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PATENT SPECIFICATION

(11) 1 592 873

(21) Application No. 7279/77 (22) Filed 21 Feb. 1977
(23) Complete Specification filed 15 Feb. 1978
(44) Complete Specification published 8 July 1981
(51) INT CL³ G06F 15/50
(52) Index at acceptance G4A 13M 5A 5X 9C 9X U
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(19)

(54) IMPROVEMENTS RELATING TO DATA PROCESSING SYSTEMS

(71) We, FERRANTI LIMITED, a Company registered under the Laws of Great Britain of Hollinwood in the County of Lancaster, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to data processing systems for pre-planning the flight of an aircraft.

The planning of routes for aircraft is commonly done to ensure that the aircraft follows path to take advantage of, or to avoid, certain specified features. For example, aircraft may be required to follow specified airways, turning at identified points. The route planning may be done whilst the aircraft is in flight, or it may be done prior to the flight to reduce the load on the crew during the flight.

It is the object of the invention to provide a data processing system operable to provide an aircraft flight plan prior to the start of the flight.

According to the present invention there is provided a data processing system for pre-planning a data processing system for pre-planning the flight of an aircraft travelling between successive ones of a number of selected points represented on a chart, the aircraft carrying an on-board navigation computer, which system includes plotting means to which the chart may be secured and including a cursor moveable over the chart to derive electrical signals indicating the relative positions of each selected point, input means for deriving further electrical signals defining known parameters relating to the characteristics of the aircraft, calculating means responsive to said electrical signals and to said further electrical signals to calculate predetermined variable factors relating to the route between each successive pair of selected points, and record means operable to store said variable factors in digital form and comprising a store which may be removed from said system and connected to the aircraft navigation computer so as to apply said variable factors to said computer.

An embodiment of the invention will now be provided with reference to the accompanying drawings, in which:—

Figure 1 shows a block schematic diagram of a data processing system; and

Figure 2 illustrates a modification to the system of Figure 1.

Referring now to Figure 1, the system is based on a plotting board PB and its associated circuitry, indicated generally by the reference 10. The plotting board consists of a surface to which a map or chart may be secured and under which are two sets of conductors. Each set comprises a large number of parallel conductors arranged as two inter-leaved arrays, one set being parallel to the X axis and the other set parallel to the Y axis of the board. A cursor C is movable over the surface of the board and carries a coil energisable by a sinusoidal waveform of constant amplitude so as to produce a symmetrical magnetic field. The cursor also carries a cross-wire which is accurately positioned in the centre of this field. The alternating current supply for the cursor is derived from a clock generator CK through a counter CTR, which for this purpose acts as a frequency divider. The square-wave output from the counter is converted to a sine wave, and a power amplifier PA produces the drive current for the cursor coil. The outputs from the set of X conductors and the set of Y conductors on the plotting board are fed through circuitry whirh produces signals representing the X and Y outputs. These signals are applied to a phase detector PD which compares the phases of the X and Y signals with the original square-wave used to drive the cursor, and produces pulses for each increment of movement of the cursor. These increments are used to increase or decrease the contents of separate X and Y counters CTX and CTY respectively to obtain the X and Y coordinates of the cursor at any instant.

The circuitry described above is well known and frequently used with plotting boards for

digitising drawings and the like. United States patent specifications Nos. 3,647,963 and 3,801,733 disclose arrangements of this type.

The X and Y counter outputs are multiplexed when required by a multiplexer MX, and applied as a 16-bit number to a processor CPU having an associated store ST. An interface IF interconnects the processor and a printer PR which may have an associated keyboard to act as an input device. Switching logic SL converts signals from a number of push buttons B carried on the cursor C to signals for controlling the printer and the processor, the latter via the interface IF. A keyboard K is connected to the interface IF.

The final elements of the system are a portable, that is removable, store PS, a visual display unit VDU and a cassette recorder CR.

In operation, a chart or map is placed on the plotting board and the cursor is set to a known datum position. The coordinates of this datum are typed in via the keyboard of the printer, either in map grid form or in terms of latitude and longitude. A second known datum, having different X and Y coordinates, is fed in similarly, thus enabling the processor to determine the scale of the map or chart in use. In addition, the processor is able to allow for any misalignment between the plotting board grid and that of the map or chart.

The manner in which the system operates depends to a large extent upon its application. Obviously the external factors, relating to the vehicle following the route, will vary considerably from one type of vehicle to another. For example an aircraft may be assumed to travel in straight lines between selected points, and to travel at a more or less constant speed. On the other hand, a road vehicle can do neither of these, and the rules for determining a route will therefore be very different for the two types of vehicle.

Considering the case of a route for an aircraft, it is a simple matter for the processor, having been supplied with parameters such as speed, fuel consumption, fuel load and bank angle (or radius of turn), to determine variable factors such as the bearing between two points, fuel consumption (or fuel reserve), and time of flight. Such items as these are of great value to the pilot of the aircraft.

In operation, once the two datum points have been defined as above, the variable parameters are identified and applied to the processor via the keyboard K of the printer. After this it is simply a case of defining each selected point along the route, when the processor will calculate and cause the printer to provide a record of the various variable factors relating to each leg of the route.

Provision may be made for changing the chart or map, two new datum points being defined each time this is done.

The portable store PS is a store in which the calculated information may be stored so that it may subsequently be transferred to the aircraft's own data processing system. This relieves the crew of the necessity to feed all the parameters into the aircraft system themselves. Similarly a tape cassette may be used in the same way, the tape being obtained from a cassette recorder CR. The visual display unit VDU is an alternative to the printer for providing a visual output, though the printer provides a permanent record. It is, of course, possible to arrange for the display to appear only on the VDU, providing a printed record only when any corrections have been effected using the VDU display. The portable store PS and tape cassette may also be used as input devices to program the processor.

Figure 2 illustrates one possible modification to the system described above. It may be that the various turning points along a route are in fact preselected and their coordinates stored in part of the store ST. It is desirable to use these preselected points rather than arbitrary points selected by the operator, if the two are sufficiently close together. The block diagram show detail within the processor and store blocks of Figure 1. A temporary store TS and a fixed-point store FPS are both connected to a comparator CMP. Both of these stores have separate inputs. The temporary store TS is also connected to a store reader SR which operates on the fixed point store FPS. The output of the comparator controls a selector S which passes data from either the temporary store or the fixed-point store to a further store WS containing the points to be used by the processor in the necessary calculation.

The comparator CMP operates to compare the coordinates of points presented to it from the two stores TS and FPS. If the two points are close enough, that is within a predetermined distance of one another, the preselected point from store FPS will be used; otherwise the point from the temporary store will take preference.

In operation, therefore, each point fed into the processor by the operator causes the store reader SR to read out at a time from store FPS the coordinates of all points in that store. The comparator then checks each one to see if it is close enough to the point fed in by the operator. The output of the comparator controls the selecor S to apply the appropriate coordinates to store WS to enable the subsequent calculations to be performed.

As already mentioned the processor may be arranged to cater for chart scale changing or misalignment, and is able if necessary to convert coordinates between map grid and latitude/longitude values. The plottting board need not use the free cursor and inductive field system described above. Other plotting boards use transducers to measure movement

along the two perpendicular axes of the board. Similarly, scanning techniques could be used with the aid of a light pen, as described in our British Patent Specification No. 1,488,814.

WHAT WE CLAIM IS:—

1. A data processing system for pre-planning the flight of an aircraft travelling between successive ones of a number of selected points represented on a chart, the aircraft carrying an on-board navigation computer, which system includes plotting means to which the chart may be secured and including a cursor moveable over the chart to derive electrical signals indicating the relative positions of each selected point, input means for deriving further electrical signals defining known parameters relating to the characteristics of the aircraft, calculating means responsive to said electrical signals and to said further electrical signals to calculate predetermined variable factors relating to the route between each successive pair of selected points, and record means operable to store said variable factors in digital form and comprising a store which may be removed from said system and connected to the aircraft navigation computer so as to apply said variable factors to said computer.

2. A system as claimed in Claim 1 in which the input means comprise a keyboard.

3. A system as claimed in either of Claims 1 or 2 which includes means for producing a printed record of the calculated variable factors.

4. A system as claimed in any one of Claims 1 to 3 in which the record means includes a magnetic tape storage medium.

5. A system as claimed in any one of Claims 1 to 3 in which the record means includes a semiconductor storage medium.

6. A system as claimed in any one of the preceding claims in which the calculating means comprise data storage means arranged to receive the electrical signals and the further electrical signals, and a processor arranged to perform the required calculations.

7. A system as claimed in Claim 6 in which the calculating means includes further data storage means arranged to store the positions of a number of predetermined points, and a comparator operable to compare the position of each selected point with the positions of the predetermined points and to apply to the processor the position of a predetermined point if this lies within a defined distance of the selected point.

8. A data processing system for pre-planning the flight of an aircraft, substantially as herein described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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Sheet 1

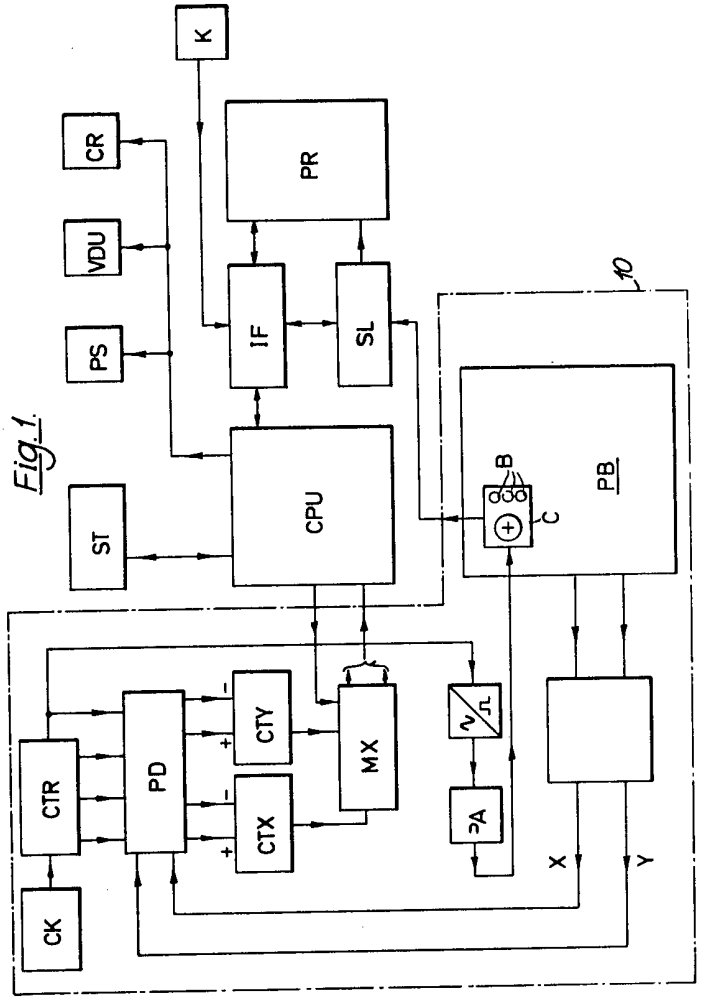

Fig.1.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

Fig.2.