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(54) Title: DEVICE AND METHOD FOR AUTOMATICALLY CONTROLLING A WINCH DEVICE AND VEHICLE EQUIPPED WITH SAID DEVICE

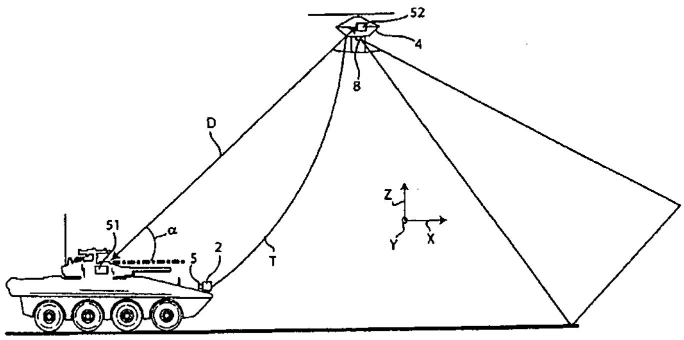

Fig. 1

(57) **Abstract**: Method for automatically controlling the movement of a winch device (2), which is adapted to pull in or let out a cable (T), to which at least one flying device 4 is connected. The method being characterized by the following subsequent steps: a) determining the relative position between the winch device 2 and the flying device (4); b) calculating the optimal length of the cable "T" as a function of the relative distance determined during the previous step; c) activating said winch device 2, so as to obtain the desired length of the cable "T" calculated during the previous step; d) repeating the sequence of steps a)- c) for a desired amount of time; in order to obtain, in real time, the optimal length of the cable (T) as a function of the changes in the relative position between the winch device (2) and the flying device (4).

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TITLE: DEVICE AND METHOD FOR AUTOMATICALLY CONTROLLING A WINCH DEVICE AND VEHICLE EQUIPPED WITH SAID DEVICE

The present invention relates to a device and to a method for automatically controlling a winch device and, in particular, its movement, said winch device being applied to a vehicle comprising a flying surveillance and patrol device, which is connected to said vehicle by means of a cable.

The relative positioning between the surveillance device and the vehicle is controlled by said control device, adapted to activate and deactivate a winch device, and by the method associated therewith.

Flying surveillance devices are known, which are connected to a fixed or mobile unit and are adapted to reach a given height with respect to the fixed or mobile unit, so as to constantly monitor a predetermined area, such as a border area, both on the ground and at sea.

These surveillance devices are provided with propulsion devices, adapted to keep said devices at a given height. Said propulsion devices are electrically operated and are, for example, electric motors. Normally, power is supplied to said motors by means of said cable, which comprises at least one power supply line.

Said surveillance devices are used in places where surveillance has to be constant and, therefore, said devices have to remain at a given height on a constant basis. It is only at the end of a mission that said devices are recovered by means of a common winch, which is manually or automatically operated.

Said surveillance devices, furthermore, are used in places where there are no obstacles to their movement. In particular, the mobile units, to which said surveillance devices are connected, are adapted to move along paths where there are no obstacles that could hinder the movement of the surveillance devices or of the cable, which is adapted to connect the surveillance device to the mobile unit.

Finally, said devices are adapted to always remain at the maximum height defined by the length of the cable and, as mentioned above, are brought back to the ground when their mission is over or when repairs have to be performed.

In case there was an obstacle that could hit the cable or the surveillance device, there would be no way to avoid the impact, since the winch that pulls in or lets out the cable is not adapted to follow the movements of the surveillance device, thus creating damages to the surveillance device itself. Furthermore, in case the relative height or position between the surveillance device and the mobile unit changes, the winch is not able to follow the movements of the surveillance device. As a matter of fact, if the surveillance device would lose height, the cable would become too loose, thus increasing the chances for the cable itself to get stuck in other objects or in the mobile unit itself, since the winch is not able to autonomously activate itself in order to pull in the excess cable. On the other hand, if the surveillance device tried to increase its flying height, it would be hindered, since the winch is not able to provide it, in a reasonable time, with the amount of cable that it needs to reach the desired height.

The object of the present invention is to solve the problems mentioned above by providing a device and a relative method for controlling a winch device, which is able to follow, in real time, the movements of a flying surveillance device, which is connected to said winch by means of a cable, by determining the optimal length of the cable itself and by activating said winch so as to obtain the optimal and/or desired length of the cable.

An aspect of the present invention is relative to a method for controlling a winch according to claim 1.

A further aspect of the present invention is relative to a device for controlling a winch according to claim 6. Finally, a further aspect of the present invention is relative to a vehicle comprising a winch controlling device according to claim 15.

Further accessory features are set forth in the appended dependent claims.

The features and advantages of the present invention will be best understood upon perusal of the following description of at least one preferred embodiment with reference to the accompanying drawings, which respectively illustrate what follows:

- figure 1 shows an application of the control device according to the present invention on a vehicle;
- figure 2 shows a flying device and a base unit comprising a winch device controlled by the control device according to the present invention;
- figure 3 shows a flowchart of the control method according to the present invention;

* figure 4 shows a block diagram of the control device according to the present invention.

With reference to the figures mentioned above, the method for automatically controlling the movement of a winch device 2, adapted to pull in or let out a cable "T", to which at least one flying device 4 is connected, comprises the following subsequent steps:

a) determining the relative position between said winch device 2 and flying device 4;
b) calculating the optimal length of cable "T" as a function of the relative position determined during the previous step;
c) activating said winch device 2, so as to obtain the desired length of cable "T" calculated during the previous step;
d) repeating the sequence of steps a)÷ c) for a desired period, in order to obtain, in real time, the optimal length of cable "T" as a function of the changes in the relative position between the winch device 2 and flying device 4.

The preferred sequence of the steps of the method according to the present invention is shown in a flowchart illustrated in figure 3.

Control device 5 associated with said method is adapted to control a which device 2 applied to a base unit 3.

Winch device 2, therefore, is adapted to pull in or let out a cable "T", which connects at least one flying device 4 to said base unit 3, as shown, by way of example, in figure 2.

Said flying device 4 comprises at least one propulsion device, not shown, which is adapted to allow flying device 4 itself to move, for example in "XYZ" space.

Said propulsion device is, for example, at least one propeller flush fitted to the rotor of at least one motor, preferably an electric motor. The motor of said propulsion device can be supplied with power by means of a battery arranged on the inside of flying device 4, or it can be supplied with power by means of a power supply line, for example arranged inside said cable "T".

Preferably, said electric motor is supplied with a voltage of 400÷600 V, for example with a direct current. Said flying device 4 is compliant with the standards for manging and designing vehicles without pilot, also known as "UAV" o "UAS".

The movements of said flying device 4 are activated only by means of said propulsion device and can be performed irrespective of cable "T" pulled in or let out by winch device 2.

Said cable "T" is preferably made of a metal material, for example mesh, with predetermined breaking loads, which is able to flex and resist possible unintentional obstacles.

The size of said cable "T" preferably is of 6÷8 mm of diameter, with a length, for example, of 100m.

Winch device 2 preferably is a winch or a hoist comprising an electric motor, which is also supplied with a voltage of 400÷600 V in direct current.

Preferably, according to the method of the present invention, the step a) of determining the relative position comprises a first sub-step a1) of determining the spatial position of said winch device 2; a second sub-step a2) of determining the spatial position of flying device 4; and a further sub-step a3) of calculating the relative position between flying device 4 and winch device 2. The order in which steps a1) and a2) are performed can be reversed and the result of the calculation performed in step a3) does not change.

In order to determine the spatial position of winch device 2, according to step a1), base unit 3 comprises a first spatial locating system 51, for example a GPS system, adapted to determine, with an uncertainty lower than one meter, the spatial position in space "XYZ" defined by the three Cartesian axes (X, Y, Z).

Furthermore, in order to determine the spatial position of flying device 4, according to step a2), said at least one flying device 4 comprises a second spatial locating system 52, for example a GPS system, adapted to determine, with an uncertainty lower than one meter, the spatial position in space "XYZ" defined by the three Cartesian axes (X, Y, Z).

Control device 5 comprises a data processing unit 50, adapted to determine the relative position between said at least one flying device 4 and said base unit 3 as a function of the data obtained from said first and second spatial locating systems (51, 52). Determining the relative position between said at least one flying device 4 and said base unit 3 leads to controlling, in real time, the movement of said winch device 2, in order to obtain the optimal length of cable "T" as a function of the changes in the relative position. The changes in the relative distance between said at least one flying device 4 and said base unit 3 are in real time.

For the purposes of the present invention, the term "real time" means that the operations aimed at calculating the relative position are performed on a constant basis, at predetermined time intervals, as a function of the speed at which the method according to the present invention is carried out.

Said data processing unit 50 is, by way of example, a microprocessor, adapted to process the data coming from the first and second spatial locating systems (51, 52), thus calculating the relative position between flying device 4 and base unit 3.

The calculation of the relative position between flying device 4 and base unit 3, besides determining linear distance "D", allows the user to obtain a plurality of additional items of information, such as, for example, elevation angle "α" and the azimuthal angle between flying device 4 and base unit 3. These data, i.e. linear distance "D", elevation angle "α" and azimuthal angle, allows the user to unequivocally determine, for example in polar coordinates, the position of flying device 4 with respect to the reference position of base unit 3.

Said data processing unit 50, furthermore, is able to perform the step b) of calculating the optimal length of cable "T". Indeed, by means of a predetermined calculus, for example a recursive algorithm, the user can calculate the optimal tension of cable "T" and, as a consequence, determine the optimal length as a function of the results obtained in the step a3) of calculating the relative position.

Preferably, said algorithm can be stored in a non-volatile memory medium (54), aapted to be connected to said data processing unit 50, as shown by way of example in figure 4.

For the purposes of the present invention, the term "optimal length" indicates a length of cable "T" that allows flying device 4 to perform a predetermined movement, such as, for example, increasing the flying height by a value lower than one meter.

The term "optimal tension" of cable "T" indicates a tension of cable "T" that avoids the formation of loops in the cable itself, which might get stuck in objects arranged between base unit 3 and flying device 4. The tension of cable "T" and, therefore, its length, in any case, are such as to allow flying device 4 to be able to perform movements without cable "T" reaching a tension state before control device 5 has activated winch device 2 to let out cable "T".

The method according to the present invention comprises, prior to the step b) of calculating the optimal length of cable "T", a further step b0) of acquiring environmental parameters, which are useful to calculate the optimal length of cable "T". These parameters are, for example, wind, humidity, etc. or presence of obstacles close to the flying device and/or to cable "T" and/or to base unit 3. Said environmental parameters can also include the morphology of the ground close to unit 3.

In order to acquire said environmental parameters, control device 5 and, in particular, data processing unit 51 are adapted to be connected to a plurality of sensors 8, which are adapted to acquire environmental parameters, such as temperature, humidity and wind force, which are useful for the calculation of the optimal length of cable "T".

Control device 5 is adapted to be connected to sensors, which are able to detect the presence of obstacles and objects, such as sonars, radars, infrared sensors and visual sensors such as video cameras.

Said flying device 4 comprises a plurality of said sensors 8, which, besides acquiring environmental parameters, are able to provide images of places that cannot be directly seen from the ground, where said base unit 3 is normally positioned, so as to perform surveillance or patrol tasks in sensitive areas. By means of said plurality of sensors 8, which are located on said flying device 4, it is possible to patrol sensitive areas without the need for the vehicles or the people to be directly close to said areas to be subject to surveillance and patrol operations.

For the purposes of the present invention, the term "sensitive areas" indicates those places where moving around is difficult due to both natural and geopolitical reasons, such as battle fields and border areas.

Said flying device 4, therefore, allows users to widen their visual field without the need to directly expose people or vehicles.

Said plurality of sensors 8 are preferably adapted to monitor predetermined portions of space, which are identified, for example, by an imaginary cone or visual cone.

Said algorithm preferably is recursive, for example an algorithm able to follow the movements of flying device 4 in real time.

According to the method of the present invention, the step c) of activating said winch device 2 comprises a step c1) of accelerating and decelerating the rotation speed of said winch 2 according to a predetermined development in time. Preferably, as a function of the acceleration with which said flying device 4 moves with respect to unit 3, the control device, thanks to data processing unit 50 and to the calculation algorithm, is able to send an activation signal to said winch device 2, which also specifies the

acceleration with which said winch device 2 has to rotate in order to let out or pull in cable "T".
The acceleration with which flying device 4 moves with respect to unit 3, and vice versa, is determined as a function of the data obtained from said first and second spatial locating systems (51, 52).
Preferably, since winch device 2 has to follow the movements of said flying device 4, the acceleration with which said winch device 2 has to rotate to pull in or let out cable "T" is directly proportional to the acceleration with which flying device 4 moves.
Furthermore, in case the acceleration is equal to zero, i.e. the movement of flying device 4 has a constant speed, the rotation of winch device 2 to pull in or let out cable "T" has an acceleration/deceleration that is such as to cause the length of cable "T" to always be the optimal length. In order to determine the rotation speed and the acceleration/deceleration, one also has to take into account the quantity of cable "T" already wound in winch device 2, so as to cause cable "T" to be pulled in or let out so as to always guarantee the optimal length of cable "T" between winch device 2 and flying device 4. Indeed, as a skilled already knows, the rotation speed of winch device 2 varies as a function of the length of cable wound in winch device 2 itself.
Control device 5, thanks to said data processing unit 50, is able to generate a control signal for the winch device 2, which is such as to obtain a rotation speed and/or an acceleration/deceleration of the rotation speed according to a predetermined function, so as to follow, in real time, the relative movements between flying device 4 and unit 3.

Said control signal is generated by said control device 5 as a function of a plurality of parameters, which are obtained from said plurality of sensors 8 and from the data obtained after step b).

Said function is determined in such a way that the length of cable "T" between winch device 2 and flying device 4 always is the optimal length.

Said control device 5, in a first preferred embodiment, can be applied to any winch device 2.

In an alternative preferred embodiment, control device 5 is an integral part of winch device 2, said winch comprising said control device 5.

In a further embodiment, control device 5 according to the present invention is preferably applied to a vehicle 30, which is considered as he above-mentioned base unit 3.

As shown in figure 1, said vehicle 30 comprises a winch device 2, adapted to pull in or let out a cable "T", which connects at least one flying device 4 to vehicle 30 itself.

In this embodiment, the vehicle is tracked and/or provided with wheels.

Said vehicle 30 can also be a watercraft, for example a boat. Said vehicle 30 can be robotized or provided with a pilot.

Said cable "T", in the present embodiment, comprises at least on data communication line 81 between said flying device 4 and said control device 5, which, by way of example, is arranged in said vehicle 30.

Both the data coming from said plurality of sensors 8 and the commands for the movements of flying device 4 are transferred by means of said data communication line 81.

Preferably, flying device 4 is remotely controlled by a console or joystick 83, which, by way of example, is arranged in said vehicle 30.

The control signals from said console or joystick 83 are sent by means of said data line 81.

Said plurality of sensors 8 are able to provide images of places outside of the visual field of vehicle 30, i.e. not directly visible.

In the preferred embodiment, said flying device 4 preferably is a small-dimension helicopter, which can move along any desired direction, can rotate on itself and can stand still, floating, for a desired amount of time, so as to easily avoid obstacles along its path. The dimensions of this flying device are small, both to reduce manufacturing costs and to reduce the risk of being identified by third parties; hence, such flying devices are also particularly silent.

Said flying device 4 is moved by means of said console or joystick 83, which can be portable or can be arranged on said vehicle 30. Said console or joystick 83 is able to communicate with said flying device 4 in wireless mode or through a cable connection. Preferably, said console or joystick 83 is arranged in vehicle 30 and communicates with said flying device 4 through said data line 81, which is comprised in cable "T".

The device and the method for controlling a winch device 2 according to the present invention allow said flying device 4 to be freely moved in order to perform surveillance and/or patrol tasks in areas where there are many obstacle; indeed, as a function of the data obtained from said plurality of sensors 8 and of the relative position between flying device 3 and base unit 3 or vehicle 30, the length of cable "T" is such as to reduce the chances of cable "T" getting stuck in objects or obstacles available close to the two devices (3, 4).

Furthermore, tanks to the fact that flying device 4 is supplied with power by means of a power supply line comprised in said cable "T", the duration of the patrol operations can be much longer than the one of the patrol operations performed with patrol devices having an autonomous propulsion system; furthermore, thanks to control device 5 according to the present invention and to the method associated thereto, the movements carried out to perform the surveillance and patrol operations are very dynamic, which guarantees self-sufficient surveillance devices.

One single cable "T" allows many different tasks to be fulfilled, namely transmitting the energy necessary to move flying device 4 to the propulsion device, receiving data from said plurality of sensors 8, receiving data from said spatial locating systems (51, 52), by means of said data line 81, and, if necessary, transmitting commands for the movement of flying device 4 generated by said console or joystick 83. In alternative embodiments, like for example the one shown in figure 4, part of the data transfer can be performed in wireless mode.

This solution allows users to perform patrol and surveillance tasks in special areas, with the possibility to dynamically move, in real time, flying device 4 for a desired amount of time. Furthermore, when applying control device 5 according to the present invention on a vehicle 30, users can further improve the patrol and/or surveillance abilities of flying device 4, since they can position vehicle 30 in the desired position, which may change in time.

NUMERICAL REFERENCES

Winch device 2

Base unit 3

Vehicle 30

Flying device 4

Control device 5

Data processing unit 50

First spatial locating system 51

Second spatial locating system 52

Non-volatile memory medium 54

Sensors 8

Data communication line 81

Console or joystick 83

Cable "T"

CLAIMS

1. Method for automatically controlling the movement of a winch device (2), for pulling in or letting out a cable (T), to which at least one flying device (4) is connected, said method being characterized by the following subsequent steps:

a) determining the relative position between the winch device (2) and the flying device (4);
b) calculating the optimal length of the cable (T) as a function of the relative distance determined during the previous step;
c) activating said winch device (2), so as to obtain the desired length of the cable (T) calculated during the previous step;
d) repeating the sequence of steps a)÷ c) for a desired amount of time;

in order to obtain, in real time, the optimal length of the cable (T) as a function of the changes in the relative position between the winch device (2) and the flying device (4).

2. Method according to claim 1, wherein the step a) of determining the relative distance comprises the following sub-steps:

a1) determining the spatial position of said winch device (2);
a2) determining the spatial position of the flying device (4);
a3) calculating the relative position between the flying device (4) and the winch device (2).

3. Method according to claim 1, wherein the step b) of calculating the optimal length of the cable (T) is carried out by means of a recursive algorithm.

4. Method according to claim 1 or 3, wherein a further step b0) for acquiring environmental parameters, which are useful to calculate the optimal length of the cable (T), is provided prior to the step b) for calculating the optimal length of the cable (T).

5. Method according to claim 1, wherein the step c) of activating said winch device (2) comprises a step c1) for accelerating and decelerating the rotation speed of said winch (2) according to a predetermined development in time.

6. Control device (5) for a winch device (2) applied to a base unit (3);
said winch device (2) is adapted to pull in or let out a cable (T), which connects at least one flying device (4) to said base unit (3);
characterized in that said base unit (3) is provided with a first spatial locating system (51);
said at least one flying device (4) is provided with a second spatial locating system (52);
said control device (5) comprises a data processing unit (50), for determining the relative position between said at least one flying device (4) and said base unit (3) as a function of the data obtained from said first and second spatial locating systems (51, 52), so as to control the movement of said winch device (2), in order to obtain, in real time, the optimal length of the cable (T) as a function of the changes in the relative position.

7. Device according to claim 6, wherein said first spatial locating system (51) is a GPS system, for

determining the spatial position, with an uncertainty lower than one meter, in the space defined by the three Cartesian axes (X, Y, Z).

8. Device according to claim 6, wherein said second spatial locating system (52) is a GPS system, for determining the spatial position, with an uncertainty lower than one meter, in the space defined by the three Cartesian axes (X, Y, Z).

9. Device according to claim 6, wherein said control device (5) comprises a non-volatile memory medium (54), for being connected to said data processing unit (50), on which a recursive algorithm is stored, for calculating the optimal tension of the cable (T) and, as a consequence, to determine the optimal length of the cable (T).

10. Device according to claim 6, wherein said control device (5) is adapted to be connected to a plurality of sensors (8), for acquiring environmental parameters, which are useful to calculate the optimal length of the cable (T).

11. Device according to claim 6, wherein the same control device (5), as a function of the signals received from said data processing unit (50) and as a function of a plurality of parameters, is able to generate a control signal for the winch device (2), such to obtain an acceleration or deceleration of the rotation speed of said winch device (2) according to a predetermined function.

12. Vehicle (30) comprising a winch device (2), for pulling in or letting out a cable (T), which connects at least one flying device (4) to said vehicle (30); characterized in that it comprises a control device (5) according to claim 1.

13. Vehicle according to claim 12, wherein said at least one flying device (4) comprises at least one propelling member.

14. Vehicle according to claim 12 or 13, wherein said cable (T) comprises at least one data communication line (81) for the communication of data between said flying device (4) and said control device (5).

15. Vehicle according to claim 12, wherein said flying device (4) is remotely controlled by means of a console or joystick (83) arranged in said vehicle (30).

16. Vehicle according to claim 12, wherein said flying device (4) comprises a plurality of sensors (8), for both acquiring environmental parameters and providing images of places that cannot directly be seen from the vehicle (30).

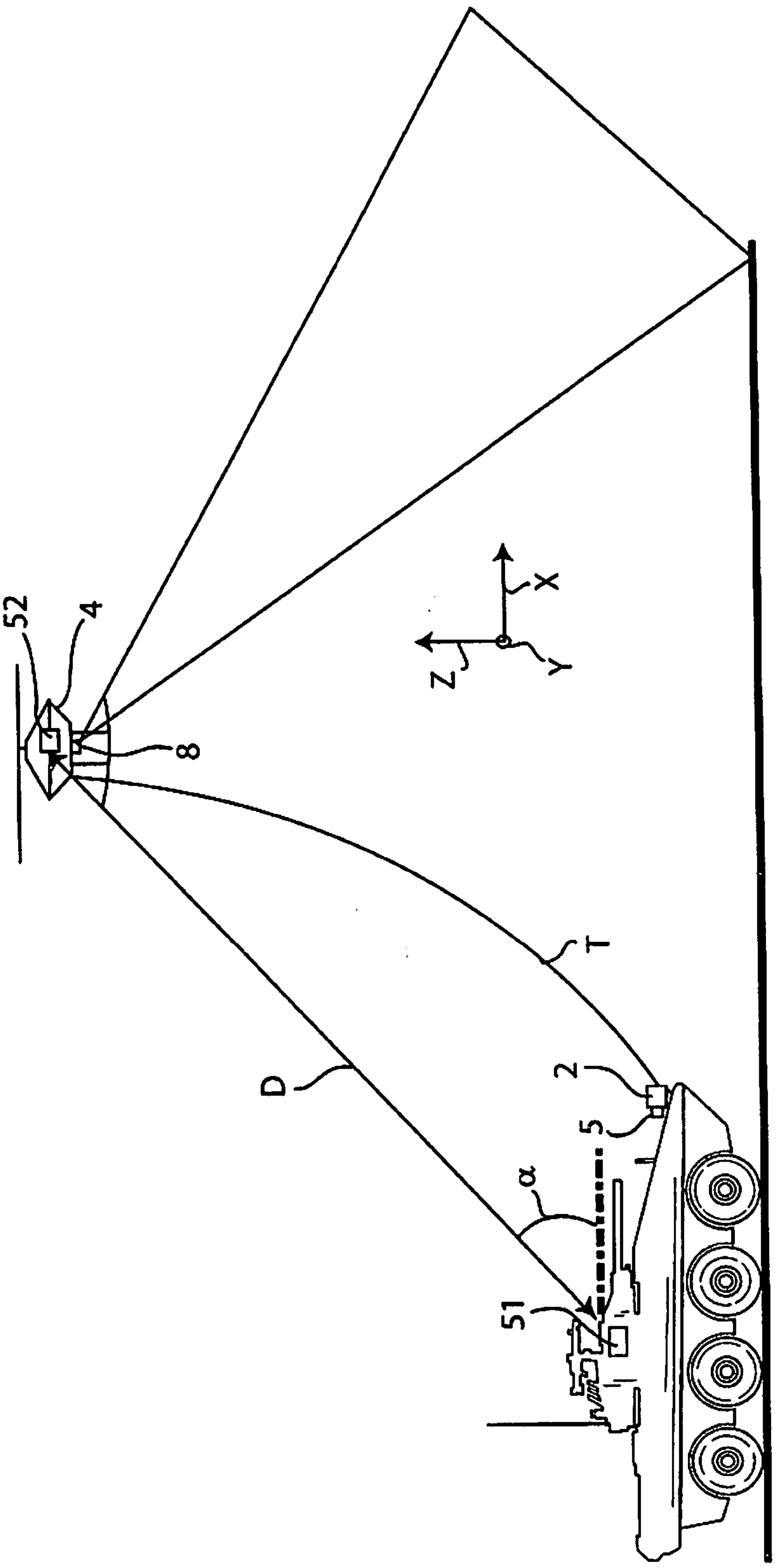

Fig. 1

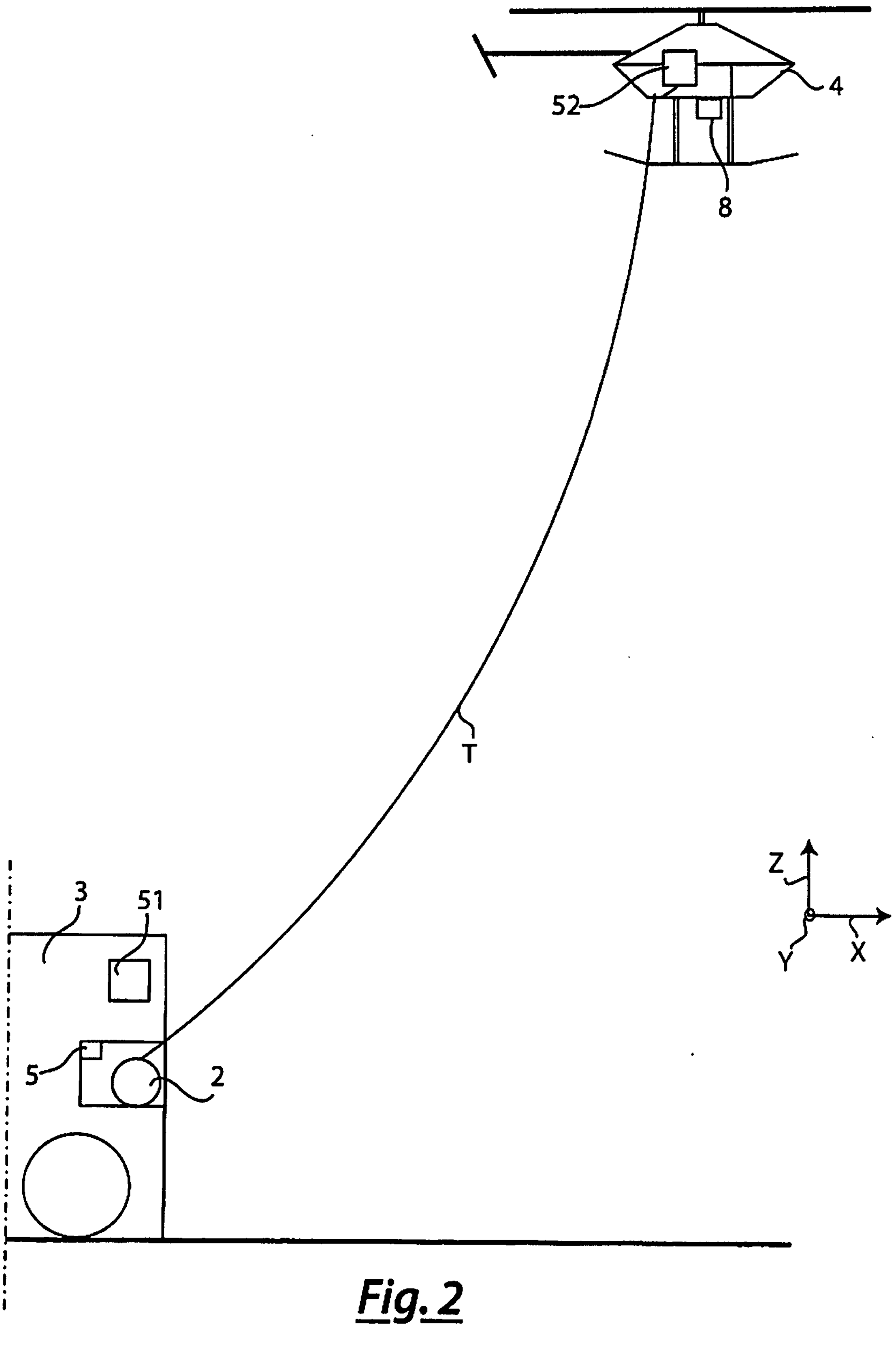

Fig. 2

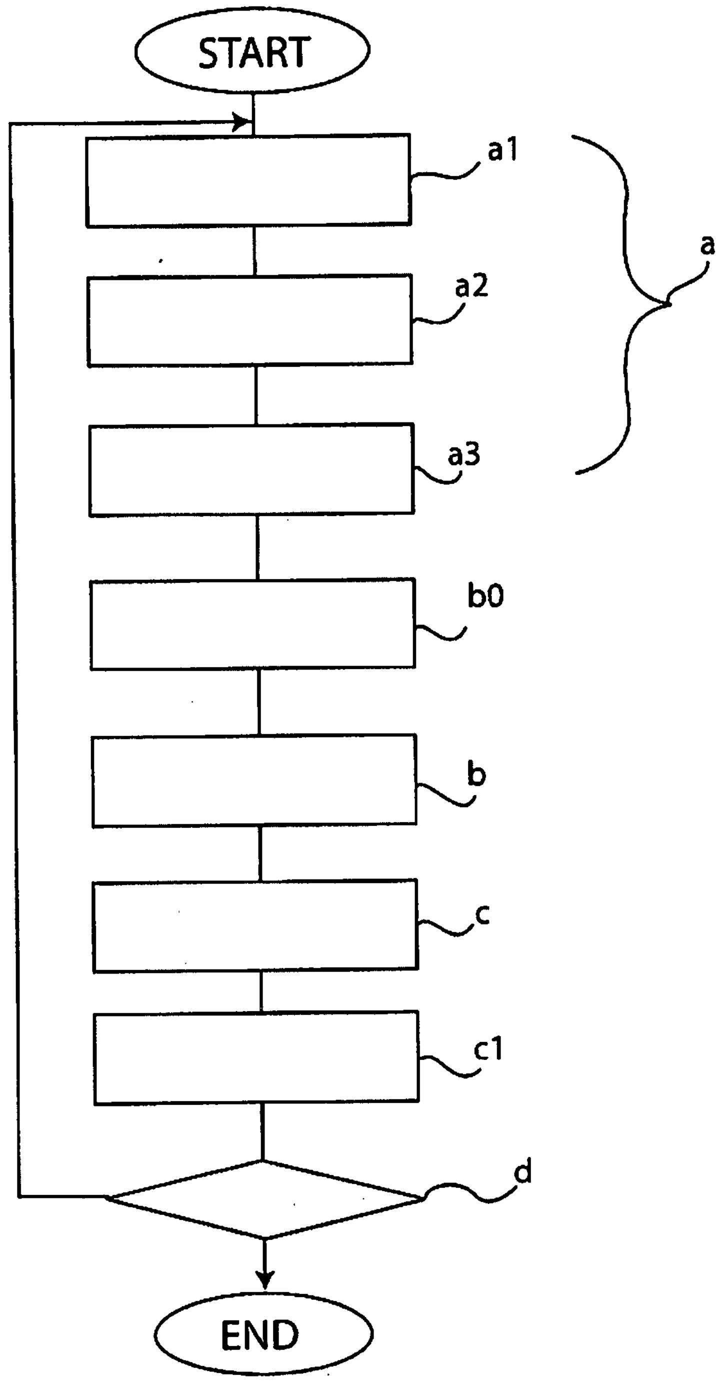

Fig. 3

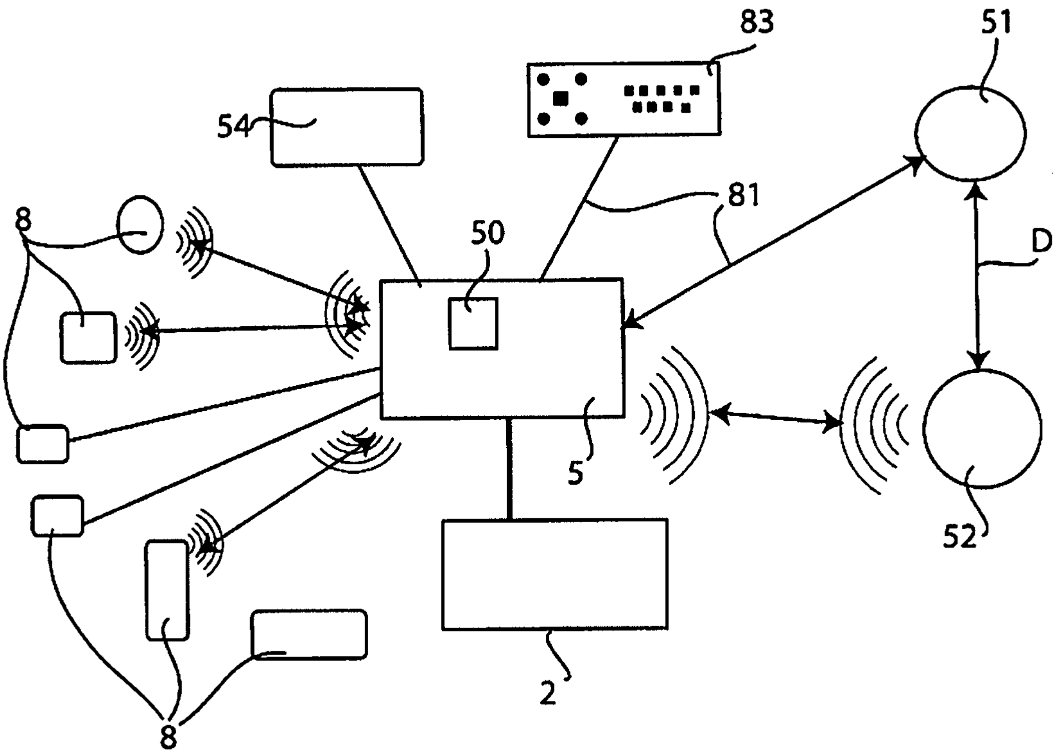

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/052618

A. CLASSIFICATION OF SUBJECT MATTER
INV. B64F3/02
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)
B64F

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, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/092253 A1 (BECKER PIERRE [FR]; ESTEYNE DIDIER [FR]; SANGOUARD DIDIER [FR]; GEOCEA) 19 August 2010 (2010-08-19) page 13, line 30 - page 21, line 11	1-4, 6-10, 12-16
A	US 4 058 277 A (KOZAKIEWICZ HUGO ET AL) 15 November 1977 (1977-11-15) column 1, line 7 - column 4, line 62; figures 1,2	1-16

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

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
6 June 2013	12/06/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Nicolaucig, Aldo

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2013/052618

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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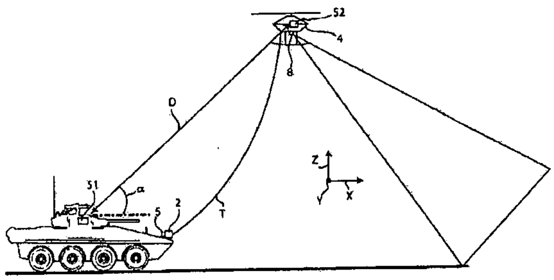
(54) 发明名称

用于自动地控制绞盘装置的装置和方法以及装备有所述装置的车辆

(57) 摘要

本发明涉及用于自动地控制适于拉入或放出缆线 (T) 的绞盘装置 (2) 的运动的方法，至少一个飞行装置 4 连接到该缆线。该方法的特征在于包括以下步骤 :a) 确定绞盘装置 2 和飞行装置 (4) 之间的相对位置 ;b) 作为在前述步骤期间确定的相对距离的函数，计算缆线“T”的最佳长度 ;c) 启用所述绞盘装置 2，以便获得在前述步骤期间计算得到的缆线“T”的期望长度 ;d) 重复步骤 a)-c) 的序列一段期望的时间 ;以便作为绞盘装置 (2) 和飞行装置 (4) 之间的相对位置的变化的函数，实时获得缆线 (T) 的最佳长度。



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1. 一种用于自动地控制绞盘装置 (2) 的运动以拉入或放出缆线 (T) 的方法，至少一个飞行装置 (4) 连接到所述缆线，所述方法的特征在于包括以下的步骤：

a) 确定所述绞盘装置 (2) 和所述飞行装置 (4) 之间的相对位置；

b) 作为在前述步骤期间确定的相对距离的函数，计算所述缆线 (T) 的最佳长度；

c) 启用所述绞盘装置 (2)，以便获得在前述步骤期间计算得到的所述缆线 (T) 的期望长度；

d) 重复步骤 a)-c) 的序列一段期望的时间段；

以便作为所述绞盘装置 (2) 和所述飞行装置 (4) 之间的相对位置的变化的函数而实时获得所述缆线 (T) 的最佳长度。

2. 根据权利要求 1 所述的方法，其中确定相对距离的步骤 a) 包括以下子步骤：

a1) 确定所述绞盘装置 (2) 的空间位置；

a2) 确定所述飞行装置 (4) 的空间位置；

a3) 计算所述飞行装置 (4) 和所述绞盘装置 (2) 之间的相对位置。

3. 根据权利要求 1 所述的方法，其中计算所述缆线 (T) 的最佳长度的步骤 b) 是借助于递归算法执行的。

4. 根据权利要求 1 或 3 所述的方法，其中在计算所述缆线 (T) 的最佳长度的步骤 b) 之前设有另一个步骤 b0)：获取环境参数，这些环境参数用于计算所述缆线 (T) 的最佳长度。

5. 根据权利要求 1 所述的方法，其中启用所述绞盘装置 (2) 的步骤 c) 包括步骤 c1)：根据预定的发展及时加速和减速所述绞盘装置 (2) 的旋转速度。

6. 一种用于施加到基部单元 (3) 的绞盘装置 (2) 的控制装置 (5)；

所述绞盘装置 (2) 适于拉入或放出缆线 (T)，所述缆线将至少一个飞行装置 (4) 连接到所述基部单元 (3)；

其特征在于，所述基部单元 (3) 设置有第一空间定位系统 (51)；

所述至少一个飞行装置 (4) 设置有第二空间定位系统 (52)；

所述控制装置 (5) 包括数据处理单元 (50)，以用于作为从所述第一空间定位系统和第二空间定位系统 (51、52) 获得的数据的函数来确定所述至少一个飞行装置 (4) 和所述基部单元 (3) 之间的相对位置，以便控制所述绞盘装置 (2) 的运动，从而作为所述相对位置的变化的函数而实时获得所述缆线 (T) 的最佳长度。

7. 根据权利要求 6 所述的装置，其中所述第一空间定位系统 (51) 是 GPS 系统，以用于以小于一米的不确定性来确定在由三个笛卡尔轴 (X、Y、Z) 限定的空间中的空间位置。

8. 根据权利要求 6 所述的装置，其中所述第二空间定位系统 (52) 是 GPS 系统，以用于以小于一米的不确定性来确定在由三个笛卡尔轴 (X、Y、Z) 限定的空间中的空间位置。

9. 根据权利要求 6 所述的装置，其中所述控制装置 (5) 包括与所述数据处理单元 (50) 连接的非易失性存储介质 (54)，递归算法存储在所述非易失性存储介质中，以用于计算所述缆线 (T) 的最佳张力，并且由此确定所述缆线 (T) 的最佳长度。

10. 根据权利要求 6 所述的装置，其中所述控制装置 (5) 适于连接到多个传感器 (8)，以用于获取环境参数，这些环境参数用于计算所述缆线 (T) 的最佳长度。

11. 根据权利要求 6 所述的装置，其中作为从所述数据处理单元 (50) 接收的信号的函数并且作为多个参数的函数，同一个控制装置 (5) 能够生成用于所述绞盘装置 (2) 的控制

信号，以便根据预定的函数获得所述绞盘装置 (2) 的旋转速度的加速度或减速度。

12. 一种车辆 (30)，其包括用于拉入或放出缆线 (T) 的绞盘装置 (2)，所述缆线将至少一个飞行装置 (4) 连接到所述车辆 (30)；

其特征在于，所述车辆包括根据权利要求 1 所述的控制装置 (5)。

13. 根据权利要求 12 所述的车辆，其中所述至少一个飞行装置 (4) 包括至少一个推进构件。

14. 根据权利要求 12 或 13 所述的车辆，其中所述缆线 (T) 包括用于所述飞行装置 (4) 和所述控制装置 (5) 之间的数据通信的至少一个数据通信线路 (81)。

15. 根据权利要求 12 所述的车辆，其中所述飞行装置 (4) 借助于布置在所述车辆 (30) 中的控制台或操纵杆 (83) 进行远程控制。

16. 根据权利要求 12 所述的车辆，其中所述飞行装置 (4) 包括多个传感器 (8)，这些传感器用于获取环境参数和提供从所述车辆 (30) 不能够直接看到的地方的图像。

用于自动地控制绞盘装置的装置和方法以及装备有所述装置的车辆

技术领域

[0001] 本发明涉及用于自动地控制绞盘装置的装置和方法，具体地，控制绞盘装置的运动，所述绞盘装置应用于车辆，车辆包括飞行监管和巡查装置，该飞行监管和巡查装置通过缆线连接到所述车辆。

[0002] 监管装置和车辆之间的相对位置由所述控制装置和相关的方法控制，该控制装置适于启用和停用绞盘装置。

背景技术

[0003] 飞行监管装置是已知的，其连接到固定或移动单元，并且适于相对于固定或移动单元到达指定的高度，以便不断地监控陆地和海上的预定区域，例如边界区域。

[0004] 这些监管装置设置有推进装置，该推进装置适于将所述装置保持在指定高度处。所述推进装置被电气地操作，并且是例如电动马达。通常，借助于所述缆线向所述马达供电，所述缆线包括至少一个供电线路。

[0005] 所述监管装置用在必须不断地进行监管的地方，因此，所述装置必须在恒定的基础上保持在指定高度处。仅仅在任务结束时，所述装置借助于通用绞盘而被覆盖，这是手动地或自动地操作的。

[0006] 此外，所述监管装置用在对它们的运动没有障碍的地方。具体地，与所述监管装置连接的移动单元适于沿着没有障碍的路径运动，这些障碍可能阻碍监管装置的运动，或者阻碍适于将监管装置连接到移动单元的缆线的运动。

[0007] 最后，所述装置适于总是保持在缆线的长度所限定的最大高度处，并且如上所述当它们的任务结束时或者当必须进行修复时将所述装置带回到地面。

[0008] 在具有可能冲击缆线或监管装置的障碍的情况下，将不可能避免冲击，原因是拉入或放出缆线的绞盘不适于跟随监管装置的运动，因此对监管装置自身产生损伤。此外，在监管装置和移动单元之间的相对高度或位置变化的情况下，绞盘不能够跟随监管装置的运动。事实上，如果监管装置损失高度，那么缆线将变得太松，因此增大了缆线自身卡在其它物体或移动单元自身中的机会，原因是绞盘不能够自主地启用自身以拉入多余的缆线。另一方面，如果监管装置试图增加其飞行高度，那么其将受到阻碍，原因是绞盘不能够在合理的时间内向其提供到达期望高度所需量的缆线。

发明内容

[0009] 本发明的目的在于通过提供用于控制绞盘装置的装置和相关方法来解决上述问题，其能够通过确定缆线自身的最佳长度和通过启用所述绞盘以获得缆线的最佳和／或期望长度，而实时跟随借助于缆线与所述绞盘连接的飞行监管装置的运动。

[0010] 本发明的一个方面涉及根据权利要求 1 所述的用于控制绞盘的方法。

[0011] 本发明的另一个方面涉及根据权利要求 6 所述的用于控制绞盘的装置。最后，本

发明的另一个方面涉及根据权利要求 15 所述的包括绞盘控制装置的车辆。

[0012] 在所附的从属权利要求中列出的另外的附加特征。

附图说明

[0013] 参考附图，在阅读以下至少一个优选实施例的描述的情况下，将最佳地理解本发明的特征和优点，以下的附图分别示出了：

[0014] • 图 1 示出了根据本发明的控制装置在车辆上的应用；

[0015] • 图 2 示出了飞行装置和包括绞盘装置的基部单元，该绞盘装置由根据本发明的控制装置控制；

[0016] • 图 3 示出了根据本发明的控制方法的流程图；

[0017] • 图 4 示出了根据本发明的控制装置的方框图。

具体实施方式

[0018] 参考上述附图，绞盘装置 2 适于拉入或放出缆线“T”，至少一个飞行装置 4 连接到该缆线，用于自动地控制绞盘装置 2 的运动的方法包括以下后续步骤：

[0019] a) 确定所述绞盘装置 2 和飞行装置 4 之间的相对位置；

[0020] b) 作为在前述步骤期间确定的相对位置的函数，计算缆线“T”的最佳长度；

[0021] c) 启用所述绞盘装置 2，以便获得在前述步骤期间计算得到的缆线“T”的期望长度；

[0022] d) 重复步骤 a)-c) 的序列一段期望的时间段，以便作为绞盘装置 2 和飞行装置 4 之间的相对位置的变化的函数而实时获得缆线“T”的最佳长度。

[0023] 在图 3 所示的流程图中示出了根据本发明的方法的步骤的优选序列。

[0024] 与所述方法相关的控制装置 5 适于控制施加到基部单元 3 的绞盘装置 2。

[0025] 因此，绞盘装置 2 适于拉入或放出缆线“T”，该缆线将至少一个飞行装置 4 连接到所述基部单元 3，以举例的方式，如图 2 所示。所述飞行装置 4 包括未示出的至少一个推进装置，推进装置适于允许飞行装置 4 自身例如在“XYZ”空间中运动。

[0026] 所述推进装置例如是至少一个推进器，推进器平齐地配合到至少一个马达（优选地是电动马达）的转子。所述推进装置的马达可以借助于布置在飞行装置 4 的内侧上的电池进行供电，或者其可以借助于例如布置在所述缆线“T”内侧的供电线路进行供电。

[0027] 优选地，所述电动马达的供电电压为 400-600V，例如供应有直流电。所述飞行装置 4 遵循用于管理和设计无人驾驶车辆（也被称为“UAV”或“UAS”）的标准。

[0028] 所述飞行装置 4 的运动仅仅借助于所述推进装置启动，并且能够与通过绞盘装置 2 拉入或放出的缆线“T”无关地执行。

[0029] 所述缆线“T”优选地由金属材料制成，例如网线，具有预定的断裂载荷，其能够挠曲并抵抗可能的无意中的障碍。

[0030] 所述缆线“T”的尺寸优选地直径为 6-8mm，长度为例如 100m。

[0031] 绞盘装置 2 优选地是绞盘或卷扬机，包括电动马达，该电动马达所供应的直流电的供电电压也为 400-600V。

[0032] 优选地，根据本发明的方法，确定相对位置的步骤 a) 包括：第一子步骤 a1)，确定

所述绞盘装置 2 的空间位置；第二子步骤 a2)，确定飞行装置 4 的空间位置；以及另一个子步骤 a3)，计算飞行装置 4 和绞盘装置 2 之间的相对位置。步骤 a1) 和 a2) 执行的顺序可以颠倒，在步骤 a3) 中执行的计算的结果不会改变。

[0033] 根据步骤 a1)，为了确定绞盘装置 2 的空间位置，基部单元 3 包括第一空间定位系统 51，例如 GPS 系统，其适于以小于一米的不确定性来确定在由三个笛卡尔轴 (X、Y、Z) 限定的空间“XYZ”中的空间位置。

[0034] 此外，根据步骤 a2)，为了确定飞行装置 4 的空间位置，所述至少一个飞行装置 4 包括第二空间定位系统 52，例如 GPS 系统，其适于以小于一米的不确定性来确定在由三个笛卡尔轴 (X、Y、Z) 限定的空间“XYZ”中的空间位置。

[0035] 控制装置 5 包括数据处理单元 50，其适于作为从所述第一和第二空间定位系统 (51、52) 获得数据的函数来确定所述至少一个飞行装置 4 和所述基部单元 3 之间的相对位置。确定所述至少一个飞行装置 4 和所述基部单元 3 之间的相对位置导致实时控制所述绞盘装置 2 的运动，以便作为相对位置的变化的函数获得缆线“T”的最佳长度。所述至少一个飞行装置 4 和所述基部单元 3 之间的相对距离的变化是实时的。

[0036] 就本发明的目的而言，术语“实时”指的是，目的在于计算相对位置的操作是作为根据本发明的方法所实施的速度的函数，在不变的基础上以预定的时间间隔执行的。

[0037] 以举例的方式，所述数据处理单元 50 是微处理器，其适于处理来自第一和第二空间定位系统 (51、52) 的数据，从而计算飞行装置 4 和基部单元 3 之间的相对位置。

[0038] 飞行装置 4 和基部单元 3 之间的相对位置的计算除了确定线性距离“D”之外，还允许用户获得多项额外的信息，例如，仰角“α”以及飞行装置 4 和基部单元之间的方位角 3。这些数据，即线性距离“D”、仰角“α”和方位角，允许用户例如在极坐标中明确地确定飞行装置 4 相对于基部单元 3 的基准位置的位置。

[0039] 此外，所述数据处理单元 50 能够执行步骤 b)：计算缆线“T”的最佳长度。实际上，借助于预定的微积分，例如递归算法，用户可以计算缆线“T”的最佳张力，并且由此作为在计算相对位置的步骤 a3) 中获得的结果的函数来确定最佳长度。

[0040] 优选地，所述算法可以存储在非易失性存储介质 (54) 中，该非易失性存储介质适于连接到所述数据处理单元 50，以举例的方式如图 4 所示。就本发明的目的而言，术语“最佳长度”表明允许飞行装置 4 执行预定运动的缆线“T”长度，该预定运动为例如增加小于一米的飞行高度。

[0041] 术语缆线“T”的“最佳张力”表明避免缆线自身形成环的缆线“T”张力，缆线形成环可能被卡在布置于基部单元 3 和飞行装置 4 之间的物体中。在任何情况下，缆线“T”的张力以及由此其长度允许飞行装置 4 能够在控制装置 5 已经启用绞盘装置 2 放出缆线“T”之前缆线“T”没有到达张紧状态的情况下执行运动。

[0042] 在计算缆线“T”的最佳长度的步骤 b) 之前，根据本发明的方法包括另一个步骤 b0)：获取环境参数，该环境参数用来计算缆线“T”的最佳长度。这些参数例如是风力、湿度等，或者是存在靠近飞行装置和 / 或缆线“T”和 / 或基部单元 3 的障碍。所述环境参数还可以包括靠近单元 3 的地面的形态。

[0043] 为了获取所述环境参数，控制装置 5 以及尤其是数据处理单元 51，适于连接到多个传感器 8，这些传感器适于获取环境参数，例如温度、湿度和风力，这些环境参数用来计算

缆线“T”的最佳长度。

[0044] 控制装置 5 适于连接到传感器,传感器能够检测障碍和物体的存在,例如声纳、雷达、红外线传感器和可视传感器(例如摄像机)。

[0045] 所述飞行装置 4 包括多个所述传感器 8,这些传感器除了获取环境参数之外,还能够提供从所述基部单元 3 通常所处的地面不能够直接看到的地方的图像,以便在敏感区域中执行监管或巡查任务。借助于位于所述飞行装置 4 上的所述多个传感器 8,能够巡查敏感区域,而不需要车辆或人员直接靠近待经受监管和巡查操作的所述区域。

[0046] 就本发明的目的而言,术语“敏感区域”表示由于自然和地缘政治原因而来回移动较为困难的地方,例如战场和边界区域。

[0047] 因此,所述飞行装置 4 允许用户扩宽它们的视野,而不需要直接暴露人员或车辆。

[0048] 所述多个传感器 8 优选地适于监控预定空间部分,这些部分识别为例如假想锥形或可视锥形。

[0049] 所述算法优选地是递归算法,例如能够实时跟随飞行装置 4 的运动的算法。

[0050] 根据本发明的方法,启用所述绞盘装置 2 的步骤 c) 包括步骤 c1):根据预定发展及时加速和减速所述绞盘 2 的旋转速度。优选地,作为所述飞行装置 4 相对于单元 3 运动的加速度的函数,控制装置由于数据处理单元 50 和计算算法而能够向所述绞盘装置 2 发送启用信号,该信号还指定所述绞盘装置 2 必须旋转以放出或拉入缆线“T”的加速度。

[0051] 作为从所述第一和第二空间定位系统 (51、52) 获得的数据的函数,确定飞行装置 4 相对于单元 3 和单元 3 相对于飞行装置 4 运动的加速度。

[0052] 优选地,因为绞盘装置 2 必须跟随所述飞行装置 4 的运动,所以所述绞盘装置 2 必须旋转以放出或拉入缆线“T”的加速度与飞行装置 4 运动的加速度直接成比例。

[0053] 此外,在加速度等于零的情况下,也就是在飞行装置 4 的运动具有恒定速度的情况下,绞盘装置 2 用以拉入或放出缆线“T”的旋转具有的加速度 / 减速度使得缆线“T”的长度总是最佳长度。为了确定旋转速度和加速度 / 减速度,还必须考虑已经缠绕在绞盘装置 2 中的缆线“T”的量,以使得缆线“T”被拉入或放出,而总是确保绞盘装置 2 和飞行装置 4 之间的缆线“T”的最佳长度。实际上,本领域技术人员已知的是,绞盘装置 2 的旋转速度作为缠绕在绞盘装置 2 自身中的缆线的长度的函数而变化。

[0054] 控制装置 5 由于所述数据处理单元 50 而能够生成用于绞盘装置 2 的控制信号,该控制信号用以根据预定函数获得旋转速度和 / 或旋转速度的加速度 / 减速度,以便实时跟随飞行装置 4 和单元 3 之间的相对运动。

[0055] 所述控制信号作为从所述多个传感器 8 获得的以及从步骤 b) 之后获得的数据获得的多个参数的函数而由所述控制装置 5 生成。

[0056] 所述函数被确定为使得绞盘装置 2 和飞行装置 4 之间的缆线“T”的长度总是最佳长度。

[0057] 在第一个优选实施例中,所述控制装置 5 可以应用于任何绞盘装置 2。

[0058] 在可供选择的优选实施例中,控制装置 5 是绞盘装置 2 的整体部分,所述绞盘包括所述控制装置 5。

[0059] 在另一个实施例中,根据本发明的控制装置 5 优选地应用于车辆 30,该车辆被看作是上述基部单元 3。

[0060] 如图1所示,所述车辆30包括绞盘装置2,该绞盘装置适于拉入或放出将至少一个飞行装置4连接到车辆30自身的缆线"T"。

[0061] 在这个实施例中,车辆是履带式的和/或设置有车轮。

[0062] 所述车辆30还可以是水运工具,例如船只。所述车辆30可以是自动化的,或者可以设置有领航员。

[0063] 在当前实施例中,所述缆线"T"包括处于所述飞行装置4和所述控制装置5之间的至少一个数据通信线路81,以举例的方式,该控制装置布置在所述车辆30中。

[0064] 来自所述多个传感器8的数据和用于飞行装置4的运动的命令两者均借助于所述数据通信线路81进行传递。

[0065] 优选地,飞行装置4由控制台或操纵杆83远程控制,以举例的方式,控制台或操纵杆布置在所述车辆30中。

[0066] 来自所述控制台或操纵杆83的控制信号借助于所述数据线81进行发送。

[0067] 所述多个传感器8能够提供车辆30视野之外(即不能够直接看到)的地方的图像。

[0068] 在优选实施例中,所述飞行装置4优选地是小型直升机,其能够沿着任何期望的方向运动,可以绕其自身旋转,并且可以保持静止、漂浮一段期望的时间,以便容易地避开沿着其路径的障碍。这种飞行装置的尺寸是小型的,以降低制造成本并降低被第三方识别的风险;因此,这样的飞行装置还尤其是无声的。

[0069] 所述飞行装置4借助于所述控制台或操纵杆83进行运动,该控制台或操纵杆可以是便携式的,或者可以布置在所述车辆30上。所述控制台或操纵杆83能够以无线模式或者通过缆线连接而与所述飞行装置4通信。优选地,所述控制台或操纵杆83布置在车辆30中,并且通过所述数据线81与所述飞行装置4通信,所述数据线包含在缆线"T"中。

[0070] 根据本发明的用于控制绞盘装置2的装置和方法允许所述飞行装置4自由地运动,以便在存在许多障碍的区域中执行监管和/或巡查任务;实际上,作为从所述多个传感器8获得的数据以及飞行装置3和基部单元3或车辆30之间的相对位置的函数,缆线"T"的长度用以减少缆线"T"卡在靠近两个装置(3、4)而能够获得的物体或障碍中的机会。

[0071] 此外,由于飞行装置4借助于包含在所述缆线"T"中的供电线路进行供电的事实,而使得巡查操作的持续时间可以远远长于利用具有自主推进系统的巡查装置执行的巡查操作的持续时间;此外,由于根据本发明的控制装置5及其相关的方法,而使得被实施以执行监管和巡查操作的运动是非常动态的,这确保了自足的监管装置。

[0072] 单个缆线"T"能够完成许多不同的任务,也就是将使飞行装置4运动所需的能量传递到推进装置,接收来自所述多个传感器8的数据,借助于所述数据线81接收来自所述空间定位系统(51、52)的数据,并且在需要的情况下传递由所述控制台或操纵杆83生成的用于飞行装置4运动的命令。在可供选择的实施例中,例如在如图4所示的实施例中,数据的一部分可以以无线模式进行传递。

[0073] 在能够使飞行装置4实时动态地运动期望时间段的情况下,这种方案允许用户在特定的区域中执行巡查和监管任务。此外,当将根据本发明的控制装置5应用于车辆30上时,用户还可以改进飞行装置4的巡查和/或监管能力,原因是它们能够将车辆30定位在能够及时改变的期望位置中。

[0074] 附图标记列表

[0075] 绞盘装置 2

[0076] 基部单元 3

[0077] 车辆 30

[0078] 飞行装置 4

[0079] 控制装置 5

[0080] 数据处理单元 50

[0081] 第一空间定位系统 51

[0082] 第二空间定位系统 52

[0083] 非易失性存储介质 54

[0084] 传感器 8

[0085] 数据通信线路 81

[0086] 控制台或操纵杆 83

[0087] 缆线“T”

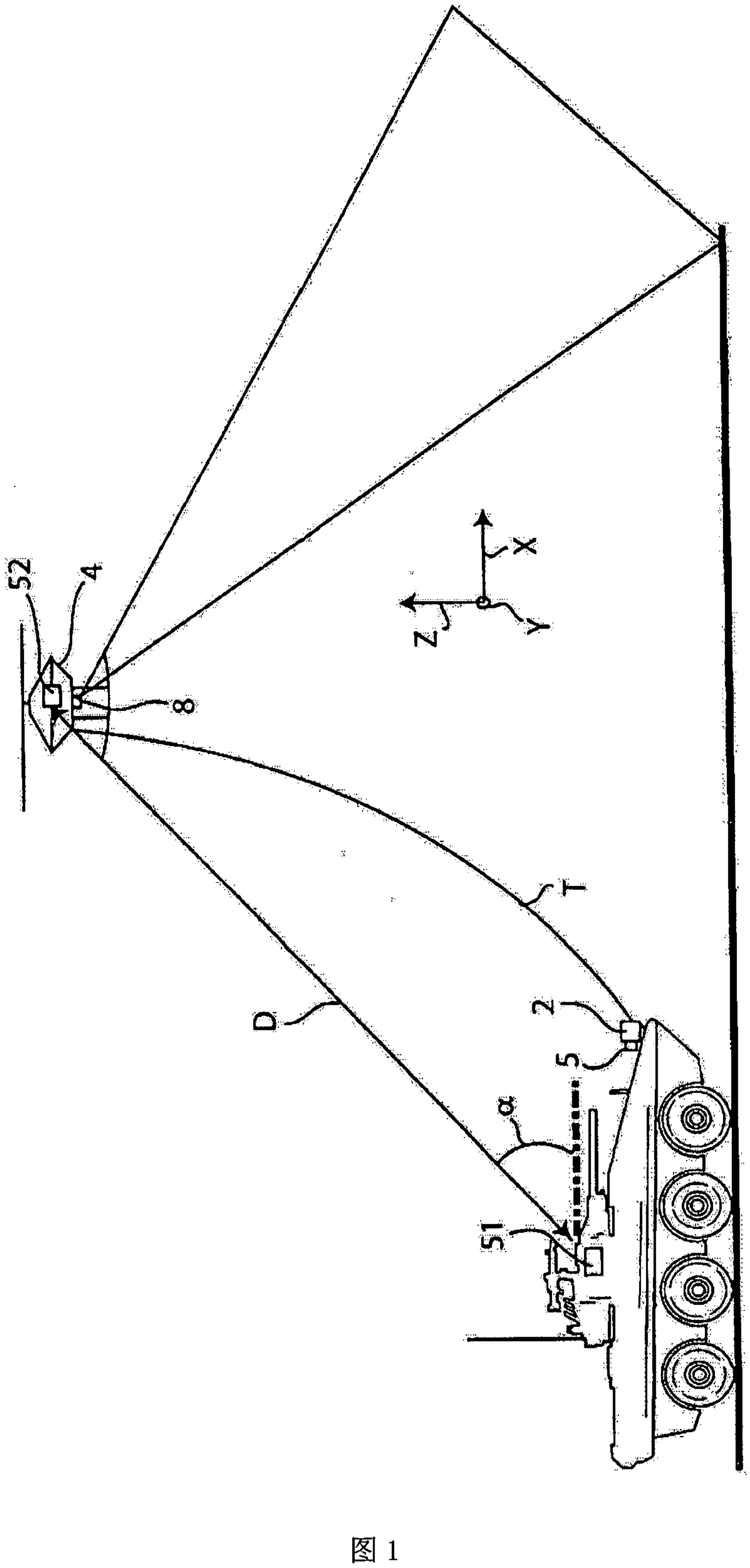

图 1

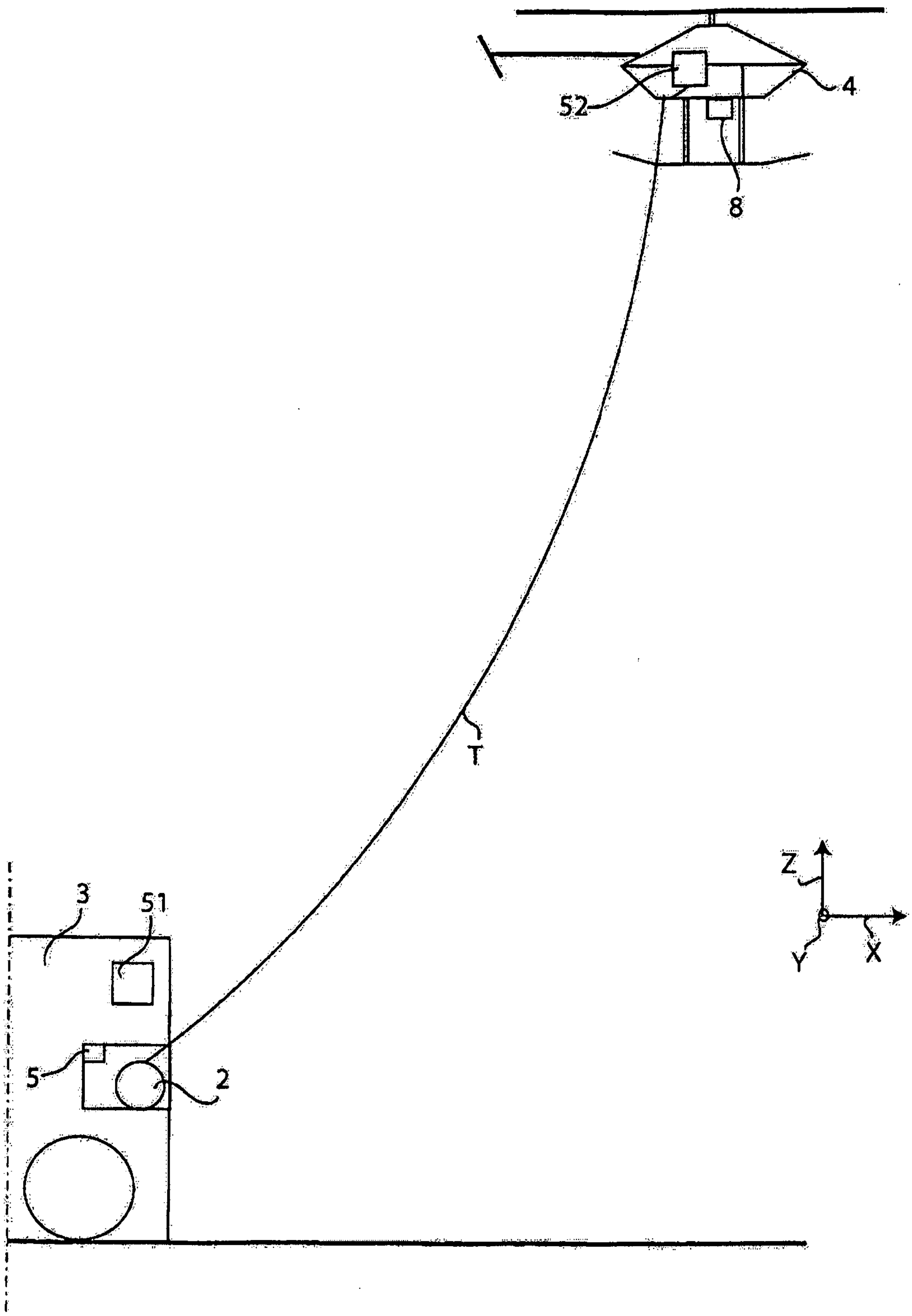

图 2

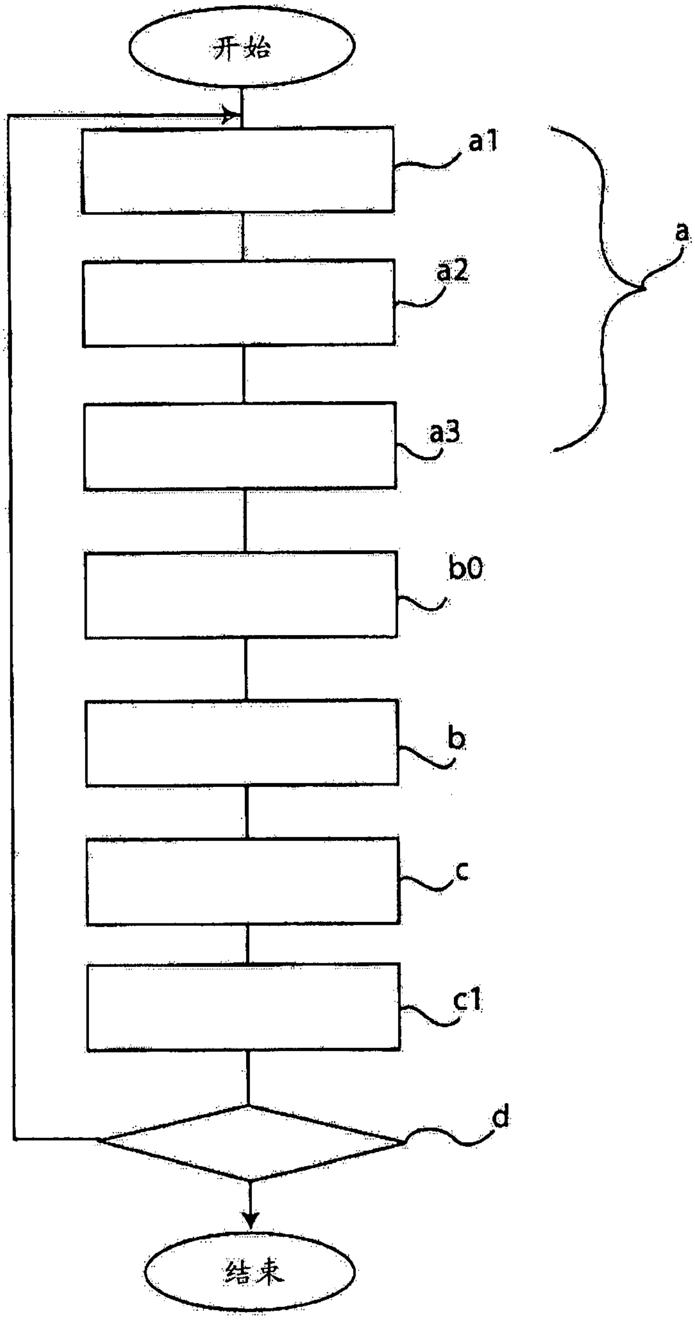

图 3

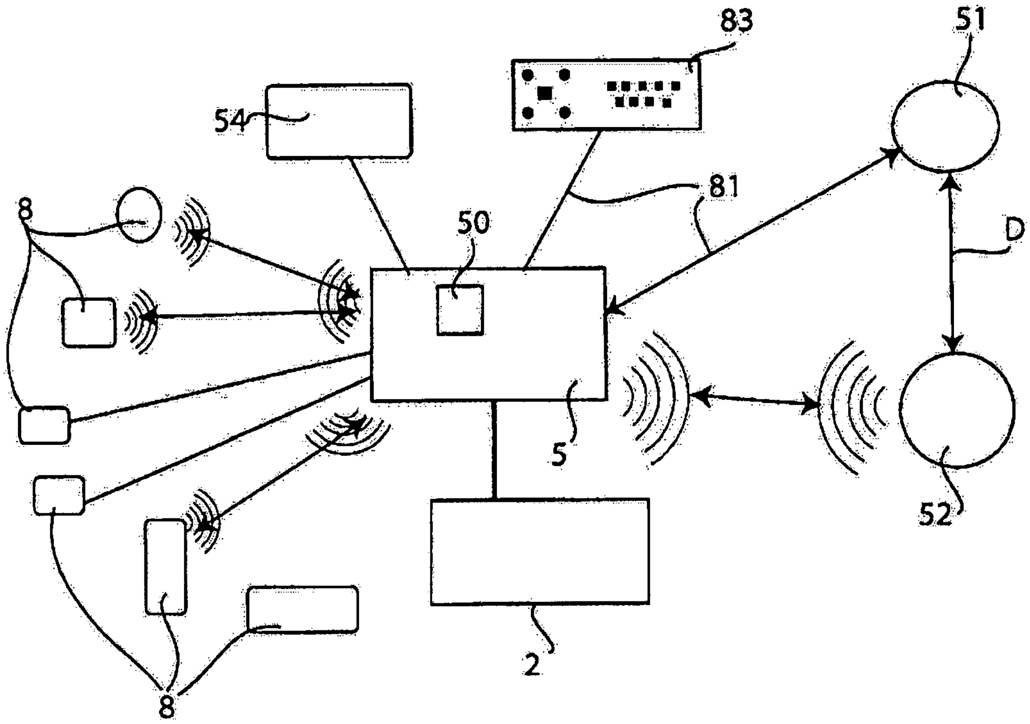

图 4