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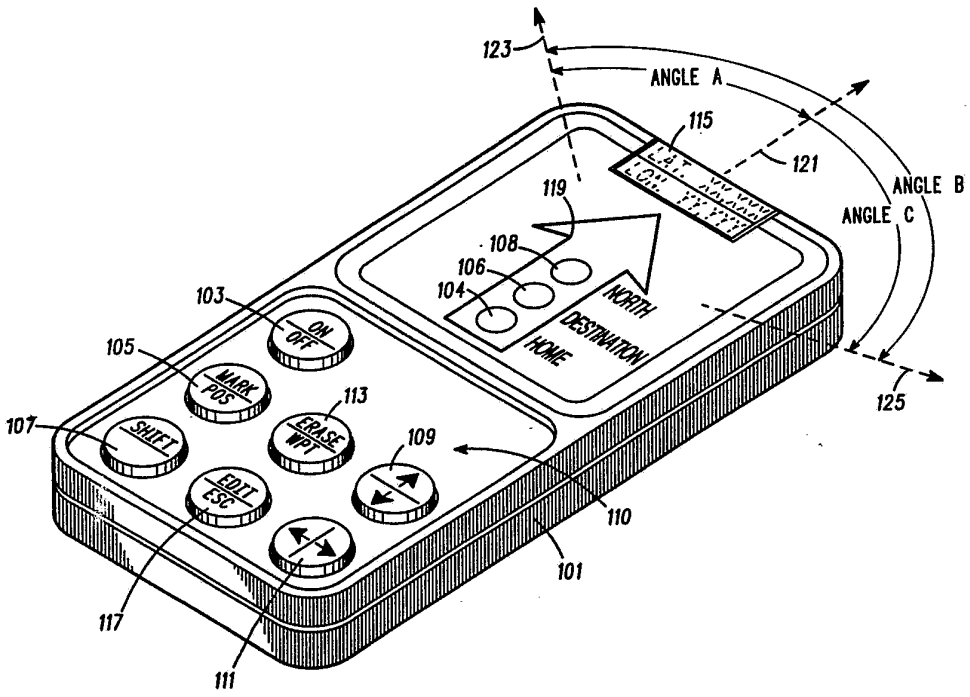

(57) Abstract

A guidance device (101) determines direction, and indicates with a discrete transition indicator (104, 106, 108) when the guidance device axis is aligned that direction. This is accomplished through the integration of a radio navigation receiver, in this case a GPS receiver (203) and a flux-gate compass (205) in a hand held unit with a user interface including a keypad (110), a direction display (119) and a configurable display (115).

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GUIDANCE DEVICE

Field of the Invention

This invention is directed generally to the field of guidance devices, and more particularly to an electronic guidance device, which provides a traveler with information as to the direction and distance from the traveler's present position to a desired location.

Background of the Invention

Present guidance systems employ complex indication man-machine interfaces. These guidance systems, in the form of radio navigation devices, such as NAVSTAR GPS (Global Positioning System) receivers, Loran C receivers, and the like, can provide a traveler with the latitude and longitude of the traveler's present position. If the latitude and longitude of a desired destination is input to the navigation device, the device can readily ascertain the distance and bearing to the destination from the user's present position. This is useful for skilled navigators in a controllable situation in which they may be provided detailed topological maps and a compass to guide them.

A problem with this approach arises when the traveler is not familiar with such traditional navigation practice, or when an experienced navigator gets into an uncontrollable situation. What travelers are most concerned about is getting lost. When a hunter for instance, is chasing a turkey, he has a need to run in a random pattern traversing potentially great distances while virtually focused on this turkey, until he completes his task. This may take minutes or hours. In another case, a casual traveler hikes for hours and gets in trouble when night falls as he can't navigate by sight anymore. Or an inexperienced traveler gets unexpectedly

separated from the group and is unable to find her way to a common meeting point. This can be fatal in some cases.

The basic compass also has its limitations as it requires someone with navigational ability to use it. Of course it only provides direction information not information about the traveler's current position, distance to destination or home position.

Summary of the Invention

The present invention encompasses a guidance device having an axis. This guidance device can determine a direction, and indicate with a discrete transition indicator when the guidance device axis is aligned with that direction.

Brief Description of the Drawings

FIG. 1 shows a guidance device constructed according to the invention; and

FIG. 2 is a schematic block diagram illustrating the internal construction of the guidance device shown in FIG. 1.

Detailed Description of a Preferred Embodiment

The guidance device described herein offers an elegantly simple solution to the former problem statement. This guidance device employs a simple indicator to communicate to the traveler pertinent information, such as direction to home (also referred to as trip origin or point of origin), direction to geographic north, and direction to destination (also referred to as trip destination, location, or waypoint) when the traveler points the guidance

device in the correct direction. In addition, a configurable display is provided in order to communicate further information about the location of interest. This information may be in the form of latitude, longitude, altitude, estimated time of arrival, estimated time of transit and distance to the location to name a few. For instance the estimated time of arrival is based on time of day, distance traveled in last contiguous periods (indicating fatigue), altitude, and distance to the destination. The casual traveler, for instance, can enter his home position at the start of a trip. Later when he decides to return to home he simply points the guidance device and rotates in a circular pattern until the indicator transitions, indicating his direction home.

The preferred embodiment of the present invention is illustrated in FIG. 1. The guidance device 101 is powered on by the on/off switch 103. To identify the traveler's current position, the traveler initiates the mark/pos switch 105. Pos, in this case, is an abbreviation for position determination. The configurable display 115 will then display the traveler's current position. Of course being configurable allows the device to display other information such as altitude, time of day to indicate a few possibilities.

He may then choose to give a name to his current position. At this point, the cursor on the configurable display 115 is in the left uppermost position. The character displayed is an "A". By initiating the increment/decrement switch 109, the traveler then increments or decrements through the alphabet and the digits zero through nine, until he is satisfied with the first character naming the location defined in the former step, in this case home, or base camp or whatever he desires. The traveler then initiates the tab/backtab key 111 and the cursor moves to the next right most position on the configurable display 115. The traveler then repeats this sequence until he is satisfied with the second character defining the destination of interest. This process of incrementing and decrementing and tabbing/back tabbing is repeated until the traveler has entered the name of his current position. When this

process is complete, the traveler can store this current position name and location by initiating the mark/pos key 105. This action registers the current position into the waypoint database 219, that is part of the guidance computer 207 more fully disclosed later. Other definitions of position such as altitude, time and others are storable as well. Other naming schemes could include provision for selecting commonly used names from a menu.

The traveler then may enter a destination by initiating first the increment/decrement switch 109, which will change the latitude first. When the desired latitude is indicated on the configurable display 115, the traveler initiates the tab/backtab switch 111 to shift the configurable display 115 to longitude and then initiates the increment/decrement switch 109 to set the desired longitude. When both the latitude and longitude displayed on the configurable display 115, to the traveler's satisfaction, the traveler then initiates the erase/wpt switch 113. This action stores the desired destination into the waypoint database 219. Of course the traveler could enter multiple destinations or waypoints in this manner with their respective names as described earlier.

The traveler can then start applying the guidance device to locate his destination, geographic north and home. He would typically do this by standing and holding the guidance device 101 pointed outwards. As the traveler rotates in a circular pattern, the guidance device 101 performs its indication and display function when the guidance device's axis, indicated in this case by the graphical arrow, encompassing the direction display, 119 is aligned with one of the predetermined directions, destination, geographic north or home. Of course the guidance device could also be mounted in a vehicle, such as a car or boat where as the bearing changed, the guidance device would indicate the direction of interest.

When the traveler points in the direction of geographic north, the discrete transition indication device 108, or simply an

indication device, in this case an LED, will change state from off to on. As the traveler continues to rotate, the indication device 108 will transition from on to off. As a traveler points to a predetermined destination, the indication device 106 will change from off to on. As the traveler continues to rotate the indication device 106 will transition from on to off. As a traveler points to a predetermined trip origin, or home position, the indication device 104 will change from off to on. As the traveler continues to rotate the indication device 104 will transition from on to off.

When the individual indication devices 104, 106, 108 transition on, the configurable display 115 will indicate further information. This may include the name of the destination, its latitude, longitude, altitude, and estimated time of arrival to name a few. The traveler may then continue to rotate and identify another destinations or waypoints in the same manner. As the traveler travels, he may check the orientation of geographic north, destination or home as frequently as he desires in this manner.

Returning to the case of the lost turkey hunter, we can see the utility of the guidance device. Of course the other travelers can benefit as well. For instance before the a group expedition starts their trek, the travelers' program in a safe meeting point. If one gets lost the invention can guide them to this point, even in inclement weather. A coal miner lost in a mine would benefit from this invention, preventing him from traversing down blind exits while finding his way out. This will be a great device for children as well. Of course if Hansel and Gretel had this invention, the birds eating Hansel's carefully placed guidance bread crumbs wouldn't matter and we would have a different story to tell.

The discrete transition indication devices, which are humanly perceptible, in this case LED's, 104, 106, 108 are virtual devices. One of ordinary skill in the art may choose an acoustic device, visual display devices such as light emitting diodes, liquid crystal displays, incandescent lamps as well as tactile transducer

devices such as a motor with a rotating weight, a pendulum, a piezoelectric transducer to name a few. In fact an acoustic device has utility where the user is inconvenienced by looking at the display. This may be very valuable in the military or hunting environments. While we describe a guidance device 101 with three indicators 104, 106, and 108 it would be obvious to one of ordinary skill in the art to reduce this to 1 device with a plurality of discrete states. For instance a light emitting diode that transitions to red when the guidance device 101 is aligned to the geographic north, green when it's aligned to home and amber when aligned with the destination. Of course other means such as acoustic devices could work in a similar manner.

While FIG. 1 illustrates the relationship between the guidance device's axis and the vectors to geographic north 123, the user heading, 121 and to destination or waypoint 125, FIG. 2 further discloses the details of the invention.

In FIG. 2 we find an antenna 201 coupled to a radio navigation receiver 203, deriving position information, preferably a GPS receiver such as the Magellan C/A code module, available from Magellan Systems Corporation, 260 E. Huntington Dr. Monrovia, CA 91016 (818) 358-2363. Alternatively the radio navigation receiver architecture such as Loran-C, Glonass and others could be substituted for the GPS receiver. The GPS receiver 203 is coupled to the guidance computer 207 through an RS232 serial data link 209. A flux-gate compass 205, such as the one available from Etak Inc., 1430 O'Brien Drive, Menlo Park, CA 94025, (415) 328-3825, is coupled to the guidance computer 207. Of course an alternative bearing indication device may be used for this function. The guidance computer 207 is further comprised of a Motorola 68HC16 microcontroller with an analog to digital converter, a serial data link interface, conventional ROM and RAM. Of course it would be obvious to one having ordinary skill in the art that this guidance computer could be comprised of other available microcontrollers or computers which have similar

attributes. The output of the flux-gate compass 205, is an analog voltage which represents the bearing deviation from magnetic north. The guidance computer 207, applying its analog to digital converter, transforms this information into a binary representation of this for further processing. When considering both latitude and longitude information, derived from the GPS receiver 203, and bearing relative to north derived from element 205, the guidance computer 207 corrects for magnetic anomalies, as illustrated by element 213. The output of element 213 yields an indication of geographic north 215. This information, geographic north 215, and the position information 209, derived from the GPS receiver 203, are then further processed to compute bearing 227, as illustrated by element 217. The keypad 110, is used as described earlier, to enter waypoint position and name information into the guidance computer 207. The configurable display 115, as described earlier, indicates additional information about the desired destination and is controlled by the guidance computer 207. When the appropriate information is entered through the keypad 110 it is stored in the waypoint database 219. This information includes the name or the waypoint, as well a the waypoint position information which includes, but is not limited to, latitude, longitude and altitude. This waypoint information, along with the position information 209 is then used to compute the distance to a desired waypoint position by element 221. And finally, element 223 is a method employed to calculate the appropriate action to be displayed on the guidance display 119 as a traveler desires. The inputs to the process are indication of geographic north, 215, bearing, 227 and waypoint, 225. As indicated earlier, if the bearing of the guidance device 101 axis is geographic north the north indicator, 108 transitions on. As the traveller moves the guidance device 101 away from this vector the north indicator 108 transitions off.

It is the intention of the preferred embodiment that the elements internal to the guidance computer 207 indicated by

elements 213, 217, 221, and 223 are software elements embedded in the Motorola 68HC16 microcontroller, performing the necessary work to accomplish the task at hand. It would be obvious to one of ordinary skill in the art, that this could be accomplished many other ways including a pure hardware implementation, or hybrid of hardware and software.

What is claimed is:

Claims

1. A guidance device, with an axis comprising:

means for determining a first direction; and

indicating means, responsive to said means for determining a first direction, said indicating means providing a discrete transition in state when the guidance device axis is aligned with said first direction.

2. A guidance device in accordance with claim 1 wherein said indicating means comprises a light that is illuminated when the guidance device axis is aligned with said first direction.

3. A guidance device in accordance with claim 1 wherein said first direction is geographic north.

4. A guidance device in accordance with claim 1 wherein said indicating means is humanly perceptible.

5. A guidance device in accordance with claim 1 further comprising a configurable display communicating to the traveller a name of said first direction with which the guidance device axis is aligned.

6. A guidance device in accordance with claim 1 further comprising:

means for determining a second direction; and

second indicating means having a discrete transition in state when the guidance device axis is aligned with said second direction.

7. A guidance device in accordance with claim 6 wherein said indicating means and said second indicating means comprises a visual display, and wherein the visual display indicates when the guidance device is aligned with said first direction and indicates when the guidance device is aligned with said second direction.

8. A guidance device in accordance with claim 1 wherein said means for determining a first direction further comprises means for determining a location and an alternative direction from said device to said location; and

indicating means, responsive to said means for determining a direction, said indicating means providing a discrete transition in state when the guidance device axis is aligned with said alternative direction.

9. A guidance device in accordance with claim 8 further comprising:

means for determining a distance to said determined location; and

means for indicating said distance to said determined location, responsive to said means for determining a distance.

10. A guidance device in accordance with claim 8 further comprising:

means for determining an altitude to said determined location; and

means for indicating said altitude to said determined location, responsive to said means for determining an altitude.

11. A guidance device in accordance with claim 8 further comprising:

means for determining an estimated time of travel to said determined location; and

means for indicating said estimated time of travel to said determined location, responsive to said means for determining an estimated time of travel.

12. A guidance device in accordance with claim 8 further comprising a configurable display communicating to the traveller the name of said determined location that the guidance device axis is aligned with.

13. A guidance device in accordance with claim 1 wherein said means for determining a first direction further comprises:

means for determining a point of origin location and a direction from said device to said point of origin location;

means for determining a geographic north location and a direction from said device to said geographic north location;

means for determining a destination location and a direction from said device to said destination location; and

indicating means, responsive to at least one of said means for determining, said indicating means providing a discrete transition in state for indicating direction to at least one of said locations when the guidance device axis is aligned with at least one of these locations.

14. A method of guidance comprising the steps of:

determining a first direction; and

indicating, responsive to said step of determining, when the guidance device axis is aligned with said first direction.

15. A method in accordance with claim 13 wherein said step of determining a first direction further comprises determining a location and a direction from said device to said location.

16. A method in accordance with claim 15 further comprising the steps of:

determining a point of origin location and a direction from said device to said location;

determining a geographic north location and a direction from said device to said location;

determining a destination location and a direction from said device to said location; and

indicating, responsive to said at least one step of determining, when the guidance device is aligned with at least one of the locations determined by at least one of said steps of determining a location and the direction from said device to said location.

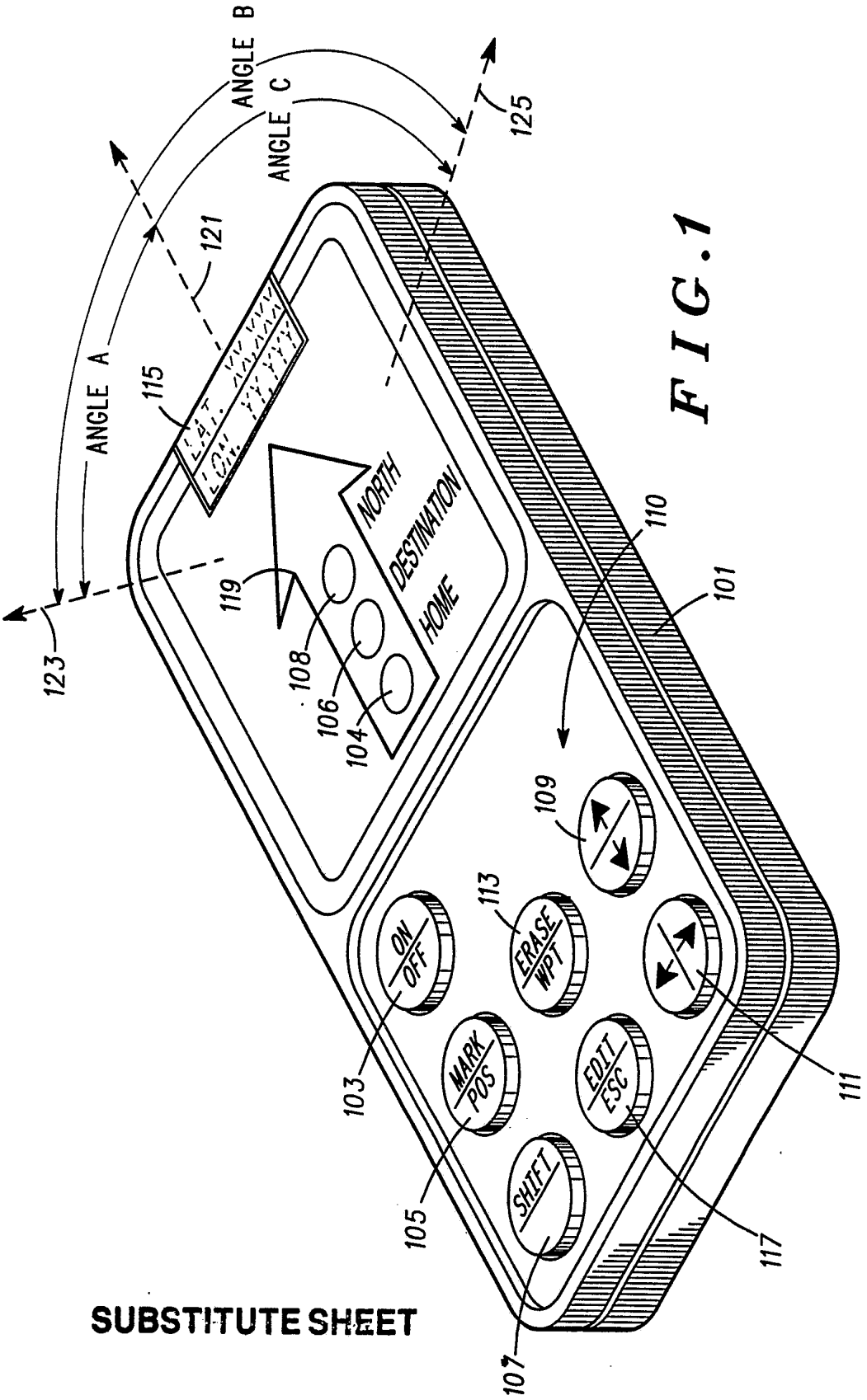
ANGLE A
ANGLE B
ANGLE C
121
125
115
123
119
NORTH
DESTINATION
HOME
108
106
104
110
101
109
113
ON/OFF
ERASE/WPT
MARK/POS
EDIT/ESC
SHIFT
103
105
107
111
117

FIG. 1

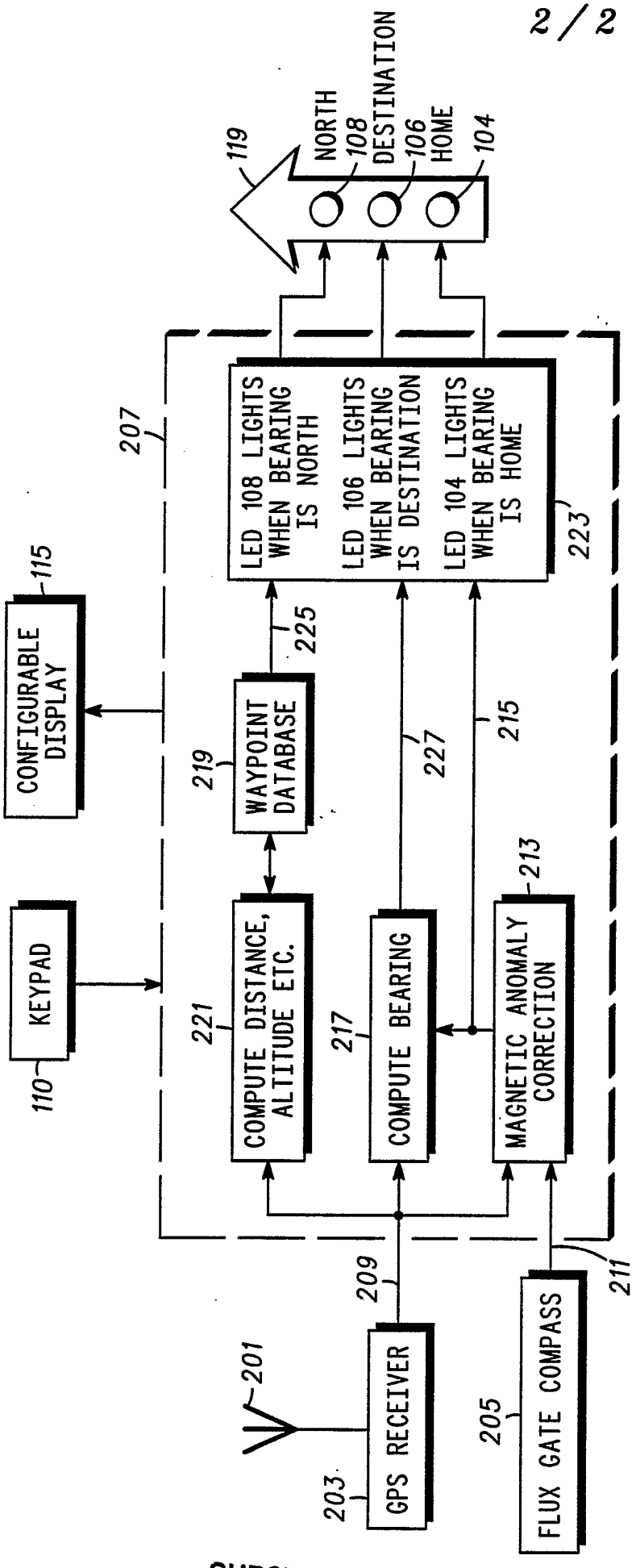
119
NORTH
108
DESTINATION
106
HOME
104
207
LED 108 LIGHTS WHEN BEARING IS NORTH
LED 106 LIGHTS WHEN BEARING IS DESTINATION
LED 104 LIGHTS WHEN BEARING IS HOME
223
115
CONFIGURABLE DISPLAY
225
219
WAYPOINT DATABASE
227
215
110
KEYPAD
221
COMPUTE DISTANCE, ALTITUDE ETC.
217
COMPUTE BEARING
213
MAGNETIC ANOMALY CORRECTION
209
211
201
GPS RECEIVER
205
FLUX GATE COMPASS
203

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/06285

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :G06F 15/20,50; G01C 21/08
US CL :364/444;,448,449; 342/357,359,443,450,458.
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)

U.S. : 73/178R; 364/443; 364/460; 33/356.

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)

Please See Extra Sheet.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A, 3,840,726 (HARRISON) 08 OCTOBER 1974. SEE ABSTRACT; FIGURE 1; COLUMN 9, LINES 1-35.	1-8,12,14
A	US,A, 4,103,279 (DILDY, JR. ET AL.) 25 JULY 1978. SEE THE ENTIRE DOCUMENT.	1-16
X	US,A, 4,464,622 (FRANKLIN) 07 AUGUST 1984. SEE FIGURES 3 AND 4; COLUMN 5, LINES 33-57.	1,2,4,14
X Y	US,A, 4,563,685 (MATSUMOTO ET AL.) 07 JANUARY 1986. SEE THE ENTIRE DOCUMENT.	1,4-9,11-16 2,3,10
X Y	US,A, 4,814,989 (DOBEREINER ET AL) 21 MARCH 1989. SEE COLUMN 2, LINE 14 - COL. 6, LINE 3.	1-9,11-16 10
X	US,A, 4,841,449 (SUYAMA) 20 JUNE 1989. SEE THE ENTIRE DOCUMENT.	1-16

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
14 SEPTEMBER 1992	30 NOV 1992
Name and mailing address of the ISA/ Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer VINCENT N. TRANS Telephone No. (703) 308-1396

Form PCT/ISA/210 (second sheet)(July 1992)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/06285

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A, 4,857,840 (LANCHAIS) 15 AUGUST 1989. SEE COLUMN 1, LINES 32-43; COLUMN 5, LINE 11-COLUMN 7, LINE 37; COLUMN 14, LINE 44-COLUMN 15, LINE 45.	1-16
Y	US,A, 4,949,089 (RUSZKOWSKI,JR.) 14 AUGUST 1990. SEE THE ENTIRE DOCUMENT.	1-16
X	US,A, 4,977,509 (PITCHFORD ET AL.) 11 DECEMBER 1990. SEE ABSTRACT; FIGURE 1; COL.11, LINE 43-COL.13, LINE 17; COL.17, LINE 61-COL.19, LINE 31; CLAIMS 1 AND 11.	1-16
P,X	US,A, 5,067,081 (PERSON) 19 NOVEMBER 1991. SEE THE ENTIRE DOCUMENT.	1-16
P,X	US,A, 5,075,693 (MCMILLAN ET AL.) 24 DECEMBER 1991. SEE THE ENTIRE DOCUMENT.	1-16
P,A	US,A, 5,131,154 (SCHIERBEEK ET AL.) 21 JULY 1992. SEE THE ENTIRE DOCUMENT.	1-16
E,X	US,A, 5,146,231 (GHAEM ET AL.) 08 SEPTEMBER 1992. SEE THE ENTIRE DOCUMENT.	1-16

B. FIELDS SEARCHED
Electronic data bases consulted (Name of data base and where practicable terms used):

APS. GLOBAL POSITION SYSTEM OR GPS; FLUX GATE SENSOR; ELECTRONIC STUD SENSOR/FINDER; POSITION (5A) (LOCAT? OR FIND?) AND DESTINATION AND (ORIG? OR HOME); (PORTABLE OR HAND HELD OR PERSONAL) (10A) (GUIDANCE OR NAVIGATION).