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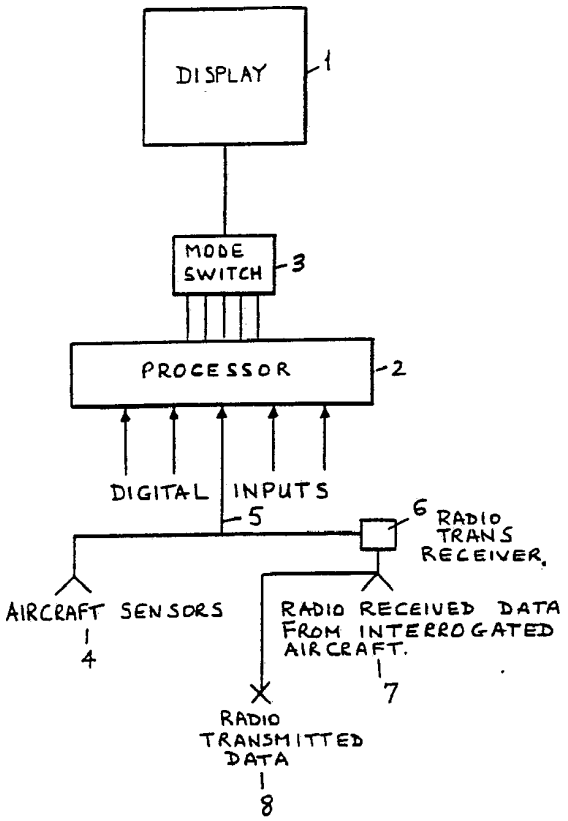
(57) Abstract

Each of a plurality of vehicles, aircraft and/or ground stations is provided with a radio transreceiver (6) having a corresponding plurality of channels, coupled to PPI sensors (4) and via a data processor (2) to a display VDU (1) whereby PPI information and received data may be displayed. The interrogation of one or more of the plurality by an interrogating one of the plurality enables the display of relative position of the one or more interrogated vehicles, aircraft or ground stations on the VDU of the interrogating vehicle, aircraft or ground station.



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'RELATIVE POSITION INDICATING MEANS AND METHOD'

This invention relates to relative position indicating means.

It is known to use ground or airborne radar to ascertain the position and relative position of a plurality of land or airborne objects such as ground vehicles and aircraft. A disadvantage is the capital cost of the equipment required and also that during radar operation there is exposure in a military situation, to hostiles homing on the radar emission.

It is known to provide present position indication in an aircraft or other vehicle or ship by radio signals from known beacons but this does not allow for one vehicle, aircraft or ship or other station knowing the relative positions of a plurality.

It is known that VHF/UHF radio transmissions require relatively low power and are capable of traversing long distances such that, for example, they are capable of being used for satellite communication or through drone or helicopter to relay messages even further distances.

It is also known that data can be readily scrambled or coded in VHF/UHF radio communication such that access to the data by a hostile can be rendered difficult.

It is an object of the invention to provide improved means whereby any one of a plurality of land, sea or air vehicles may establish relative positions of each of the plurality.

According to the present invention means whereby the object can be met comprises a VHF/UHF or other frequency range radio transreceiver operatively coupled to means for displaying data received by the transreceiver on a display and for transmitting data relevant

to the vehicle aircraft or station in which the means whereby the object can be met is mounted said radio transreceiver having a plurality of radio channels whereby each channel may be allocated to a respective one of a plurality of vehicles or stations each of which carries means according to the invention and each vehicle may receive data relevant to each of the plurality and display it on its own display to indicate the relative positions of the plurality.

Suitably the means for displaying data is arranged to be driven by present position indication signals of the vehicle in which it is carried. Such signals may be generated by a PPI on the vehicle or by a remote PPI transmitting to the transreceiver. In the former case the transreceiver and the PPI are coupled to the means eg area navigation system, for display such that PPI data is transmitted from the transreceiver.

Suitably the transreceiver is adapted such that it may be operated from any one of the plurality and identifier means are provided so that data is transmitted only when an enquiry is from an acceptable identity.

Suitably means according to the invention is provided with scrambler code-decode means whereby transmitted data may be in scrambled form, and further means may be provided whereby scramble codes may be varied according to a programmed control. Likewise means may be provided whereby operating frequency of each of the plurality of channels is varied at intervals according to a programme.

The invention provides the advantages of presently used radar relative position indicators but has the advantage of substantially reduced costs, low power operation, for example up to 5 watts, reduced weight of equipment, extended range potential, and reduced exposure to homing devices.

In an example means according to the invention may be mounted in a plurality of search aircraft or helicopters, a control station such as a base ship and on sonar buoys adapted to be dropped from the air vehicles at a sea location where an underwater intruder is thought to be located. Each of the aircraft or helicopters and the control station may on enquiry ascertain the relative position of each other which is advantageous, particularly in low visibility and adverse weather conditions, and also ascertain sonar signals from the buoys whereby the underwater intruder may be located. Suitably the buoys include present position indicators driven by satellite signal receiver whereby drift can be taken into account and the buoy transreceivers transmit data relevant to their position and the sonar signal relevant to the intruder position, and the buoy can be designed to last for predictable hours.

A particular advantage of the invention is that existing avionics position indicating equipment may be used with add-on adaptation to meet the object of the invention.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a block diagram of means according to the invention for aircraft mounting and connection to aircraft sensors and to a radio transreceiver for communication with and interrogation of other aircraft or gound stations, and

Figures 1 A to H are illustrations the means of Figure 1 and of typical displays which may be developed on the display unit.

In the embodiment illustrated in the figures which is suited for civil aircraft use, the means to be mounted in an aircraft comprises as seen in Figure 2A and the block diagram of Figure 1 a conventional display unit 1 coupled to a data processor or computer 2 for example an RS2 32C microprocessor through a mode switch 3 arranged to couple different programmes to the processor so that different displays can be selected as required.

The computer 2 is coupled to sensors 4 on the aircraft for the input of digital data 5 relative to position, navigational information and altitude and to a radio transreceiver adapted to transmit and receive such data between it and compatible units on other aircraft or static stations.

The computer 2 is programmed to compute aircraft speed as received data from sensors 4 is updated at clocked intervals, and to compare data related to its own 4, 5 and to received signals 6, 7 such that the

relative data may be presented in different forms of display by use of the mode switch 3, of Figure 2B and is suitably programmed to provide a switch-on check and all satisfactory display, Figure 2C, to indicate that the unit and associated inputs are functioning when the unit is switched on.

The computer 2 is programmed to develop relative position display in a forward locking mode as in Figure 2D with the interrogating aircraft 10 at centre bottom and its course indicated by vector 11, or in a 360° display with interrogating aircraft in centre as at 10 in Figures 2E and 2F, and relative course by a forwardly extending vectors 11 and 13 as shown in Figures 2D and 2F for the interrogating aircraft 10 and interrogated aircraft 12. The mode switch and the programmes being such that the nature of the display can be manually selected.

The computer 2 is suitably programmed to compare altitude data and to generate a different colour display signal for the contacted aircraft according to whether the altitude separation is greater or less than a predetermined or selectable amount, e.g. 500 ft. In a suitable system red (orange) is used if the altitude separation is less than 500 ft. and green if greater than 500 ft.

The computer 2 is suitably programmed to present by appropriate selection on the mode switch 3 a display of transmitted and received data in alphanumeric manner as shown in Figures 2G so that by use of the mode switch 3 the alphanumeric display may be selected when

required.

As the transmitted 8 and received 7 data is clocked the displays are continuously updated and the computer is programmed to compute speed and relative speed from the changing data.

The display may be superimposed on a radar screen so that it may, for example, be displayed above a ground picture.

The computer 2 may be programmed to present the displays in other than head up relation to the aircraft carrying the display, for example as in Figure 2G where the display is North up and the vector courses 11, 13 of both aircraft 10, 11 are both inclined to the North up direction. Also arrangements may be embodied to embody an overlay display, for example imposed by a control station, to display limitations on or requirements of the aircraft. This could be useful in displaying ground control flight path requirements.

In a potential military application illustrated in Figure 2I the angled vectors 14, 15 around the flight path of each aircraft or carrying vehicle might be represented by a permitted arc of fire determined by a control aircraft or ground station.

In the embodiment described the mode switch has a reset button and 6 two position switches arranged to select display as follows:-

1. Overlay i.e. the overlay of predetermined data on the screen.
2. North up or head up display
3. Centre or bottom position of interrogating aircraft.

4. Arc on or Arc-off i.e. the presence or absence of arcs of fire as indicated in Fig. 2H.
5. Graphic or text display i.e. the displays according to Figures 2C-F and 2H as graphic display or that of Fig. 2G as text.
6. vector on and vector off i.e. the presence or absence in a graphic display of vector representation of course and speed as in Figures 2D, 2F, 2H.

The text display is arranged as in Figure 2G to display data in two lines, the first line comprising longitude, lattitude and altitude, and the second line comprising speed in knots, course made good, arc-left and right of the field of fire, as seen in Fig. 2H, range of field of fire.

Thus, in Figure 2G, the upper row of heading codes indicates the following:-

ID - Identification
KTS - Speed in knots
CMG - Course made good
LFT - Left
RGT - Right
RNG - Range
ALT - Altitude

The first set of data adjacent the ID FP-interrogating aircraft, represents in the upper row Longitude 56.59 N Lattitude 001.59 W Altitude 2080 ft. and in the second line speed 105 knots, course made good 115 Arc left 100 Arc Right 130 Range 25 miles. Corresponding data for the interrogated aircraft is

indicated in the two rows of data adjacent the identification FN. The nature of the data displayed is exemplary but typical of the data requirements for the pilot of an aircraft requiring relative position information.

CLAIMS

1. A method of relative position of a plurality of vehicles, aircraft and/or ground stations which is characterised by providing each of the plurality with a respective radio transreceiver (6) having a corresponding plurality of channels, operatively coupled to means (1) for displaying data received by the respective transreceiver (6) and to means (4) on the vehicle, aircraft or gorund station for developing, displaying and transmitting present positive data of the associated vehicle, aircraft or ground station, whereby each display (1) of the plurality may display continuously updated display of the relative positions of the plurality of vehicles, aircraft or ground stations

2. A method as in claim 1 characterised in that each channel of each transreceiver (6) is arranged to be activated on receipt of an interrogating signal from the respective transreceiver (6) of an interrogating vehicle, aircraft or ground station.

3. A method as claimed in claim 1 or claim 2 characterised in that each means (1) for displaying data is driven by PPI signals of the vehicle, aircraft or ground station in which it is carried.

4. A method as claimed in claim 1 or claim 2 in which a or each means (1) for displaying data is driven by PPI signals from a remote station.

5. Relative position indicator means for carrying out the method of claim 1, characterised by a radio transreceiver (6) having a plurality of channels, coupled to PPI sensors (4) and via a data processor (2) to a VDU (1) whereby PPI information and received

data (7) may be displayed on the VDU (1) to present relative position of an interrogating and interrogated aircraft vehicle or ground station.

6. Means as claimed in claim 5 characterised in that the PPI sensors (4) , the processor (2) and the radio transreceiver (6) are adapted to communicate digital data.

7. Means as claimed in claim 5 or claim 6 characterised in that the data processor (2) is controlled by a mode switch (3) adapted to select programmes for the presentation of data in graphic or text display.

8. Means as claimed in claim 5 or claim 6, characterised in that the data processor (2) is controlled by a mode switch (3) adapted to select programmes for the presentation of data in graphic or text display and means are provided for overlaying a display of predetermined data.

9. Means as claimed in claim 5 or claim 6 characterised in that the display (1) is operatively coupled to a radar whereby displayed data is above a ground picture.

10. Means according to any of claims 5 to 9 characterised by scrambler - decode means coupled to the radio transreceiver (6) whereby transmitted data may be in scrambled form, and further means are provided whereby scramble codes and radio operating frequency may be varied according to a programmed control.

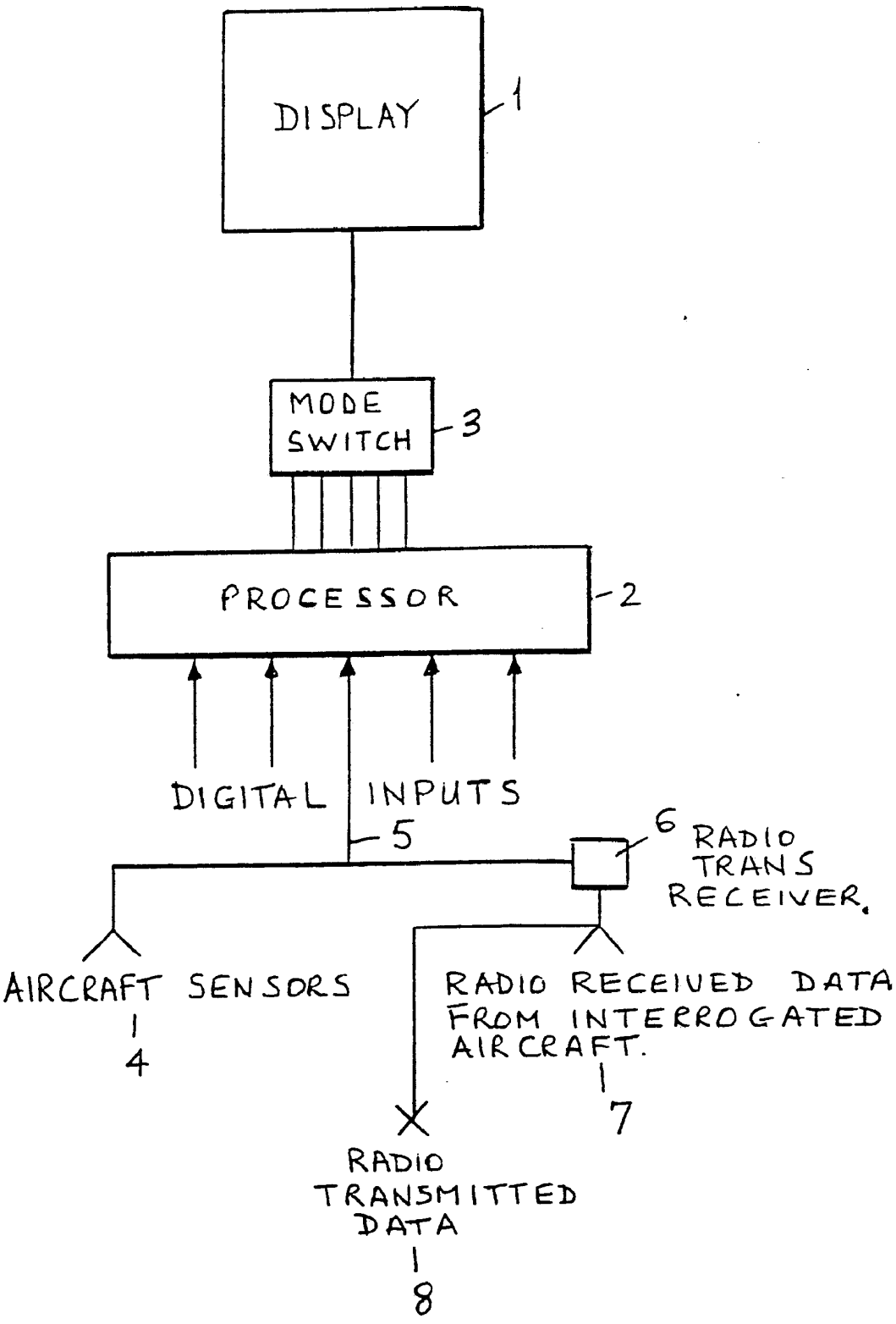

DISPLAY
1
MODE SWITCH
3
PROCESSOR
2
DIGITAL INPUTS
5
6
RADIO TRANS RECEIVER
AIRCRAFT SENSORS
4
RADIO RECEIVED DATA FROM INTERROGATED AIRCRAFT.
7
RADIO TRANSMITTED DATA
8

Fig.1

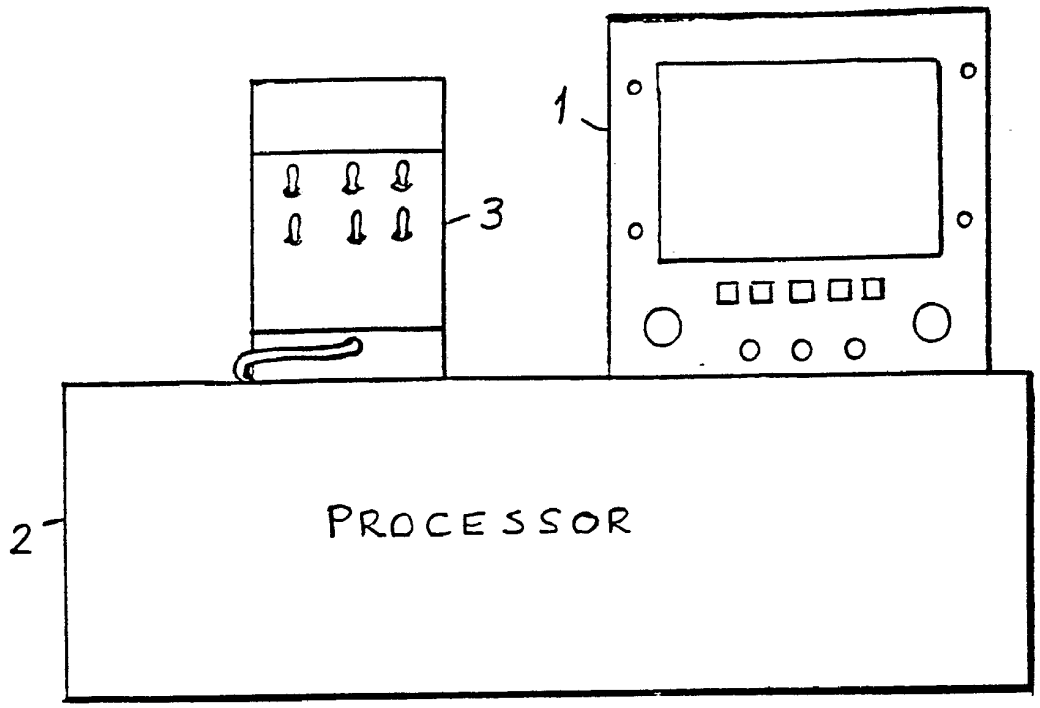
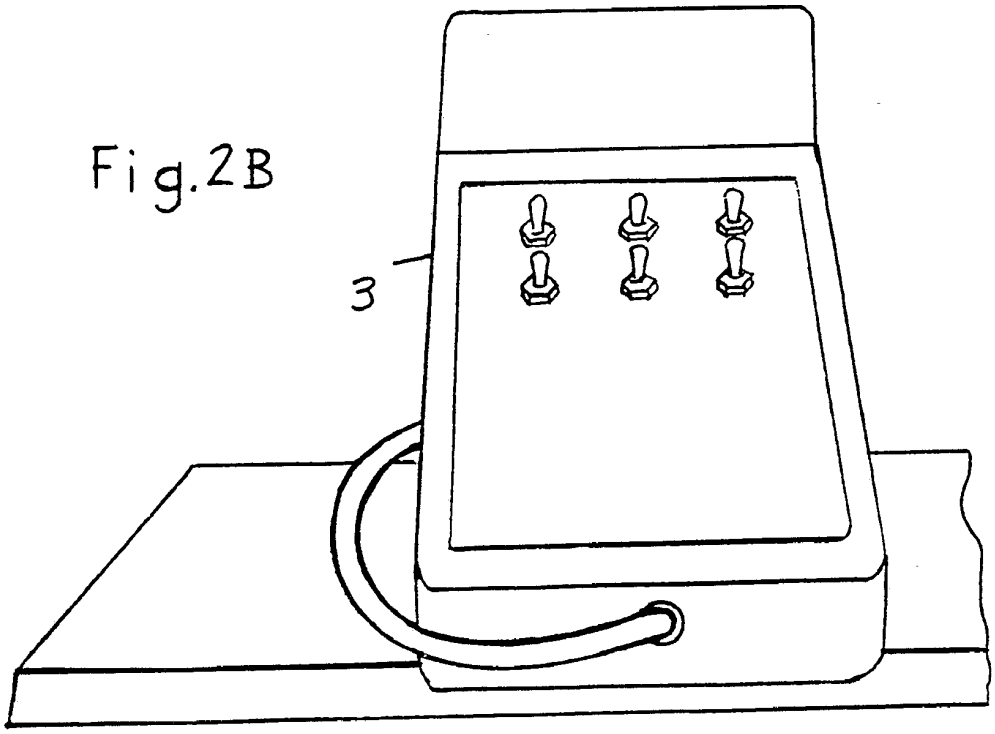


Fig. 2 A

Fig. 2B



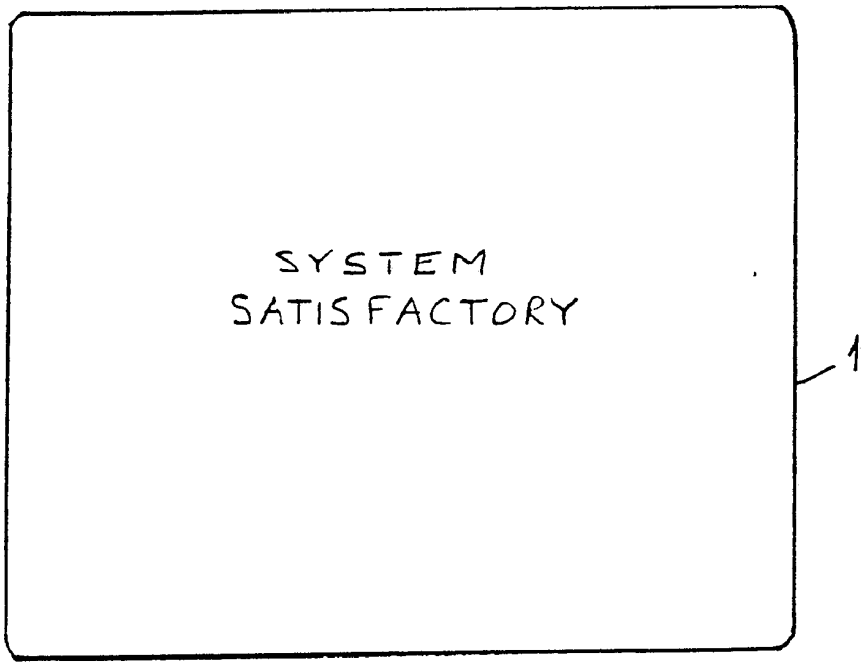


Fig.2C

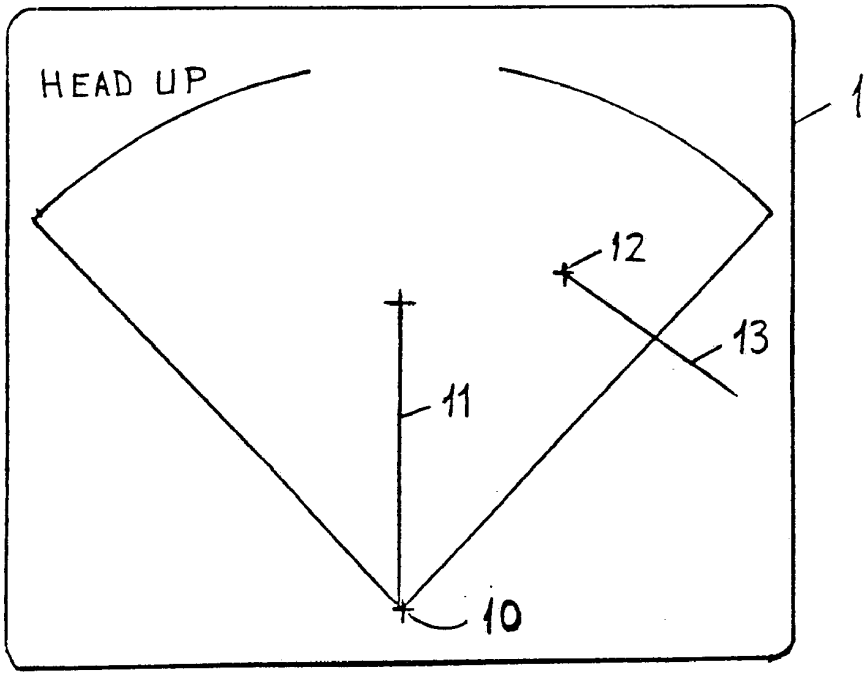


Fig.2D

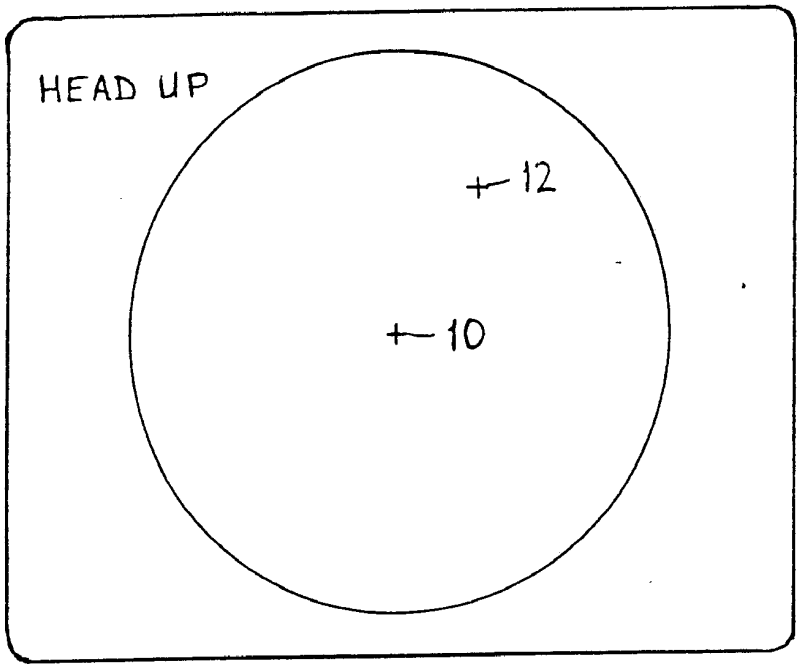


Fig. 2E

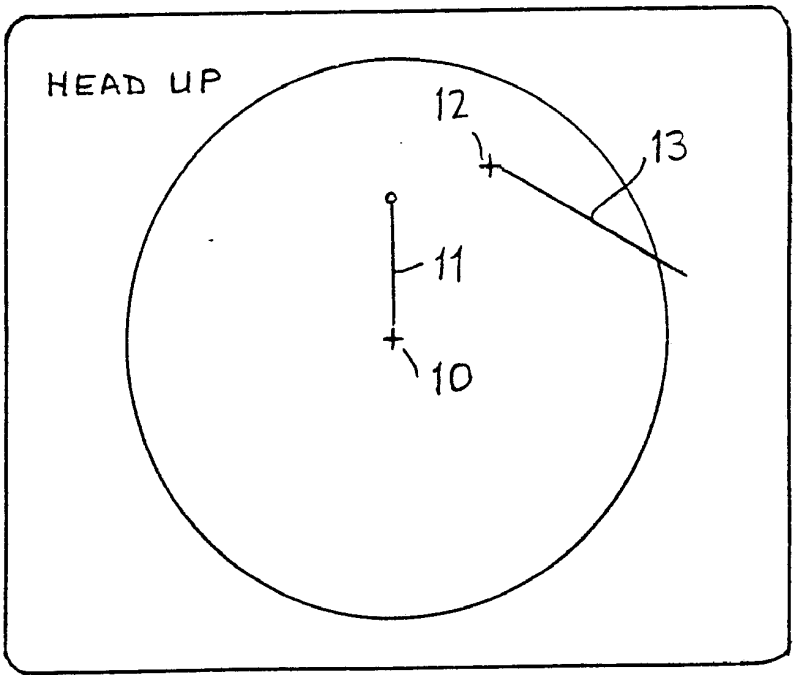


Fig. 2F

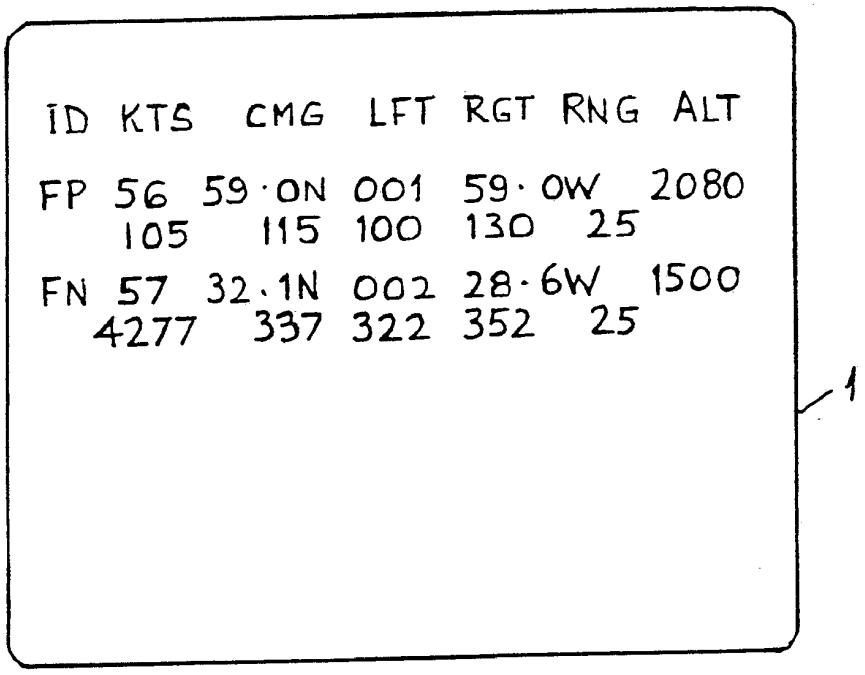

ID KTS CMG LFT RGT RNG ALT
FP 56 59·0N 001 59·0W 2080
105 115 100 130 25
FN 57 32·1N 002 28·6W 1500
4277 337 322 352 25
1

Fig.2G

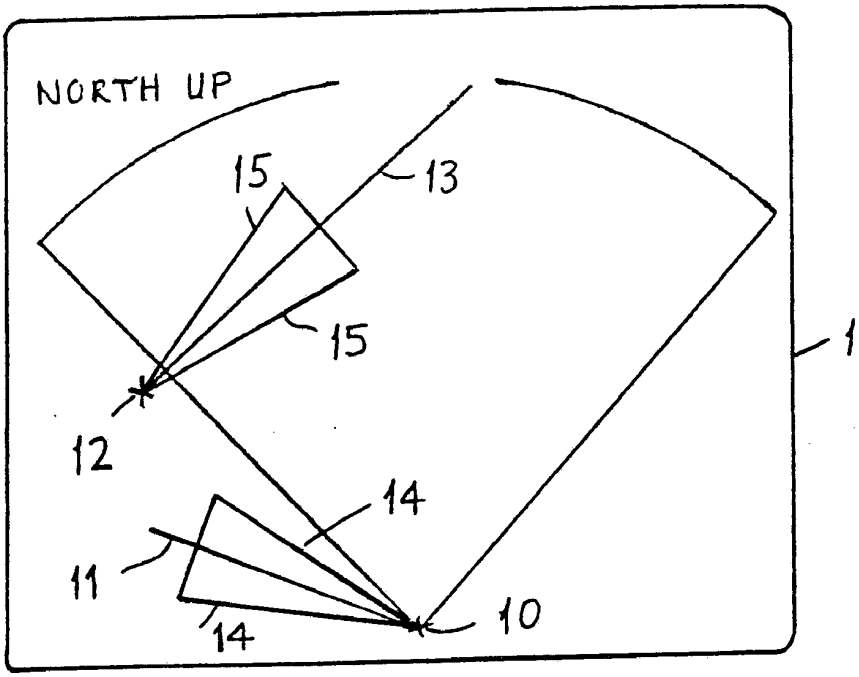

NORTH UP
15
13
15
1
12
14
11
14
10

Fig.2H

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/00162

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: G 01 S 5/02; G 01 S 7/02; G 01 S 13/93

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	G 01 S

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4380050 (J.H. TANNER) 12 April 1983 see column 3, lines 9-26; column 7, lines 9-30; abstract; column 9, lines 50-58; column 12, lines 24-36; figures 1,7,9	1-8
X	US, A, 4197538 (G.H. STOCKER) 8 April 1980 see abstract; column 3, line 25 - column 9, line 12; figures 1-3	1-6
X	US, A, 4188581 (R.A. STEVENSON) 12 February 1980 see column 2, line 56 - column 4, line 60; figures 1,2	1-6
X	FR, A, 2356153 (M.Q. CABROL) 20 January 1978 see the whole document	1-6
A	US, A, 3750166 (J.S. DEARTH) 31 July 1973 see column 3, line 42 - column 5, line 24; figures 1-8	1

* Special categories of cited documents: [10]

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

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

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17th May 1988	13 JUN 1988
International Searching Authority: EUROPEAN PATENT OFFICE	Signature of Authorized Officer: P.C.G. VAN DER PUTTEN

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8800162 SA 20994

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4380050	12-04-83	None	
US-A- 4197538	08-04-80	None	
US-A- 4188581	12-02-80	None	
FR-A- 2356153	20-01-78	None	
US-A- 3750166	31-07-73	None	