MICROPROCESSOR-BASED NAVIGATIONAL AID SYSTEM WITH EXTERNAL ELECTRONIC CORRECTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a navigational aid system and, more particularly, to a navigational aid system for a vessel which periodically corrects positional information stored in an addressable peripheral memory device of a microprocessor with satellite provided electronic positional information at predetermined intervals of distance traveled by the vessel such that current set and drift can be electronically determined onboard.

2. Discussion of the Related Art

U.S. Pat. No. 4,340,936 to Mounce discloses a navigational aid system for the navigation of a vessel. The Mounce system receives information from a number of sensors, and then processes the information by a microprocessor in order to operate a display that indicates various quantities germane to the operation of the vessel. The specific information inputs from the sensors are wind direction, wind speed, heading (as determined by a compass), hull speed (the velocity of the vessel through the water), and leeway angle (the angle between the direction of motion and the center line of the vessel).

The Mounce system also requires the manual input of certain data into the random access memory (RAM) of a microprocessor, and particularly the current set and drift in the portion of the body of water in which the vessel is to navigate, and the course and distance to a destination. The microprocessor uses the inputs to provide running information to aid in the operation of the vessel. It has been found that accurate information pertaining to current set and drift is difficult to obtain, however, because it changes with time and the location of the vessel. Fortunately, electronic systems are now available that provide highly accurate electronic positional information. A microprocessor aboard a vessel that utilizes such electronic information would eliminate the need for inserting the current set and drift manually. Thus, there exists a need for a self-sufficient navigational aid system that may be placed aboard a vessel and is capable of receiving and using external electronic positional information to determine current set and drift, thereby eliminating any need to manually input the same information. Such a resulting self-sufficient navigational aid system would constitute an improvement over the Mounce system.

Any navigational system which determines vessel position by a summation of continuously taken data is subject to accumulated errors. Consequently, the accuracy of the position of the vessel determined by such a navigational system deteriorates with time and distance from its starting position. The recently developed electronic systems provide absolute position to a high degree of accuracy and enable the periodic correction of the generally inaccurate position determined by the summation process.

To satisfactorily accomplish the determination of current set and drift and position correction, the electronic positional information system must provide: (1) position information of the highest possible accuracy; (2) a means for transferring that position information to the RAM of a microprocessor aboard a vessel; and (3) a rate of response that is compatible with the rate at which information is available so that a display aboard a vessel can adequately indicate the rate of change of the physical quantities.

The first electronic position information system that offered worldwide coverage is known today as Omega. Omega uses a number of very low frequency transmitters, located at various positions on the globe, that emit transmissions capable of being received practically anywhere on earth. The Omega system uses very precise timing to determine the difference in distance between two or more transmitters and the point of reception, and uses that distance to determine a fix. However, the Omega system as presently available is cumbersome and of insufficient accuracy to be used as a source of positional information for the purposes of this invention.

A second system known as LORAN is also presently in wide use. LORAN operates in a manner similar to Omega, but on a vastly smaller scale. Particularly, radio transmitters are precisely located, usually along a coast line, and their transmissions are accurately synchronized such that by measuring the phase difference of the signals from two or more transmitters, a position fix can be determined. Present LORAN receivers, under ideal conditions, are capable of providing the type of information required by the microprocessor navigation system of this invention. However, the accuracy of position fixing is highly variable and depends on the arrangement of the transmitters and their distances from the point of reception. Furthermore, LORAN is not available worldwide. Accordingly, the LORAN system is also inadequate for the purposes of this invention.

There are presently three known systems utilizing satellites that provide electronic positional information. The first system is known as Satnav and is already becoming obsolete. The Satnav system will eventually be replaced by another system known as the Global Positioning System (GPS) which will provide worldwide coverage when a full complement of satellites is finally in orbit. A somewhat similar system is being implemented by Russia. The GPS is the preferred system for use in this invention. Even though the full complement of satellites is not yet operational, worldwide coverage is available, although for less than 24 hours per day. Furthermore, GPS receivers are available at a moderate cost and provide information readily utilized by a microprocessor-based navigation system.

GPS receivers are available that provide combined numeric and alpha readouts of some of the quantities provided by the microprocessor-based system of this invention. But, the only actual measurement performed by the GPS receiver results in the determination of present position, which must be compared to a past position in order to calculate quantities such as speed and heading which can be read out. In other words, the determination of any information other than present position by the GPS is obtained indirectly by calculation using additional positional data, in contrast to the known microprocessor-based system which receives that same information directly from onboard sensors.

The proper navigation of a vessel, and especially a sailing vessel, requires a knowledge of: (1) the actual speed and direction in which the vessel is moving relative to the bottom; (2) the direction the vessel should move in to sail directly to a destination; and (3) the wind direction and speed.

The actual speed and direction in which the vessel is moving relative to the bottom in turn depend on the