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(54) **ORIENTATION SIGNALLING AND DETERMINATION METHOD AND DEVICE**

ORIENTIERUNGSSIGNALISIERUNGS- UND -ERMITTLUNGSVERFAHREN UND -VORRICHTUNG

PROCEDE ET DISPOSITIF DE SIGNALISATION ET DE DETERMINATION D'ORIENTATION

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Description

[0001] This invention relates to orientation signalling and determination methods and devices adapted for beam riding guidance. In particular, these orientation methods could be applied in course correction system.

[0002] In beam riding guidance, a guided object has to follow a guidance beam aimed in the desired direction as disclosed for example in WO 97/28416 A, FR2 441 145 A and US 4 910 410. In flight, the guided object measures its own position with respect to the guidance beam and translates these measurements into appropriate control signals for its own control means. For this purpose, the orientation (roll angle) of the guided object has to be known.

[0003] Beam riding guided objects can determine their orientation by measurement of the polarisation of the beam also used as, for example, the course correction system of the EP 0354608. Thus, this technique gives a measure with an orientation ambiguity (also called "up-down" ambiguity). It is easily understandable that with such ambiguity, a guided object instead of flying up could be directed to crash over the ground or the sea surface, causing the destruction of the guided object.

[0004] In the state of the art, some solutions have been proposed to solve this "up-down" ambiguity.

[0005] One of these solutions is based on the use of sunlight. The guided object is equipped with light sensors. These light sensors are connected to "up-down" determination means. The "up-down" determination means is provided with a memory comprising the distribution of the light sensors over the guided object. So, the "up-down" determination means could compare the light intensity measured by each of the light sensors, and amalgamate the light sensors in two different groups : the light exposed group, which comprises the light sensors which measure the highest light intensities, and the light non exposed group, which comprises the light sensors which
measure the lowest light intensities. Thus, the "up-down" determination means, knowing the distribution of the light sensors over the guided object, gives the "up-down" direction as the direction from the light exposed group to the light non exposed group.

[0006] Unfortunately, such light based "up-down" determination method does not work under all circumstances. It needs a sufficient difference in light intensity between the measurements of the light sensors. So, the "up-down" ambiguity resolution with such determination method is null at night. In addition, even during daylight hours, a dark weather could cause a low or even null "up-down" ambiguity resolution.

[0007] Another proposed solution known in the state of the art is based on the measurement of the earth magnetic field using a magnetic sensor. For example, the EP 0503214 patent relates to an orientation device including a magnetic sensor. The orientation device is suitable for providing an observer with his indicative positioning error with respect to a preset direction. In this purpose, an external unit provides a preset direction to a computer that compares it with an alignment data and calculates an alignment error data. The alignment data, measured with respect to the magnetic north, is provided in the form of an electric signal by the magnetic sensor.

[0008] However, such earth magnetic field based "up-down" determination method does not work under all circumstances. When the guided object moves in parallel with the magnetic field lines, the "up-down" ambiguity resolution obtained using a magnetic sensor is null.

[0009] Moreover, both the light based "up-down" determination method and the magnetic field based "up-down" determination method are expensive to implement.

[0010] In order to address the above-mentioned drawbacks and raise the orientation ambiguity independently from the circumstances of use, there is provided an orientation signalling method as defined in claim 1, an orientation signalling device as defined in appended claim 8, an orientation determination method as defined in appended claim 10, and an orientation determination device as defined in appended claim 12. Several embodiments are defined in the dependent claims.

[0011] So, the orientation signalling method could be also implemented without the risk that the guided object crashes in the case the target is, for example, a low height flying object or an over sub marine ground skimming object.

[0012] Moreover, as usually in order to reduce the influence of multipath, the guidance beam is wider in the horizontal direction than in the vertical direction, this embodiment has a smaller risk that the guided object during execution of the invention goes outside the guidance beam.

[0013] Further features and advantages of the invention will be apparent from the following description of examples of embodiments of the invention with reference to the drawings, which shows details essential to the invention, and from the claims. The individual details may be realised in an embodiment of the invention either severally or jointly in any combination.

- Figure 1, a principle scheme of the beam riding guidance system implementing the invention,
- Figure 2, a time diagram showing the principle of the first embodiment of the orientation signalling according to the invention,
- Figure 3, a time diagram showing the principle of the second embodiment of the orientation signalling according to the invention,
- Figures 4a and 4b, an example of flow charts of the orientation method, respectively, the orientation signalling method and the orientation determination method, according to the invention,
- Figures 5a and 5b, an example of the orientation system, respectively, the orientation signalling device and the orientation determination device, ac-

cording to the invention,

- Figure 6, an example of the beam riding guidance system in which the first embodiment of the orientation system according to the invention is implemented,
- Figure 7, an example of the beam riding guidance system in which the second embodiment of the orientation system according to the invention is implemented.

[0014] Figure 1 shows a principle scheme of the beam riding guidance system. A beam emitter P sends a guidance beam B in the direction of the target T to guide the guided object G to this target T. So, the guided object G enters the guidance beam B and follows the route the guidance beam B indicates.

[0015] The purpose of the orientation signalling method is to offset O the relative position of the guidance beam B with respect to the guided object G in a predetermined direction during a predetermined time duration.

[0016] Hereinafter will be described two embodiments of the orientation signalling. Whereas in the first embodiment, it is the guided object G that is moved from the indicated route to get said offset, in the second embodiment, it is the guidance beam B that is moved to get said offset.

[0017] The predetermined direction could be parallel to sea or ground surface. In this manner, the orientation signalling method could be also implemented without crashing risks in beam riding guidance system whose target T is, for example, a low height flying object or a water surface skimming object.

[0018] Moreover, as usually the beam is wider in the horizontal direction than in the vertical direction, so the second embodiment has a smaller risk that the guided object G during execution of the invention goes outside the guidance beam B.

[0019] The following examples show a single offset but, if necessary, the relative position could be offset more than one time.

[0020] Figure 2 shows a time diagram illustrating the route of the guided object G. The guided object G moves mostly in a direction dg(t) given by the guidance beam B. In order to indicate the orientation, the guided object G will be moved from this route during a predetermined duration T in a predetermined direction O. The example shows an offset O at a predetermined time t_0.

[0021] Figure 3 shows a time diagram illustrating the route indicated by the guidance beam B. The guidance beam B moves mostly in a direction $d_b(t)$. In order to indicate the orientation, the guidance beam B will be moved during a predetermined duration T in a predetermined direction O. The example shows an offset O at a predetermined time t_0.

[0022] In this second embodiment, the predetermined duration T could be short enough not to be taken into account by the guided object G since the offset is small.

[0023] Figure 4a shows a flow chart of an example of the orientation signalling method.

[0024] In the first embodiment, the control signal c(t) provides the guided object control means 80 with the direction dg(t) to be followed. Whereas, in the second embodiment the control signal c(t) provides the guidance beam emitter P control means with the direction $d_b(t)$ in which the guidance beam B has to be emitted. So, the control signal c(t), whatever the embodiment is, provides a direction $d_1(t)$, as called original direction hereinafter.

[0025] One way to achieve the orientation signalling is in a first step S1 to receive said control signal c(t) = [d_1(t) ...] and to extract said direction $d_1(t)$. At a predetermined time t_0, during a predetermined duration T, said direction $d_1(t)$ is offset in a second step S2. In the third step S3, the direction d(t) is reintroduced in said control signal c(t) such that c(t) now comprises the offset direction $d_2(t)$ during said duration T from said predetermined time t_0.

[0026] The predetermined time t_o could be such that the offset is introduced shortly after the guided object has been fired in this direction $d_1(t)$.

[0027] So, the orientation signalling device 20,70 provides a modified control signal c(t) = [d(t) ...] wherein the direction d(t) corresponds to the original direction $d_1(t)$ except in the following time interval $[t_o, t_o+T]$ and to the offset direction $d_2(t)$during this time interval $[t_o, t_o+T]$.

[0028] In addition, offset direction $d_2(t)$ could be calculated in step S2 by adding to the original direction d1 (t) given by the first step S1, an offset o(t). Said offset o(t) gives the predetermined direction in which said original direction $d_1(t)$ is to be offset.

[0029] The guided object orientation ORT is determined as a function of an offset direction ô(t) read from the detected direction $d(t)$ and the predetermined direction of the offset o(t) applied to the direction $d_1(t)$.

[0030] Figure 4b shows a flow chart of an example of the orientation determination method. The orientation signalling method treats a detected direction $d(t)$.

[0031] In a first step D1, a detected offset direction ô(t) is read from said detected direction $\hat{d}(t)$. For example, this offset could be determined at the predetermined time t_0 and/or during the predetermined duration T. In a second step D2, said detected offset direction ô(t) is compared to the predetermined offset direction o(t) providing a guided object orientation ORT.

[0032] An example of orientation signalling device 20, 70 not illustrated comprises an offset means which receives the control signal c(t) comprising the original direction $d_1(t)$ and modifies directly the original direction $d_1(t)$ into $d_2(t)$ corresponding to the offset direction $d_1(t)+o(t)$ at the predetermined time t_0 during the predetermined duration T within the control signal c(t).

[0033] Figure 5a shows another example of the orientation signalling device 20,70 in which the orientation signalling method is implemented. The orientation signalling device of the first embodiment 20 and the orientation signalling device of the second embodiment 70 have the same principle as shown by Figure 5a.

[0034] The control signal c(t) is received by the receiving means 21,71 which extract the original direction $d_1(t)$ from the control signal c(t). Substitution means 23,73 are connected to said receiving means 21,71 for receiving the control signal c(t). Said substitution means 23, 73 replace in said control signal c(t) = [$d_1(t)$...] said original direction $d_1(t)$ by a direction d(t). So, the orientation signalling device 20,70 provides a modified control signal c(t) = [d(t) ...] where d(t) = $d_1(t)$, the original direction for $t \neq [t_o, t_o+T]$ and $d_2(t)$, the offset direction for $t = [t_o, t_o+T]$.

[0035] Offset means 22, 72 could be connected to the receiving means 21, 71 and the substitution means 23, 73, for providing said direction d(t) to the substitution means 23, 73. Calculation means 23 add an offset o(t) in a predetermined direction to said original direction $d_1(t)$ provided by the receiving means 21 at a predetermined time t_o, during a predetermined duration T to obtain the offset direction $d_2(t)$.

[0036] Figure 5b shows an example of the orientation determination device 90 in which the orientation determination method is implemented. An offset direction ô(t) is read by the reading means 91 from the detected beam direction $\hat{d}(t)$. Orientation evaluation means 92 are connected to said offset direction reading means 91. A function of the detected offset direction ô(t) and the predetermined direction of the offset o(t) applied to the primary beam direction $d_1(t)$ is implemented in the orientation evaluation means 92.

[0037] The orientation evaluation means 92 comprise comparison means connected to the offset direction reading means 91, providing the guided object orientation ORT by comparing said detected offset direction ô(t) to said predetermined offset direction o(t).

[0038] So, figures 5a and 5b show an orientation system comprising the orientation signalling device 20 or 70 and the orientation determination device 90.

[0039] Figures 6 and 7 show beam riding guidance systems with respectively the orientation system according to the first and second embodiment of the invention.

[0040] In the first embodiment of the invention, the guided object G is moved from the indicated route, so the orientation signalling device 70 is implemented within the guided object G as shown by Figure 6.

[0041] The transmitting part of the guidance beam emitter P comprises a beam projector 30. The beam projector 30 transmits linearly polarised waves. The direction of the beam projected by the beam projector 30 is controlled by a guidance beam B control means 10 connected to said beam projector 30.

[0042] The projected beam is received by at least one beam receiver 50 in the guided object G. The at least one beam receiver 50 could be placed in the rear of said guided object G. The guided object G could comprise 2 orthogonal beam receivers 50 50.

[0043] Alignment determination means 60 are connected to the at least one beam receiver 50. The alignment determination means 60 deduce from said projected beam received a detected direction $\hat{d}(t)$. Said detected direction $\hat{d}(t)$ is provided to the guided object control means 80 through the orientation signalling device 70. By this way, the orientation signalling device 70 transmits the detected direction $\hat{d}(t)$, as the original direction $d_1(t)$ mentioned in the above Figures 4a, for $t \neq [t_o, t_o+T]$ and $d_2(t)$, the offset direction for $t = [t_o, t_o+T]$ corresponding to the offset detected direction $\hat{d}(t)+o(t)$. By this way, the relative position of the guided object G with respect to the guidance beam B is offset during a predetermined duration T.

[0044] An orientation determination device 90 is connected to the alignment determination means 60. The orientation determination device 90 implements the guided object orientation determination as a function of the direction of the detected offset read ô(t) from said detected direction $\hat{d}(t)$ and the predetermined direction of the offset o(t) applied to the original direction $d_1(t)$.

[0045] In the second embodiment of the invention, the guidance beam B is moved, so the orientation signalling device 20 is implemented within the guidance beam emitter P as shown by Figure 7.

[0046] The transmitting part of the guidance beam emitter P comprises a beam projector 30. The beam projector 30 transmits linearly polarised waves. The direction of the beam projected by the beam projector 30 is controlled by a control signal c(t), which gives an original direction $d_1(t)$. The control signal c(t) is provided by a guidance beam B control means 10 connected to said beam projector 30.

[0047] The transmitting part comprises also an orientation signalling device 20 which implements the offset o(t) of said primary beam direction $d_1(t)$ in a predetermined direction during a predetermined duration T.

[0048] The projected beam is received by at least one beam receiver 50, in the receiving part of the beam riding guidance system. The at least one beam receiver 50 could be placed in the rear of said guided object G. The guided object G could comprise 2 orthogonal beam receivers 50 50.

[0049] Alignment determination means 60 are connected to the at least one beam receiver 50. The alignment determination means 60 deduce from said projected beam received a detected beam direction $\hat{d}(t)$. Said detected beam direction $\hat{d}(t)$ is provided to the guided object control means 80.

[0050] An orientation determination device 90 is connected to the alignment determination means 60. The orientation determination device 90 implements the guided object orientation determination as a function of the direction of the detected offset ô(t) read from said detected beam direction $\hat{d}(t)$ and the predetermined direction of the offset o(t) applied to the primary beam direction $d_1(t)$.

[0051] Such orientation method and system could be used for raising the orientation ambiguity in any system transmitting a beam. In particular, it could be used in a beam riding guidance system, as for example guided ammunition control.

[0052] Alignment determination means 60 are connected to the at least one beam receiver 50. The alignment determination means 60 deduce from said projected beam received a detected direction $\hat{d}(t)$. Said detected direction $\hat{d}(t)$ is provided to the guided object control means 80 through the orientation signalling device 70. By this way, the orientation signalling device 70 transmits the detected direction $\hat{d}(t)$, as the original direction $d_1(t)$ mentioned in the above Figures 4a, for $t \neq [t_o, t_o+T]$ and $d_2(t)$, the offset direction for $t = [t_o, t_o+T]$ corresponding to the offset detected direction $\hat{d}(t)+o(t)$. By this way, the relative position of the guided object G with respect to the guidance beam B is offset during a predetermined duration T.

[0053] An orientation determination device 90 is connected to the alignment determination means 60. The orientation determination device 90 implements the guided object orientation determination as a function of the direction of the detected offset read ô(t) from said detected direction $\hat{d}(t)$ and the predetermined direction of the offset o(t) applied to the original direction $d_1(t)$.

[0054] In the second embodiment of the invention, the guidance beam B is moved, so the orientation signalling device 20 is implemented within the guidance beam emitter P as shown by Figure 7.

[0055] The transmitting part of the guidance beam emitter P comprises a beam projector 30. The beam projector 30 transmits linearly polarised waves. The direction of the beam projected by the beam projector 30 is controlled by a control signal c(t), which gives an original direction $d_1(t)$. The control signal c(t) is provided by a guidance beam B control means 10 connected to said beam projector 30.

[0056] The transmitting part comprises also an orientation signalling device 20 which implements the offset o(t) of said primary beam direction $d_1(t)$ in a predetermined direction during a predetermined duration T.

[0057] The projected beam is received by at least one beam receiver 50, in the receiving part of the beam riding guidance system. The at least one beam receiver 50 could be placed in the rear of said guided object G. The guided object G could comprise 2 orthogonal beam receivers 50 50.

[0058] Alignment determination means 60 are connected to the at least one beam receiver 50. The alignment determination means 60 deduce from said projected beam received a detected beam direction $\hat{d}(t)$. Said detected beam direction $\hat{d}(t)$ is provided to the guided object control means 80.

[0059] An orientation determination device 90 is connected to the alignment determination means 60. The orientation determination device 90 implements the guided object orientation determination as a function of the direction of the detected offset ô(t) read from said detected beam direction $\hat{d}(t)$ and the predetermined direction of the offset o(t) applied to the primary beam direction $d_1(t)$.

[0060] Such orientation method and system could be used for raising the orientation ambiguity in any system transmitting a beam. In particular, it could be used in a beam riding guidance system, as for example guided ammunition control.

Claims

1. An orientation signalling method for beam riding guidance using a guidance beam (B) for indicating a route to be followed by a guided object (G) **characterised in that** the relative position of the guidance beam (B) with respect to the guided object (G) is offset at least one time in a predetermined offset direction o(t) during a predetermined duration T, the offset being relative to the indicated route.

2. The orientation signalling method according to claim 1, **characterised in that** the offset is implemented by moving the guided object (G) from the indicated route in the predetermined offset direction o(t) during the predetermined duration T.

3. The orientation signalling method according to claim 2, **characterised in that** it comprises offsetting the direction $d_1(t)$ comprised in a guided object control signal c(t) and corresponding to the route followed by said guided object, at a predetermined time t_0, during the predetermined duration T.

4. The orientation signalling method according to claim 1, **characterised in that** said guided object (G) is offset by moving the guidance beam (B) in the predetermined offset direction o(t) during the predetermined duration T.

5. The orientation signalling method according to claim 4, **characterised in that** it comprises offsetting the direction $d_1(t)$ comprised in a guidance beam control signal c(t) and corresponding to the route indicated by the guidance beam, at a predetermined time t_0, during the predetermined duration T.

6. The orientation signalling method according to any preceding claim, **characterised in that** the predetermined offset direction o(t) is parallel to sea or ground surface.

7. An orientation signalling device for beam riding guidance using a guidance beam (B) for indicating a route to be followed by a guided object (G) **characterised in that** the orientation signalling device (20, 70) comprises offset means (22,72) configured to offset the relative position of the guidance beam (B) with respect to the guided object (G) in a predetermined offset direction o(t) during a predetermined duration T, the offset being relative to the indicated route.

8. An orientation signalling device according to claim 7, **characterised in that** the offset means (22,72) are further configured to :

- extract a direction $d_g(t)$ from a guided object control signal c(t) controlling the direction of the guided object G, said direction $d_g(t)$ corresponding to the route followed by said guided object;
- offset said direction $d_g(t)$ at a predetermined time t_0, during the predetermined duration T, which provides an offset direction $d_2(t)$; and
- transmit a direction d(t) corresponding to the direction $d_g(t)$ outside the time interval $[t_0, t_0+T]$ and to the offset direction $d_2(t)$ during the time interval $[t_0, t_0+T]$.

9. An orientation signalling device according to the claim 7, **characterised in that** the offset means are further configured to:

- extract a direction $d_1(t)$ from a guidance beam control signal c(t) controlling the direction of the guidance beam, said direction $d_1(t)$ corresponding to the route indicated by the guidance beam;
- offset said direction $d_1(t)$ at a predetermined time t_0, during the predetermined duration T, which provides an offset direction $d_2(t)$; and
- transmit a direction d(t) corresponding to the direction $d_1(t)$ outside the time interval $[t_0, t_0+T]$ and to the offset direction $d_2(t)$ during the time interval $[t_0, t_0+T]$.

10. An orientation determination method for determining the orientation of an object G guided by a guidance beam (B) indicating a route to be followed by the guided object (G), **characterised in that** the relative position of the guidance beam (B) with respect to the guided object (G) is offset in a predetermined offset direction o(t) at a predetermined time t_0 during a predetermined duration T, the offset being relative to the indicated route, the orientation of the guided object being determined as a function of an offset of the relative position of the guidance beam (B) with respect to the guided object (G) in the predetermined offset direction during a predetermined duration T, the method comprising:

- detecting the direction $\hat{d}(t)$ of said guided object from the guidance beam;
- determining an offset direction $\hat{o}(t)$ from said detected direction $\hat{d}(t)$;
- comparing said detected offset direction to the predetermined offset direction o(t), and
- determining the orientation of said guided object from said comparison.

11. An orientation determination device for determining the orientation of an object G guided by a guidance beam (B) indicating a route to be followed by the guided object (G), the relative position of the guidance beam (B) with respect to the guided object (G) being offset in a predetermined offset direction o(t) at a predetermined time t_0 during a predetermined duration T, the offset being relative to the indicated route, the orientation determination device (90) comprising:

- Alignment determination means (60) for detecting the direction $\hat{d}(t)$ of said guided object from the guidance beam
- Offset direction reading means (91) for receiving said detected direction $\hat{d}(t)$, and determining a detected offset direction $\hat{o}(t)$ from said detected direction $\hat{d}(t)$; and
- Orientation evaluation means (92) connected to said offset direction reading means (91), for determining the orientation of said guided object from a comparison between said detected offset direction $\hat{o}(t)$ and the predetermined offset direction o(t).

12. An orientation system comprising an orientation signalling device (20,70) according to any of the preceding claim 7 to 9 and an orientation determination device (90) according to claim 11.

13. A beam riding guidance system comprising:

- A beam projector (30) for transmitting linearly polarised waves;
- Guidance beam control means (10) connected to said beam projector (30), for orientating the beam projector (30) in a guidance beam direction $d_b(t)$ given by a beam riding guidance control signal c(t);
- At least one beam receiver (50) placed in the rear of said guided object (G) and capable of receiving the projected guidance beam (B);
- Alignment determination means (60) connected to the at least one beam receiver (50), deducting from said projected beam received a detected direction $\hat{d}(t)$ and providing said detected direction to guided object control means (80);

characterised in that it comprises an orientation system according to claim 12.

14. The beam riding guidance system according to claim 13, wherein it further comprises two orthogonal beam receivers (50).

Patentansprüche

1. Orientierungssignalisierungsverfahren zur Strahlführung mit einem Führungsstrahl (B) zum Anzeigen einer von einem geführten Objekt (G) einzuhaltenden Route, **dadurch gekennzeichnet, dass** die relative Position des Führungsstrahls (B) mit Bezug auf das geführte Objekt (G) wenigstens einmal in einer vorbestimmten Versatzrichtung o(t) während einer vorbestimmten Dauer T versetzt wird, wobei sich der Versatz auf die angezeigte Route bezieht.

2. Orientierungssignalisierungsverfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das Versetzen durch Bewegen des geführten Objekts (G) von der angezeigten Route in der vorbestimmten Versatzrichtung o(t) während der vorbestimmten Dauer T implementiert wird.

3. Orientierungssignalisierungsverfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** es das Versetzen der Richtung $d_1(t)$, die in einem Geführtes-Objekt-Steuersignal c(t) enthalten ist und der von dem geführten Objekt eingehaltenen Route entspricht, zu einer vorbestimmten Zeit t_0 während der vorbestimmten Dauer T beinhaltet.

4. Orientierungssignalisierungsverfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das geführte Objekt (G) durch Bewegen des Führungsstrahls (B) in der vorbestimmten Versatzrichtung o(t) während der vorbestimmten Dauer T versetzt wird.

5. Orientierungssignalisierungsverfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** es das Versetzen der Richtung $d_1(t)$, die in einem Führungsstrahlsteuersignal c(t) enthalten ist und der von dem geführten Objekt eingehaltenen Route entspricht, zu einer vorbestimmten Zeit t_0 während der vorbestimmten Dauer T beinhaltet.

6. Orientierungssignalisierungsverfahren nach einem vorherigen Anspruch, **dadurch gekennzeichnet, dass** die vorbestimmte Versatzrichtung o(t) parallel zur Meeres- oder Landoberfläche ist.

7. Orientierungssignalisierungsvorrichtung zur Strahlführung mit einem Führungsstrahl (B) zum Anzeigen einer von einem geführten Objekt (G) einzuhaltenden Route, **dadurch gekennzeichnet, dass** die Orientierungssignalisierungsvorrichtung (20, 70) Versatzmittel (22, 72) umfasst, konfiguriert zum Versetzen der relativen Position des Führungsstrahls (B) mit Bezug auf das geführte Objekt (G) in einer vorbestimmten Versatzrichtung o(t) während einer vorbestimmten Dauer T, wobei sich der Versatz auf die angezeigte Route bezieht.

8. Orientierungssignalisierungsvorrichtung zur Strahlführung nach Anspruch 7, **dadurch gekennzeichnet, dass** das Versatzmittel (22,72) ferner konfiguriert ist zum:

- Extrahieren einer Richtung dg(t) von einem Geführtes-Objekt-Steuersignal c(t) zum Steuern der Richtung des geführten Objekts D, wobei die Richtung dg(t) der von dem geführten Objekt eingehaltenen Route entspricht;
- Versetzen der Richtung dg(t) zu einer vorbestimmten Zeit t_0 während der vorbestimmten Dauer T, die eine Versatzrichtung $d_2(t)$ bereitstellt; und
- Übertragen einer Richtung d(t) entsprechend der Richtung dg(t) außerhalb des Zeitintervalls $[t_0, t_0+T]$ und der Versatzrichtung $d_2(t)$ während des Zeitintervalls $[t_0, t_0+T]$.

9. Orientierungssignalisierungsvorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** das Versatzmittel ferner konfiguriert ist zum:

- Extrahieren einer Richtung $d_1(t)$ von einem Führungsstrahlsteuersignal c(t) zum Steuern der Richtung des Führungsstrahls, wobei die Richtung $d_1(t)$ der von dem Führungsstrahl angezeigten Route entspricht;
- Versetzen der Richtung $d_1(t)$ zu einer vorbestimmten Zeit t_0 während der vorbestimmten Dauer T, was eine Versatzrichtung $d_2(t)$ ergibt; und
- Übertragen einer Richtung d(t) entsprechend der Richtung $d_1(t)$ außerhalb des Zeitintervalls$[t_0, t_0+T]$ und der Versatzrichtung $d_2(t)$ während des Zeitintervalls $[t_0, t_0+T]$.

10. Orientierungsbestimmungsverfahren zum Bestimmen der Orientierung eines Objekts D, das von einem Führungsstrahl (B) geführt wird, der eine Route anzeigt, die von dem geführten Objekt (G) einzuhalten ist, **dadurch gekennzeichnet, dass** die relative Position des Führungsstrahls (B) mit Bezug auf das geführte Objekt (G) in einer vorbestimmten Versatzrichtung o(t) zu einer vorbestimmten Zeit t_0 während einer vorbestimmten Dauer T versetzt wird, wobei sich der Versatz auf die angezeigte Route bezieht, wobei die Orientierung des geführten Objekts in Abhängigkeit von einem Versatz der relativen Position des Führungsstrahls (B) mit Bezug auf das geführte Objekt (G) in der vorbestimmten Versatzrichtung während einer vorbestimmten Dauer T bestimmt wird, wobei das Verfahren Folgendes beinhaltet:

- Erkennen der Richtung $\hat{d}(t)$ des geführten Objekts anhand des Führungsstrahls;
- Bestimmen einer Versatzrichtung $\hat{o}(t)$ anhand der erkannten Richtung $\hat{d}(t)$;
- Vergleichen der erkannten Versatzrichtung mit der vorbestimmten Versatzrichtung o(t), und
- Bestimmen der Orientierung des geführten Objekts anhand des Vergleichs.

11. Orientierungsbestimmungsvorrichtung zum Bestimmen der Orientierung eines Objekts G, das von einem Führungsstrahl (B) geführt wird, der eine von dem geführten Objekt (G) einzuhaltende Route anzeigt, wobei die relative Position des Führungsstrahls (B) mit Bezug auf das geführte Objekt (G) in einer vorbestimmten Versatzrichtung o(t) zu einer vorbestimmten Zeit t_0 während einer vorbestimmten Dauer T versetzt ist, wobei sich der Versatz auf die angezeigte Route bezieht, wobei die Orientierungsbestimmungsvorrichtung (90) Folgendes umfasst:

- Ausrichtungsbestimmungsmittel (60) zum Erkennen der Richtung $\hat{d}(t)$ des geführten Objekts anhand des Führungsstrahls;
- Versatzrichtungslesemittel (91) zum Empfangen der erkannten Richtung $\hat{d}(t)$ und zum Bestimmen einer erkannten Versatzrichtung $\hat{o}(t)$ anhand der erkannten Richtung $\hat{d}(t)$; und
- Orientierungsbeurteilungsmittel (92), die mit dem Versatzrichtungslesemittel (91) verbunden sind, zum Bestimmen der Orientierung des geführten Objekts anhand eines Vergleichs zwischen der erkannten Versatzrichtung $\hat{o}(t)$ und der bestimmten Versatzrichtung o(t).

12. Orientierungssystem, das eine Orientierungssignalisierungsvorrichtung (20, 70) nach einem der Ansprüche 7 bis 9 und eine Orientierungsbestimmungsvorrichtung (90) nach Anspruch 11 umfasst.

13. Strahlführungssystem, das Folgendes umfasst:

- einen Strahlprojektor (30) zum Übertragen von linear polarisierten Wellen;
- Führungsstrahlsteuermittel (10), die mit dem Strahlprojektor (30) verbunden sind, zum Orientieren des Strahlprojektors (30) in einer durch ein Strahlführungssteuersignal c(t) gegebenen Führungsstrahlrichtung $d_b(t)$;
- wenigstens einen Strahlempfänger (50), der an der Rückseite des geführten Objekts (G) platziert ist und den projizierten Führungsstrahl (B) empfangen kann;
- Ausrichtungsbestimmungsmittel (60), die mit dem wenigstens einen Strahlempfänger (50) verbunden sind, zum Ableiten einer erkannten Richtung $\hat{d}(t)$ von dem projizierten Strahl und zum Übermitteln der erkannten Richtung zu Geführtes-Objekt-Steuermitteln (80);

dadurch gekennzeichnet, dass es ein Orientierungssystem nach Anspruch 12 umfasst.

14. Strahlführungssystem nach Anspruch 13, das ferner zwei orthogonale Strahlempfänger (50) umfasst.

Revendications

1. Procédé de signalisation d'orientation pour un guidage par faisceau directeur utilisant un faisceau de guidage (B) pour indiquer un itinéraire à suivre par un objet guidé (G) **caractérisé en ce que** la position relative du faisceau de guidage (B) par rapport à l'objet guidé (G), est décalée au moins une fois dans une direction de décalage o(t) prédéterminée pendant une durée T prédéterminée, le décalage se faisant par rapport à l'itinéraire indiqué.

2. Procédé de signalisation d'orientation selon la revendication 1, **caractérisé en ce que** le décalage est mis en oeuvre en déplaçant l'objet guidé (G) par rapport à l'itinéraire indiqué dans la direction de décalage o(t) prédéterminée pendant la durée T prédéterminée.

3. Procédé de signalisation d'orientation selon la revendication 2, **caractérisé en ce qu'**il comprend une étape consistant à décaler la direction $d_1(t)$, comprise dans un signal c(t) de contrôle d'objet guidé et correspondant à l'itinéraire suivi par ledit objet guidé, à un instant to prédéterminé, pendant la durée T prédéterminée.

4. Procédé de signalisation d'orientation selon la revendication 1, **caractérisé en ce que** ledit objet guidé (G) est décalé en déplaçant le faisceau de guidage (B) dans la direction de décalage o(t) prédéterminée pendant la durée T prédéterminée.

5. Procédé de signalisation d'orientation selon la revendication 4, **caractérisé en ce qu'**il comprend une étape consistant à décaler la direction $d_1(t)$, comprise dans un signal de contrôle de faisceau de guidage c(t) et correspondant à l'itinéraire indiqué par le faisceau de guidage, à un instant t_0 prédéterminé, pendant la durée T prédéterminée.

6. Procédé de signalisation d'orientation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la direction de décalage o(t) prédéterminée est parallèle à une surface marine ou terrestre.

7. Dispositif de signalisation d'orientation destiné à un guidage par faisceau directeur utilisant un faisceau de guidage (B) pour indiquer un itinéraire à suivre par un objet guidé (G), **caractérisé en ce que** le dispositif de signalisation d'orientation (20, 70) comprend un moyen de décalage (22, 72) configuré pour décaler la position relative du faisceau de guidage (B) par rapport à l'objet guidé (G) dans une direction de décalage o(t) prédéterminée pendant une durée T prédéterminée, le décalage se faisant par rapport à l'itinéraire indiqué.

8. Dispositif de signalisation d'orientation selon la revendication 7, **caractérisé en ce que** le moyen de décalage (22, 72) est en outre configuré pour :

- extraire une direction dg(t) d'un signal de contrôle d'objet guidé c(t) contrôlant la direction de l'objet guidé G, ladite direction dg(t) correspondant à l'itinéraire suivi par ledit objet guidé ;
- décaler ladite direction dg(t) à un instant t_0 prédéterminé, pendant la durée T prédéterminée, ce qui fournit une direction de décalage $d_2(t)$; et
- transmettre une direction d(t) correspondant à la direction dg(t) en dehors de l'intervalle de temps $[t_0, t_0 + T]$ et à la direction de décalage $d_2(t)$ à l'intérieur de l'intervalle de temps $[t_0, t_0 + T]$.

9. Dispositif de signalisation d'orientation selon la revendication 7, **caractérisé en ce que** le moyen de décalage est en outre configuré pour :

- extraire une direction $d_1(t)$ d'un signal de contrôle de faisceau de guidage c(t) contrôlant la direction du faisceau de guidage, ladite direction $d_1(t)$ correspondant à l'itinéraire indiqué par le faisceau de guidage ;
- décaler ladite direction $d_1(t)$ à un instant t_0 prédéterminé, pendant la durée T prédéterminée, ce qui fournit une direction de décalage $d_2(t)$; et
- transmettre une direction d(t) correspondant à la direction $d_1(t)$ en dehors de l'intervalle de temps $[t_0, t_0 + T]$ et à la direction de décalage $d_2(t)$ à l'intérieur de l'intervalle de temps $[t_0, t_0 + T]$.

10. Procédé de détermination d'orientation pour déterminer l'orientation d'un objet G guidé par un faisceau de guidage (B) indiquant un itinéraire à suivre par l'objet guidé (G), **caractérisé en ce que** la position relative du faisceau de guidage (B) par rapport à l'objet guidé (G) est décalée dans une direction de décalage o(t) prédéterminée à un instant to prédéterminé pendant une durée T prédéterminée, le décalage se faisant par rapport à l'itinéraire indiqué, l'orientation de l'objet guidé étant déterminée en fonction d'un décalage de la position relative du faisceau de guidage (B) par rapport à l'objet guidé (G) dans la direction de décalage prédéterminée pendant une durée T prédéterminée, ledit procédé comprenant les étapes consistant à :

- détecter la direction $\hat{d}(t)$ dudit objet guidé par rapport au faisceau de guidage ;
- déterminer une direction de décalage ô(t) par rapport à ladite direction $\hat{d}(t)$ détectée ;
- comparer ladite direction de décalage détectée à la direction de décalage o(t) prédéterminée, et
- déterminer l'orientation dudit objet guidé à partir de ladite comparaison.

11. Dispositif de détermination d'orientation pour déterminer l'orientation d'un objet G guidé par un faisceau de guidage (B) indiquant un itinéraire à suivre par l'objet guidé (G), la position relative du faisceau de guidage (B) par rapport à l'objet guidé (G) étant décalée dans une direction de décalage o(t) prédéterminée à un instant t_0 prédéterminé pendant une durée T prédéterminée, le décalage se faisant par rapport à l'itinéraire indiqué, le dispositif de détermination d'orientation (90) comprenant :

- un moyen de détermination d'alignement (60) pour détecter la direction $\hat{d}(t)$ dudit objet guidé par rapport au faisceau de guidage ;
- un moyen de lecture de direction de décalage (91) pour recevoir ladite direction $\hat{d}(t)$ détectée, et de déterminer une direction de décalage ô(t) détectée à partir de ladite direction $\hat{d}(t)$ détectée ; et
- un moyen d'évaluation d'orientation (92) raccordé audit moyen de lecture de direction de décalage (91), pour déterminer l'orientation dudit objet guidé à partir d'une comparaison entre ladite direction de décalage ô(t) détectée et la direction de décalage o(t) prédéterminée.

12. Système d'orientation comprenant un dispositif de signalisation d'orientation (20, 70) selon l'une quelconque des revendications 7 à 9 et un dispositif de détermination d'orientation (90) selon la revendication 11.

13. Système de guidage par faisceau directeur, comprenant :

- un projecteur de faisceau (30) pour émettre des ondes polarisées de manière linéaire ;
- un moyen de contrôle de faisceau de guidage (10) raccordé audit projecteur de faisceau (30), pour orienter le projecteur de faisceau (30) dans une direction de faisceau de guidage $d_b(t)$ fournie par un signal de contrôle de guidage par faisceau directeur c(t) ;
- au moins un dispositif de réception de faisceau (50) placé à l'arrière dudit objet guidé (G) et capable de recevoir le faisceau de guidage (B) projeté ;
- un moyen de détermination d'alignement (60) raccordé au au moins un dispositif de réception de faisceau (50), déduisant, à partir dudit faisceau projeté reçu, une direction $\hat{d}(t)$ détectée et fournissant ladite direction détectée au moyen de contrôle d'objet guidé (80) ;

caractérisé en ce qu'il comprend un système d'orientation selon la revendication 12.

14. Système de guidage par faisceau directeur selon la revendication 13, comprenant en outre deux dispositifs de réception de faisceau (50) orthogonaux.

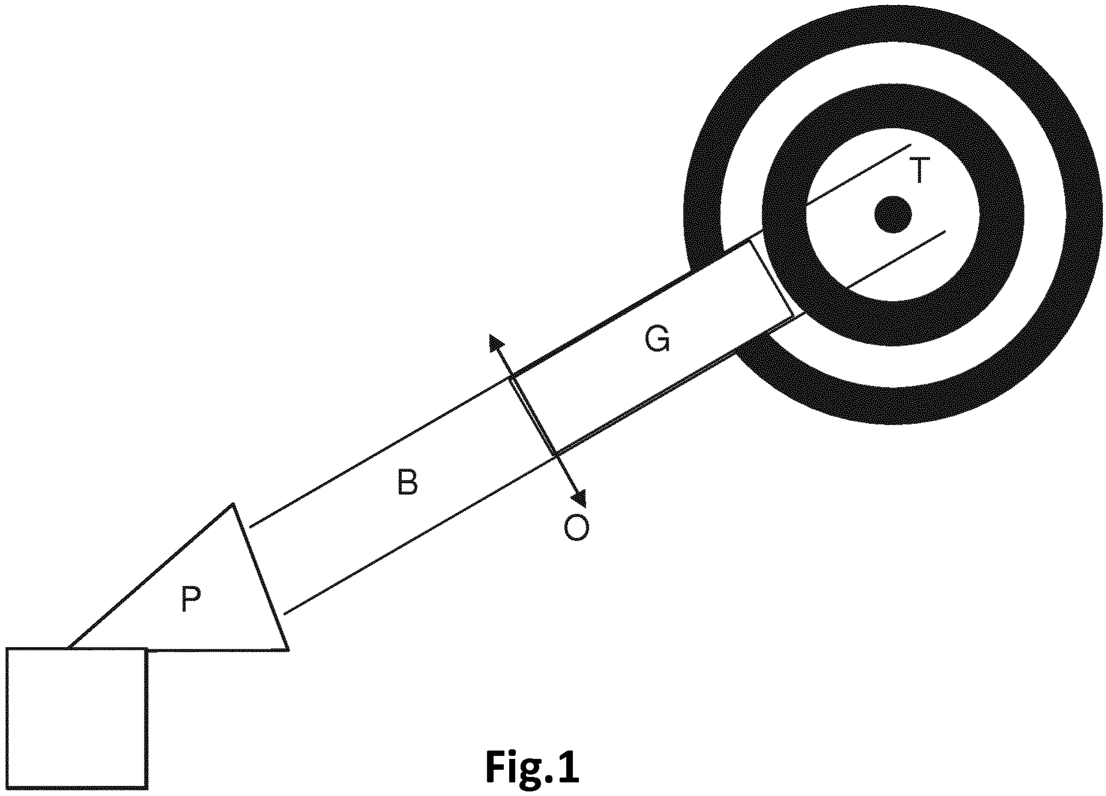

Fig.1

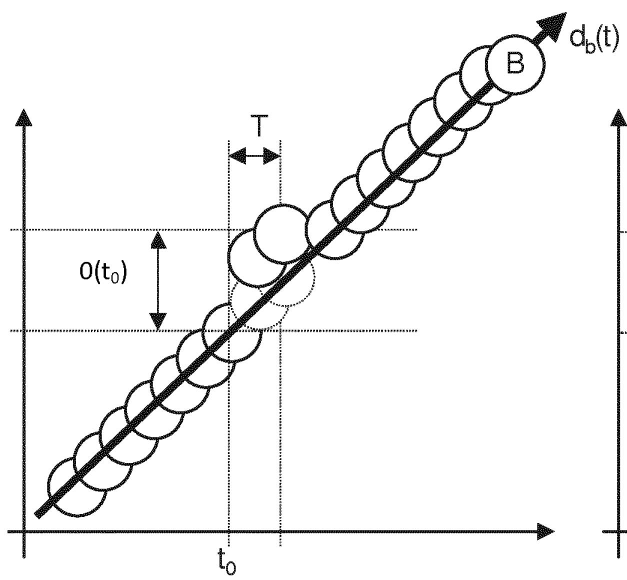

Fig.3

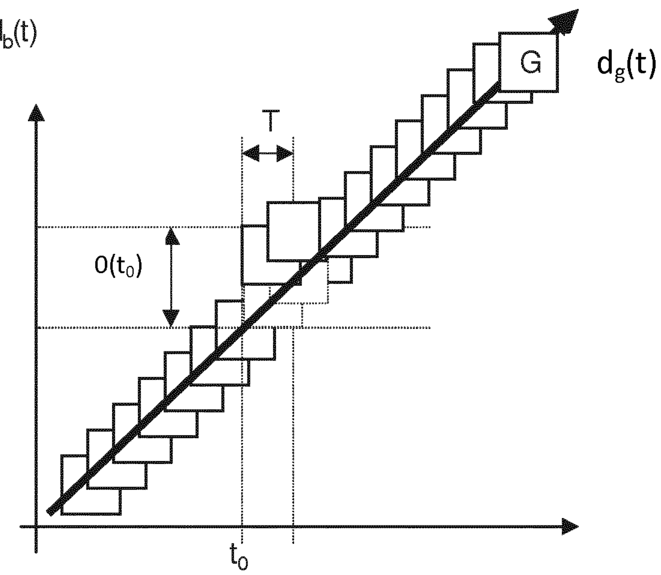

Fig.2

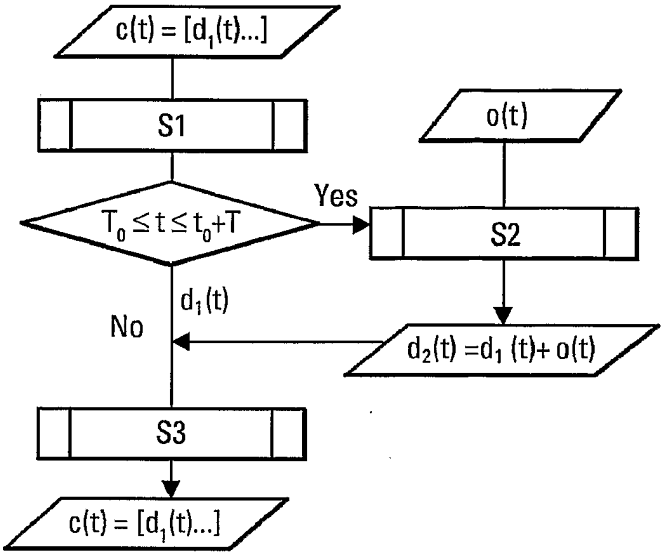

Fig. 4a

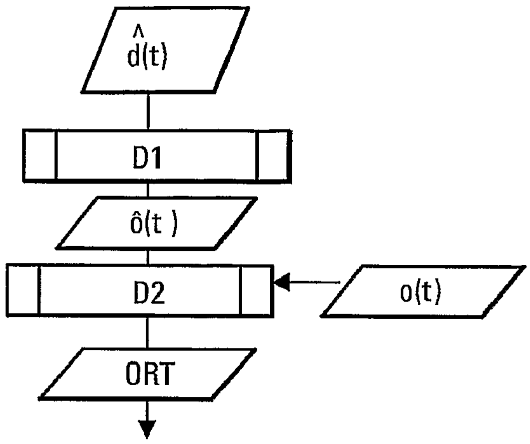

Fig. 4b

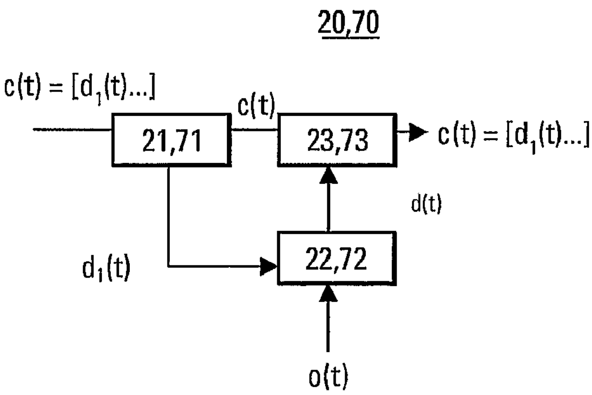

Fig. 5a

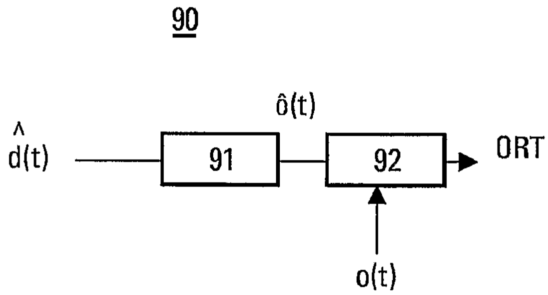

Fig. 5b

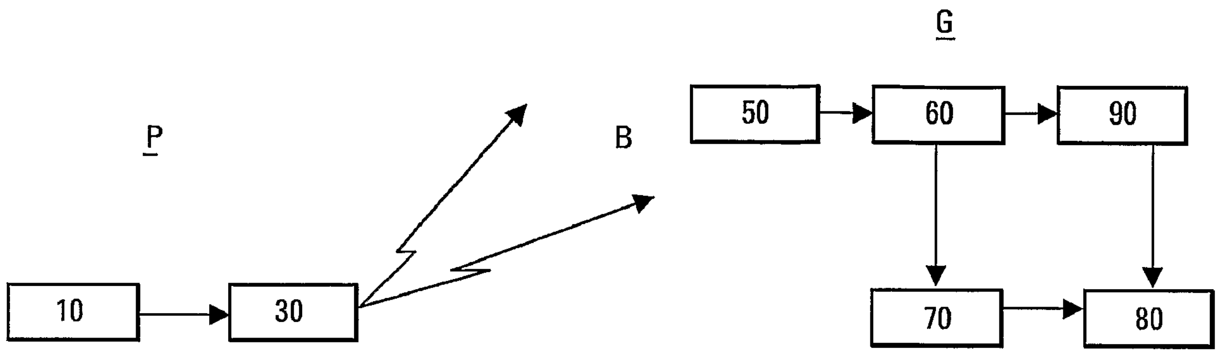

Fig. 6

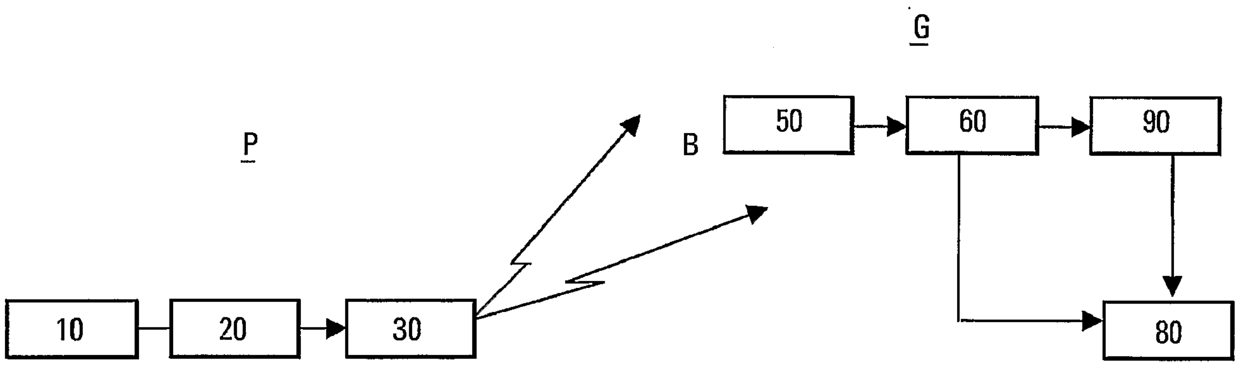

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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