

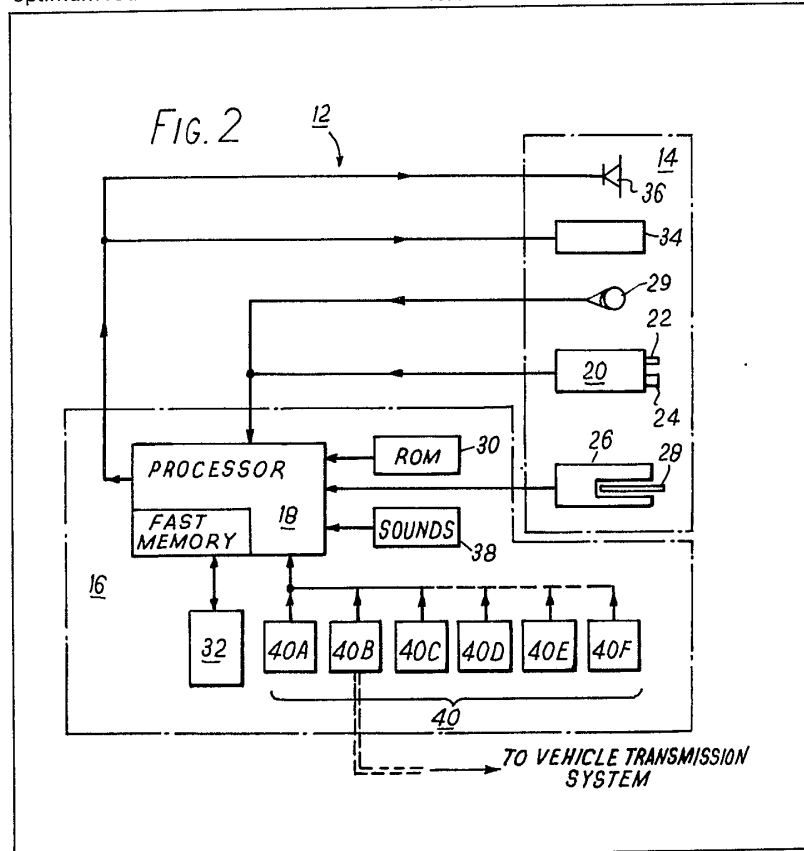
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(54) **Route selection and guidance apparatus and method**

(57) Route selection and guidance apparatus for a vehicle includes a digital data processor 18 controlled by programs stored in a ROM 30 to select an optimum route between driver-selected

journey starting and finishing positions, using driver-selected optimisation criteria. Map data is stored in a storage unit 32, entered manually or verbally by a driver-operable entry module 26. The selected route is stored in the storage unit 32, and serves to provide with an instruction during each route-stage, each instruction being announced to the driver when a vehicle-position feedback signal from a feedback device 40 corresponds with a position reference signal contained in the instruction. Additional signals may be included to cancel an announced instruction and replace it by the next when the position feedback signal corresponds to the additional reference signal.

Instructions are announced vocally 36 or visually 34. Position feedback signals are derived directly or indirectly from position feedback devices 40, which may give output signals dependent upon elapsed-time 40A, distance travelled 40B, or actual vehicle position 40C-40F.



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FIG. 1

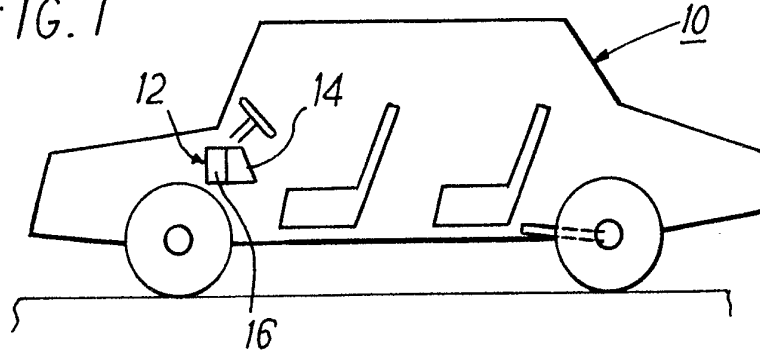
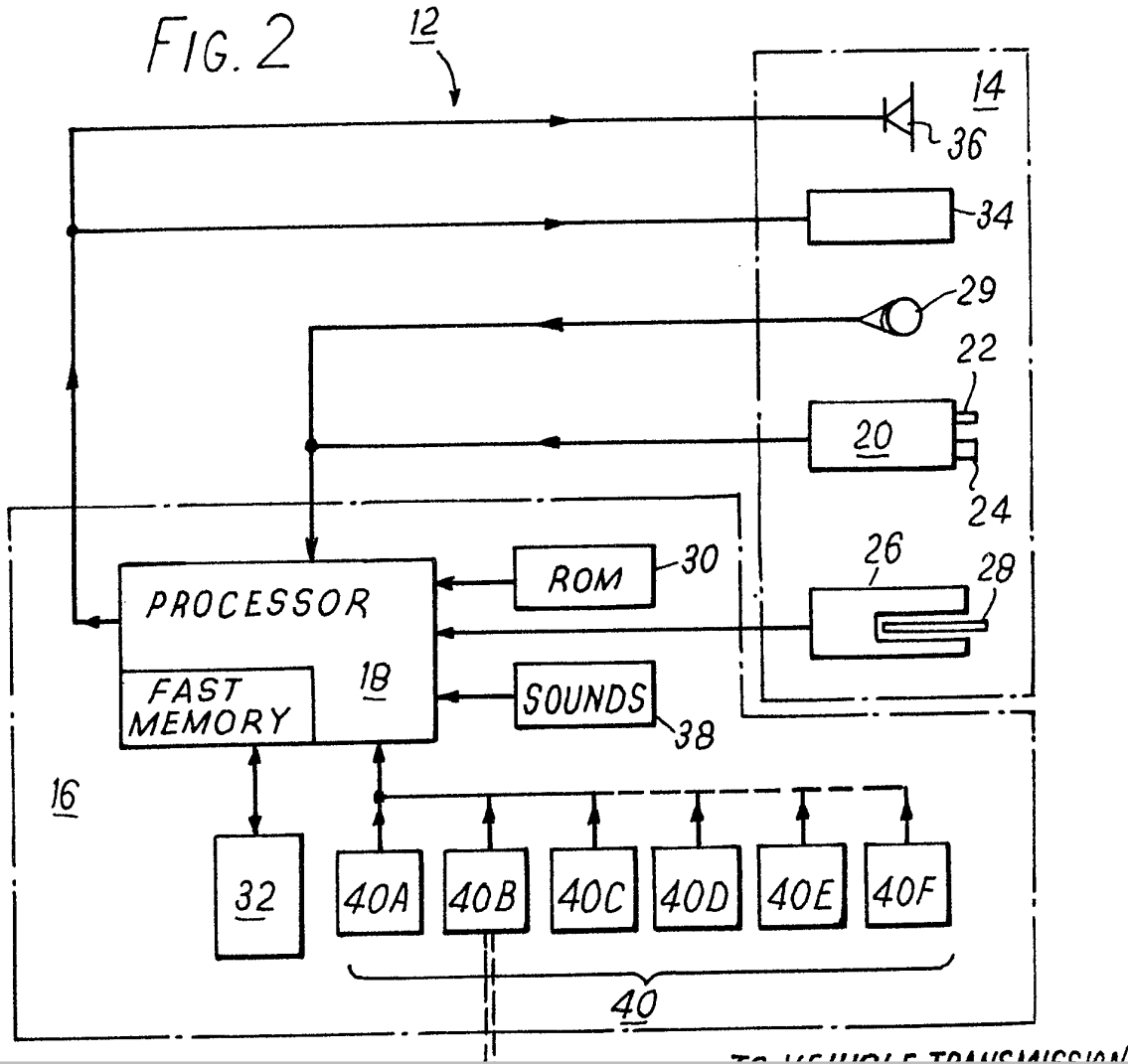


FIG. 2



SPECIFICATION

Route selection and guidance apparatus and method

- 5 This invention relates to an apparatus and method for providing a driver of a driver-controlled vehicle with information identifying successive sections of a route to be followed, so as to enable the vehicle to be driven from a selected starting point to a selected finishing point. In the specification the term "vehicle" is intended to cover any form of moving craft the route of which over land or sea, or in the air, is dependent on a driver or pilot action to direct the craft along successive sections of a selected route. 5
- 10 Though in the description that follows the invention will be described in relation to the driving of a land vehicle along roads, the invention may also be applied to the navigation of boats along waterways or across the open sea, and also to the piloting of an air-craft through the sky. 10
- It has been shown recently by transport planning authorities that in the United Kingdom the distance travelled by all vehicles in getting to their destinations is some 6 per cent greater than that which was actually necessary for the performance of the required journeys. Such an over-travel represents a loss to the United Kingdom economy of some 1500 million pounds. Hence, a means for enabling this over-travel to be reduced would be a substantial benefit to those who make the journeys, and to the UK economy. 15
- The basic source of route information for the modern road vehicle driver has been traditionally the printed map, and from that the driver (or some one acting for him) has determined, according to his own intuitive criteria, and his own personal assessment of factors such as road conditions and congestion, the route that he should follow in making any particular journey. 20
- Thus, the preliminaries to a road journey included the making of an analysis and an assessment of the possible alternative routes between the starting and finishing positions, and a selection of the route to be followed, and possibly the writing down of that route for subsequent reference during the journey. This involved some considerable time and effort, and for best results an up-to-date knowledge of the geography and traffic conditions prevailing on the various route sections shown on the map. 25
- For the private motorist, particularly, this problem of route selection has been aided by the professional motoring organisations, which have provided on request special printed route maps complete with accompanying written instructions for the guidance of the driver or navigator during the course of the journey. Unfortunately, such route maps and instructions usually required the making of a specific request some days before the intended departure on the journey, so that the relevant route could be selected and the relevant map sections and instructions compiled for despatch to the intending traveller. 30
- Furthermore, the following of such a set of route instructions required the driver or navigator to be ever attentive as to his exact position on the route map and instruction set, so that he could anticipate his arrival at the next mentioned cross-roads or turning. Moreover it was necessary for him to constantly memorize the next guidance instruction apertaining to the next route section. 35
- Though such special route maps and guidance instruction sets were of great benefit to the motorist, they had the disadvantage of involving another party in the selection and preparation of a route and also that once prepared the driver could not expeditiously or easily modify the map and guidance instruction set to deal with unforeseen conditions or events such as for example traffic diversions or adverse road conditions due for example to accidents or weather. 40
- According to a first aspect of the present invention there is provided in or for a vehicle (as hereinbefore defined), a route guidance apparatus comprising:-
- (a) *instruction producing means* for producing in sequence from a pre-planned route individual route-stage instructions each defining an action to be taken by a driver of a vehicle at the end of an associated route-stage, each such instruction including a reference signal representing the intended vehicle position at the point along the associated route-stage at which the instruction should be announced to the driver for subsequent action by him; 45
- (b) *feedback signal producing means* for producing feed back signals representative of the progress of the vehicle along the route-stage, each such feedback signal being representative directly or indirectly of the position of the vehicle on said route-stage; 50
- (c) *instruction announcing means* for announcing to the driver, on its being activated, a said instruction represented by output signals of the instruction producing means;
- (d) *signal comparison means* for comparing during each said route-stage said reference and feedback signals and for activating said instruction announcing means when said reference and feedback signals correspond, thereby to announce to the driver the instruction associated with the said reference signal, and 55
- (e) activating means for activating said instruction producing means thereby to cause it to produce the next route-stage instruction in the sequence in place of a current one.
- Said activating means may be driver-operable; though in a preferred apparatus each route-stage instruction produced by said instruction producing means also includes an additional reference signal which represents the intended vehicle position at the end of the associated route-stage, at which position the driver should act on that instruction; and there is included comparison means for comparing during each route-stage said feedback and additional reference signals and for stimulating said activating means when 60

In one form of guidance apparatus according to the present invention said instruction producing means is arranged to store a plurality of sets of route-stage instructions for enabling a driver to be guided along various routes respectively; and said instruction producing means includes driver-operable route selection means for enabling a driver to select from said various routes a specific one along which he wishes to be guided, said instruction producing means being operative on selection of route to produce in sequence and as required by said activating means the successive route-stage instructions appertaining to the selected route.

Advantageously said route selection means includes driver-operable selection means for identifying the starting and finishing positions of a journey for which guidance is required, and means for automatically selecting from said plurality of sets of route-stage instructions the set having the driver-identified starting and finishing positions, thereby to cause the desired set of route-stage instructions to be produced in sequence and as required by said activating means.

In a preferred form of guidance apparatus according to the present invention said instruction producing means includes

a route compiling means for compiling each said pre-planned route on being required by a driver, and a driver-operable journey selection means for identifying the starting and finishing positions of a journey for which guidance is required; and

said route compiling means includes -

- (a) a data processing means,
- (b) a map data storage means for storing map data defining and describing the respective road sections of a road system on a predetermined map section, each such road section being a length of road lying between adjacent points at which an approaching driver has different courses of action open to him,
- (c) a program storage means for storing programs for controlling the operation of the data processing means, and for causing it to carry out, on request and according to a predetermined optimization criterion, a route evaluation and selection process to determine an optimum route between the driver-identified journey starting and finishing positions on the said map section, and means for storing that optimum route and announcing route-stage instructions appertaining to it in sequence as required by said activating means.

Preferably, said program storage means has stored within it alternative programs, or program modifiers, for enabling the data processing means to carry out on request route evaluation and selection processes according to any one of a plurality of different optimization criteria, and there is provided driver-operable optimization criterion selection means for selecting for a particular journey to be undertaken the particular optimization criterion or criteria to be used.

Conveniently, said data processing means is also arranged to carry out the functions of the respective comparison means for comparing on the one hand said feedback and reference signals, and on the other hand said feedback and additional reference signals.

Said map data storage means may have associated therewith map data entry means for receiving removable map data storage elements, whereby data appertaining to any desired area of a map may be entered into said map data storage means for use temporarily by said data processing means.

Vocal input means for receiving a driver's spoken input information identifying a journey to be undertaken may be provided, and said data processing means may then be arranged to decode that vocal input information and to act upon it in selecting a route for a journey to be undertaken by the driver.

Preferably, said instruction announcing means is arranged to announce each said route-stage instruction in vocal form, and said data processing means is arranged to produce and/or control signals for vocalizing said instructions.

Said instruction announcing means may be arranged to announce each route-stage instruction in visual form.

Said feedback signal producing means may take any one of a plurality of different forms; for example, an elapsed-time measuring means arranged to be carried by the vehicle and to be activated by said activating means, and to deliver an output vehicle-position-indicating signal dependent on the time that has elapsed since last being activated; or alternatively a distance measuring means arranged to be driven by the vehicle and to be activated by said activating means, and to deliver an output vehicle-position-indicating signal dependent on the distance travelled by the vehicle along the route-stage since last being activated; or alternatively an inertial-guidance position determining means arranged to be carried by said vehicle and to compute from vehicle motion the position of the vehicle, and to provide an output vehicle-position-indicating signal dependent on said position for comparison with position indicating signals constituted by said reference and/or said additional reference signals incorporated in said route-stage instructions; or otherwise a vehicle position determining means arranged to be carried by said vehicle and to compute, from bearings of objects disposed externally of the vehicle on or around the earth's surface, the position of the vehicle, and to provide an output vehicle-position-indicating signal for comparison with position-indicating signals constituted by said reference and/or said additional reference signals incorporated in said route-storage instructions.

Preferably, each said route-stage instruction is represented in electrical signal form, and said reference, additional reference, and feedback signals comprise electrical signals.

- (a) generating and storing for said route a sequence of individual route-stage instructions each defining an action to be taken by the driver at the end of the associated route-stage, and each including a reference signal representing the intended vehicle position at the point along the associated route-stage at which the instruction should be announced to the driver for subsequent action by him;
- 5 (b) extracting a said instruction that is associated with a first route-stage and holding it ready for announcement to the driver; 5
- (c) generating a feedback signal representative of the progress or position of the vehicle along the route-stage;
- (d) comparing said reference and feedback signals,
- 10 (e) announcing the extracted instruction to the driver when said reference and feedback signals correspond; 10
- (f) indicating when the vehicle has passed into the next route-stage; and
- (g) repeating cyclically in turn the steps (b) to (f) above for the second and subsequent instructions in the sequence.
- 15 Each said route-stage instruction generated in said step (a) above may also include an additional reference signal representing the intended vehicle position at the end of the associated route-stage, at which position the driver should act upon that instruction; and 15
- the step (f) above may then comprise comparing said feedback and additional reference signals and indicating when said feedback and additional reference signals correspond that the vehicle has passed into the next route-stage. 20
- Such methods may also include the preliminary step of -
- specifying the starting and finishing positions of a journey for which guidance is required, and the criterion or criteria to be used in selecting an optimum route between those positions, and
- 25 in the said step (a) said sequence of instructions is obtained by generating from stored map data defining and describing the respective road sections of a road system (each such section being a length of road lying between adjacent points at which an approaching driver has different courses of action open to him) the optimum route between the specified starting and finishing positions and based on the specified optimization criterion or criteria, and storing the route-stage instructions for the successive route-stages making up that optimum route. 25
- 30 Other features and advantages of the present invention will appear from the description that follows hereafter, and from the claims appended at the end of that description. 30
- One embodiment of the present invention for providing route selection and driver guidance instructions in or for a road vehicle will now be described by way of example and with reference to the accompanying diagrammatic drawings, in which:-
- 35 *Figure 1* shows in outline a motor car in which a route selection and driver guidance system according to the present invention is installed; and 35
- Figure 2* shows schematically the various components of that system, and the manner of their interconnection.
- Referring now to the drawings, a motor car 10 has installed in it a route selection and driver guidance system 12, which includes a drivers' console 14 fitted in a forward position convenient for a driver to operate, observe and hear, and an associated equipment module 16 which is mounted preferably alongside the console, though if required its constituent components could be mounted elsewhere in or around the car. 40
- The system 12 is shown in more detail in *Figure 2*, from which it will be seen to include a digital data processor 18 which is connected to receive input information concerning a route to be determined from
- 45 (a) a driver's function control and data entry module 20 having "function control" push-buttons 22, and "data entry" keys 24, 45
- (b) a "map data" input module 26 for receiving a magnetic storage element 28 (for example a tape or disc) carrying data defining, describing and qualifying each and all of the road sections (i.e. lengths of road between pairs of adjacent road intersections) included in a particular map section of the United Kingdom road system, and 50
- (c) a driver's microphone 29 for inputting a driver's vocal instructions. 50
- Associated with the data processor 18 is a read-only, random-access, memory ("ROM"), in which is stored the operating programs for controlling the operations of the process, and various programs (and program modifiers) for use in the processor for determining alternative routes between driver-specified starting and finishing positions, according to any one or more of a variety of selected overriding criteria, e.g. shortest distance, minimum running time, best fuel consumption, avoidance of urban roads or motorways. 55
- Also associated with the processor 18 is a data storage unit 32 (preferably of the random-access kind) for storing data inputted to it via the processor 18 by the map data input module 26.
- The output of the processor 18 is transmitted to a driver's visual display unit 34 for providing visual guidance instructions, and/or to a driver's loudspeaker (or earphone) 36 for providing vocal guidance instructions. A vocabulary of sound producing signals (representing various basic phrases, words and syllables) is stored in a sound vocabulary unit 38 for use at appropriate times by the processor in formulating vocal guidance instructions for transmission over the loudspeaker. 60

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