly in a door area of said means of transport.

The electronic reading device is preferably coupled to the position-detecting apparatus or constructed in a manner integrated with said position-detecting apparatus.

The position-detecting apparatus may comprise at least one security gate and/or at least one light barrier.

The identifying element may also comprise information which is characteristic of handling requirements for the load.

The identifying element may comprise a bar-code marking and/or a transponder which is preferably constructed in the form of an RFID chip.

The electronic control unit is preferably adapted to produce and output on an output unit, a loading and trimming plan for the means of transport on the basis of the data identified by the electronic control unit regarding the mass and centre of mass of the means of transport in the loaded state.

As an alternative or in addition to this, the electronic control unit may be adapted to transmit the data it identifies regarding the mass and centre of mass of the means of transport in the loaded state to a superordinate control unit which, in turn, may be adapted to produce and output on an output unit, a loading and trimming plan for the means of transport on the basis of the data identified by the electronic control unit regarding the mass and centre of mass of the means of transport in the loaded state.

The electronic control unit may also be adapted to identify a target positional area for positioning the load within the cargo bay of the means of transport on the basis of the information contained in the identifying element and transferred to the electronic control unit, and to output a warning signal if the load is positioned in an area within the cargo bay of the means of transport that lies outside the target positional area.

A method described above for loading a means of transport is particularly well suited for use in the loading of an aircraft. Likewise, a system described above for loading a means of transport can be used particularly advantageously in the loading of an aircraft.

A preferred embodiment of the invention will now be explained in greater detail with the aid of the appended diagrammatic drawings, of which:

Figures 1 and 2 show a system for loading an aircraft, at different stages of a loading operation; and

Figure 3 shows a flow chart of a method of loading an aircraft.

Figures 1 and 2 show a system 10 which permits the loading of an aircraft 100 with a plurality of loads 12 in accordance with the method represented in Figure 3. The system 10 comprises a plurality of identifying elements 14 which are attached to the loads 12. In particular, each load 12 is provided with an identifying element 14 which is attached to an upper side of said load 12, see Step 1 in Figure 3. Each identifying element 14 comprises a transponder, for example an RFID chip, on which information which is characteristic of the identification of the load 12, the mass of said load 12 and the centre of mass of said load 12 is stored. In addition, the identifying elements 14 belonging to individual loads 12 contain, as required, information which is characteristic of handling requirements for the load 12. For example, the identifying elements 14 belonging to individual loads 12 may contain the item of information that the loads 12 must be cooled or particularly carefully handled.

The system 10 further comprises an electronic reading device 16. Said electronic reading device 16 is installed in the aircraft 100 in the area of a cargo bay door 102 of said aircraft 100. The electronic reading device 16 comprises a transmitting/receiving unit which is adapted to read in the signals outputted by the transponders of the identifying elements 14. If the transponder of the identifying elements 14 is designed in the form of an RFID chip, the transmitting/receiving unit is appropriately designed as an RFID antenna. As soon as a load 12 with an identifying element 14 fastened to it is located within the receiving range of the transmitting/receiving unit of the electronic reading device 16, said electronic receiving device 16 reads in the information contained in said identifying element 14 of the load 12 and transmits the said information to an electronic control unit 18, see Step 2 in Figure 3.

The information read in by the electronic reading device 16 makes it possible to identify the load 12 and, moreover, indicates the mass of said load 12 and the centre of mass of said load 12. If the identifying elements 14 belonging to individual loads 12 additionally contain information which is characteristic of handling requirements for the load 12 or other load-specific information, this information is also read in by

the electronic reading device 16 and transferred to the electronic control unit 18. As soon as the data inputted by the reading device 16 have been transferred to the electronic control unit 18, said electronic control unit 18 is therefore at least provided with information as to which load 12 the aircraft 100 has been loaded with, what mass the said load 12 has and where the centre of mass of the said load 12 is located.

If necessary or desired, the electronic control unit 18 identifies a target positional area for positioning the load 12 within a cargo bay 104 of the aircraft 100 on the basis of the information contained in the identifying element 14 and transferred to said electronic control unit 18 by the electronic reading device 16, see Step 3 in Figure 3. The electronic control unit 18 may specify, for example, that the load 12 must be positioned in a cooled area of the cargo bay 104 of the aircraft, if it emerges, from the information contained in the identifying element 14 and transferred to the electronic control unit 18, that said load 12 must be cooled. Suitable algorithms for identifying a target positional area for positioning a load 12 within the cargo bay 104 of the aircraft 100 are stored in a memory of the electronic control unit.

After passing beyond the electronic reading device 16, the loads are arranged in the cargo bay 104 of the aircraft 100. Said cargo bay 104 of the aircraft 100 is equipped with a position-detecting apparatus 20. Said position-detecting apparatus 20 serves to determine the position of a load 12 within the cargo bay 104 of the aircraft 100 and to transmit information which is characteristic of the position of the load 12 within said cargo bay 104 of the aircraft 100 to the electronic control unit 18; see Step 4 in Figure 3.

In the exemplified embodiment, which is shown in the figures, of a system 10 for loading an aircraft 100, the position-detecting apparatus 20 comprises a plurality of transmitting/receiving apparatuses 22 which are arranged in a manner distributed within the cargo bay 104 of the aircraft 100 and which are each adapted to read in the signals outputted by the transponders of the identifying elements 14.

In particular, the transmitting/receiving apparatuses 22 of the position-detecting apparatus 20 are each capable of reading in identifying information, which is contained in the identifying elements 14 and which permits identification of the load 12, as soon as said load 12 is located within the receiving range of a suitable

transmitting/receiving apparatus 22. Consequently, the position-detecting apparatus 20 is able to identify each load 12 individually and to transmit information which is characteristic of the position of said load 12 to the electronic control unit 18. As soon as the positional data determined by the position-detecting apparatus 20 have been transferred to the electronic control unit 18, said electronic control unit 18 is therefore also provided with information as to where a particular load 12 is positioned within the cargo bay 104 of the aircraft 100.

When the electronic control unit 18 has identified a target positional area for positioning a load 12 within the cargo bay 104 of the aircraft 100 on the basis of the information contained in the identifying element 14 and transferred to the electronic control unit 18 by the electronic reading device 16, said electronic control unit 18 outputs a warning signal if the control unit 18 establishes, with the aid of the information transmitted to it by the position-detecting apparatus 20, that the load 12 is positioned in an area within the cargo bay 104 of the aircraft 100 that lies outside the target positional area, see Step 5 in Figure 3.

On the basis of the information transferred to the electronic control unit 18 by the electronic reading device 16 and the position-detecting apparatus 20, said electronic control unit 18 finally calculates the mass and centre of mass of the aircraft 100 in the loaded state, see Step 6 in Figure 3. In calculating the mass and centre of mass of the aircraft 100 in the loaded state, the control unit 18 also draws upon data which are characteristic of the mass and centre of mass of the aircraft 100 in the non-loaded state as well as other data, for example data which are characteristic of the amount of fuel which is present in a tank belonging to said aircraft 100.

The electronic control unit 18 also produces a loading and trimming plan for the aircraft 100 on the basis of the data identified by the electronic control unit 18 regarding the mass and centre of mass of the aircraft 100 in the loaded state. The electronic control unit 18 outputs the loading and trimming plan for the aircraft 100 on an output unit which is not illustrated in the figures, see Step 7 in Figure 3. As an alternative or in addition to this, the electronic control unit 18 may also transmit the data it has identified regarding the mass and centre of mass of the aircraft in the loaded state to a superordinate control unit 18, for example a flight management system of said aircraft 100. The superordinate control unit may then, in turn, produce, and output on an output unit, a loading and trimming plan for the aircraft

100 on the basis of the data identified by the electronic control unit 18 regarding the mass and centre of mass of the aircraft 100 in the loaded state.

Patent claims

1. Method of loading a means of transport (100), said method comprising the following steps:
- providing a load (12) which is scheduled to be conveyed by the means of transport (100) with an identifying element (14) which contains at least information which is characteristic of the identification of the load (12), the mass of said load (12) and the centre of mass of said load (12),
- reading in the identifying element (14) by means of an electronic reading device (16) and transferring the information contained in said identifying element (14) to an electronic control unit (18),
- determining the position of the load (12) within a cargo bay (104) of the means of transport (100) by means of a position-detecting apparatus (20) and transferring information which is characteristic of the position of said load (12) within the cargo bay (104) of the means of transport (100) to the electronic control unit (18); and
- calculating the mass and centre of mass of the means of transport (100) in the loaded state by means of the electronic control unit (18) on the basis of the information transferred to said electronic control unit (18).

2. Method according to Claim 1,
characterised in that the reading in of the identifying element (14) takes place by means of an electronic reading device (16) which is installed in the means of transport (100), in particular an electronic reading device (16) which is installed in a door area of said means of transport (100).

3. Method according to Claim 1,
characterised in that the reading in of the identifying element (14) takes place by means of an electronic reading device (16) which is installed in the means of transport (100) and is coupled to the position-detecting apparatus (20) or constructed in a manner integrated with said position-detecting apparatus (20).

4. Method according to one of Claims 1 to 3,
characterised in that the position of the load (12) within the cargo bay (104) of the means of transport (100) is detected by means of a position-detecting

apparatus (20) which comprises at least one security gate and/or at least one light barrier.

5. Method according to one of Claims 1 to 4, characterised in that the identifying element (14) also contains information which is characteristic of handling requirements for the load (12), and/or that said identifying element (14) comprises a bar-code marking and/or a transponder.

6. Method according to one of Claims 1 to 5, characterised in that the electronic control unit (18) produces, and outputs on an output unit, a loading and trimming plan for the means of transport (100) on the basis of the data identified by said electronic control unit (18) regarding the mass and centre of mass of the means of transport (100) in the loaded state, and/or that said electronic control unit (18) transmits the data it identifies regarding the mass and centre of mass of the means of transport (100) in the loaded state to a superordinate control unit which, in turn, produces, and outputs on an output unit, a loading and trimming plan for the means of transport (100) on the basis of the data identified by the electronic control unit (18) regarding the mass and centre of mass of the means of transport (100) in the loaded state.

7. Method according to one of Claims 1 to 6, characterised in that the electronic control unit (18) identifies a target positional area for positioning the load (12) within the cargo bay (104) of the means of transport (100) on the basis of the information contained in the identifying element (14) and transferred to the electronic control unit (18), and outputs a warning signal if the load (12) is positioned in an area within the cargo bay (104) of the means of transport (100) that lies outside the target positional area.

8. System for loading a means of transport (100), which system comprises:
- an identifying element (14) which is attachable to a load (12) which is scheduled to be conveyed by the means of transport (100), and which identifying element contains at least information which is characteristic of the identification of the load (12), the mass of said load (12) and the centre of mass of said load (12),

- an electronic reading device (16) which is adapted to read in the identifying element (14) and to transfer the information contained in said identifying element (14) to an electronic control unit (18),
- a position-detecting apparatus (20) which is adapted to determine the position of the load (12) within a cargo bay (104) of the means of transport (100) and to transmit information which is characteristic of the position of the load (12) within said cargo bay (104) of the means of transport (100) to the electronic control unit (18),

wherein

- the electronic control unit (18) is adapted to calculate the mass and centre of mass of the means of transport (100) in the loaded state on the basis of the information transferred to said electronic control unit (18).

9. System according to Claim 8, characterised in that the electronic reading device (16) is installed in the means of transport (100), in particular in a door area of said means of transport (100).

10. System according to Claim 8, characterised in that the electronic reading device (16) is coupled to the position-detecting apparatus (20) or constructed in a manner integrated with said position-detecting apparatus (20).

11. System according to one of Claims 8 to 10, characterised in that the position-detecting apparatus (20) comprises at least one security gate and/or at least one light barrier.

12. System according to one of Claims 8 to 11, characterised in that the identifying element (14) also contains information which is characteristic of handling requirements for the load (12), and/or that said identifying element (14) comprises a bar-code marking and/or a transponder.

13. System according to one of Claims 8 to 12, characterised in that the electronic control unit (18) is adapted to produce and output on an output unit, a loading and trimming plan for the means of transport (100) on the basis of the data identified by said electronic control

unit (18) regarding the mass and centre of mass of the means of transport (100) in the loaded state, and/or that said electronic control unit (18) is adapted to transmit the data it identifies regarding the mass and centre of mass of the means of transport (100) in the loaded state to a superordinate control unit which, in turn, is adapted to produce and output on an output unit, a loading and trimming plan for the means of transport (100) on the basis of the data identified by the electronic control unit (18) regarding the mass and centre of mass of said means of transport (100) in the loaded state.

14. System according to one of Claims 8 to 13, characterised in that the electronic control unit (18) is adapted to identify a target positional area for positioning the load (12) within the cargo bay (104) of the means of transport (100) on the basis of the information contained in the identifying element (14) and transferred to the electronic control unit (18), and to output a warning signal if the load (12) is positioned in an area within the cargo bay (104) of the means of transport (100) that lies outside the target positional area.

15. Use of a method according to one of Claims 1 to 7 and/or of a system according to one of Claims 8 to 14 in the loading of an aircraft.

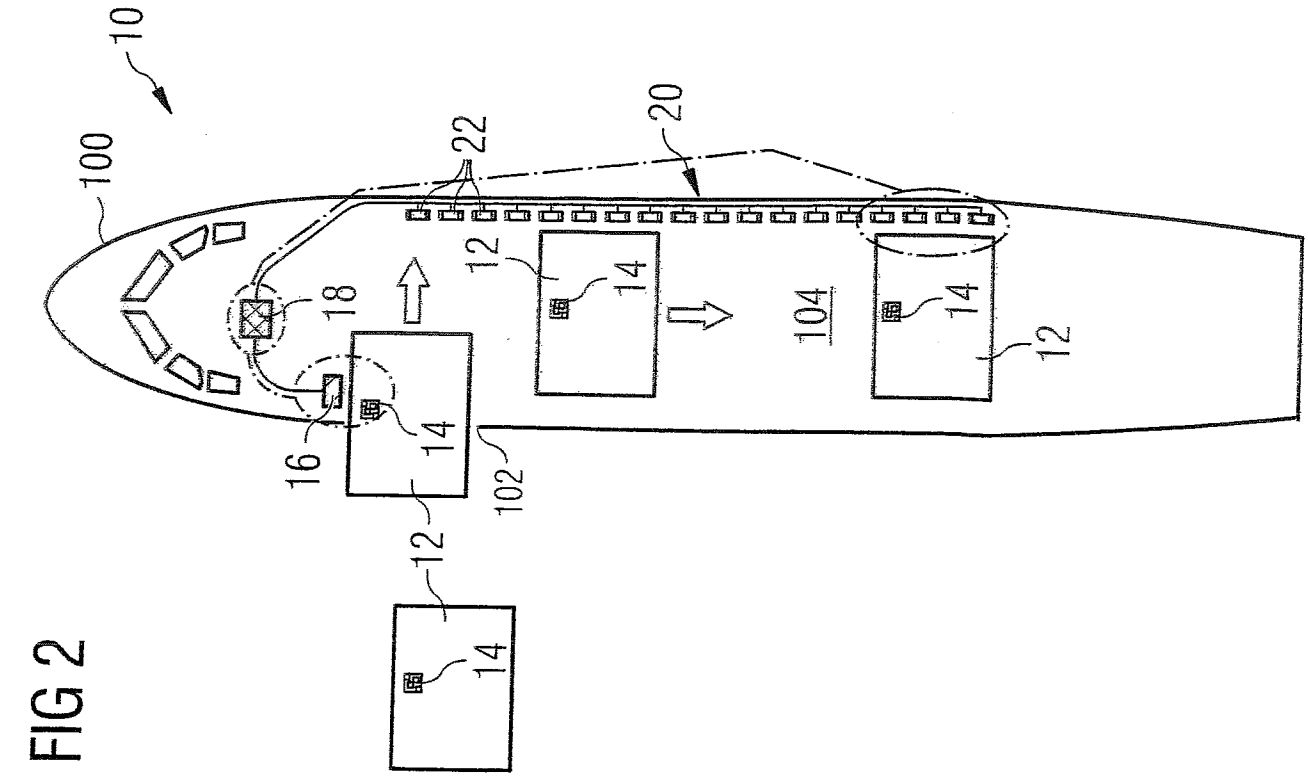

FIG 2

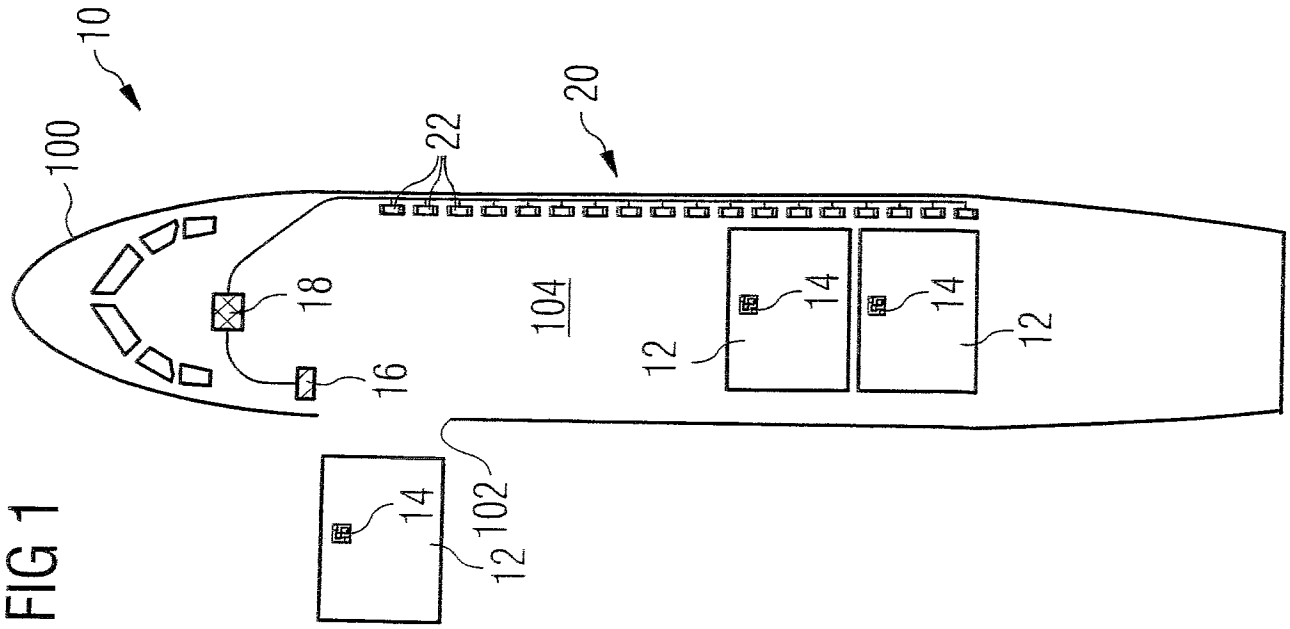

FIG 1

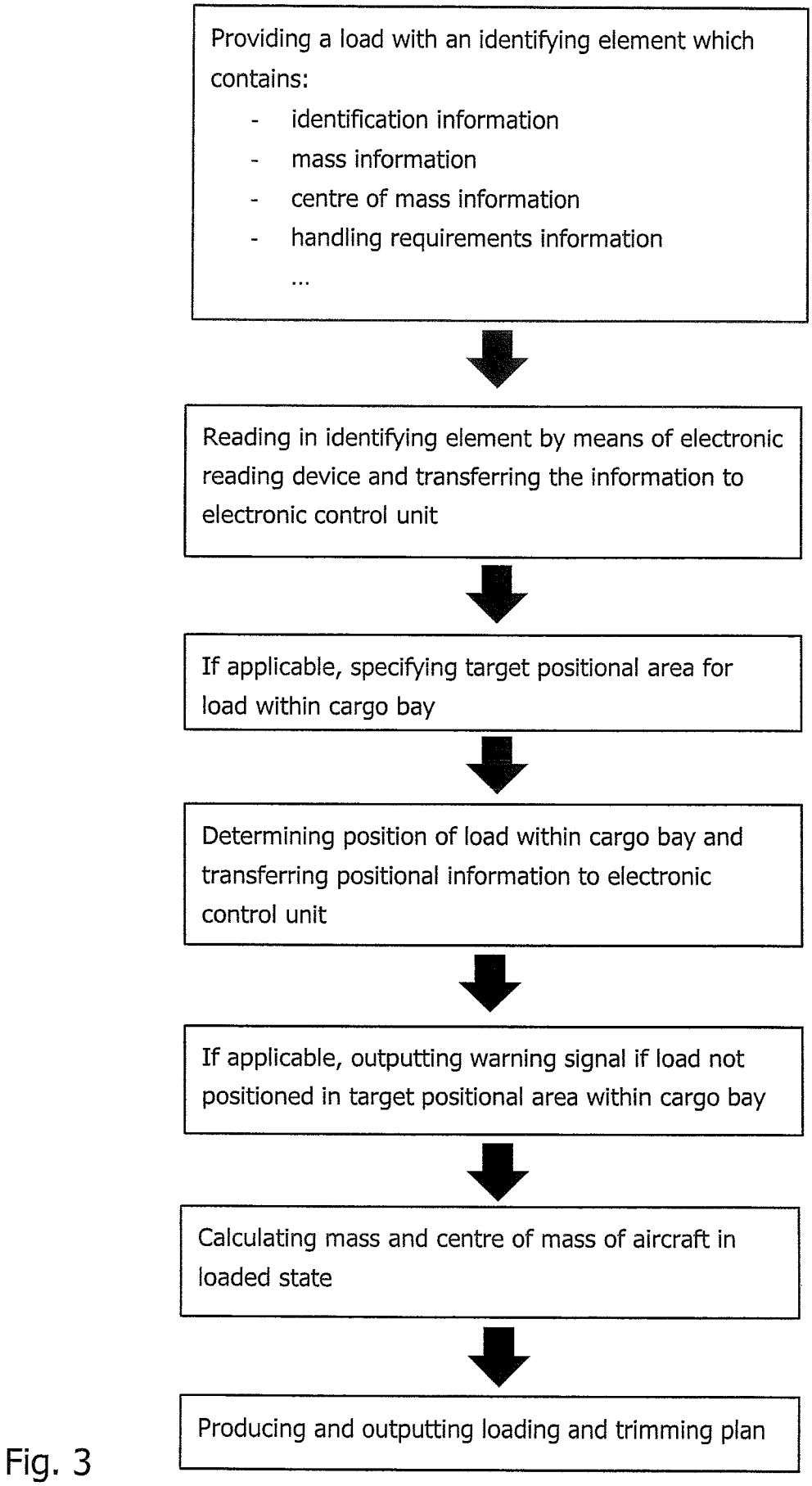
Providing a load with an identifying element which contains:
- identification information
- mass information
- centre of mass information
- handling requirements information
...
Reading in identifying element by means of electronic reading device and transferring the information to electronic control unit
If applicable, specifying target positional area for load within cargo bay
Determining position of load within cargo bay and transferring positional information to electronic control unit
If applicable, outputting warning signal if load not positioned in target positional area within cargo bay
Calculating mass and centre of mass of aircraft in loaded state
Producing and outputting loading and trimming plan

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/073699

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2008/167760 A1 (SCHERENBERGER SVEN [DE] ET AL) 10 July 2008 (2008-07-10) abstract; figure 1 paragraph [0008] - paragraph [0020] -----	1-15
Y	WO 2012/151030 A1 (VICTAULIC CO OF AMERICA [US]; RUTT JOHN D [US]; CYGLER FRANK J III [US]) 8 November 2012 (2012-11-08) abstract; figures 5,7a paragraph [0003] - paragraph [0005] paragraph [0035] paragraph [0043] - paragraph [0045] -----	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 December 2013	08/01/2014

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2013/073699

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008167760 A1	10-07-2008	DE 102007001529 A1	24-07-2008
		US 2008167760 A1	10-07-2008
WO 2012151030 A1	08-11-2012	AU 2012251041 A1	22-08-2013
		TW 201307175 A	16-02-2013
		US 2012283868 A1	08-11-2012
		WO 2012151030 A1	08-11-2012