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Colley

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[54] **DIRECTIONAL STEERING AND NAVIGATION INDICATOR**

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[51] **Int. Cl.⁶** G06G 7/78; G08G 1/123
[52] **U.S. Cl.** **364/449.1**; 364/444.1; 364/447; 364/460; 340/990; 340/994; 342/357
[58] **Field of Search** 364/424.01, 444, 364/449, 452, 458, 447, 460, 424.02; 342/357, 358, 457; 840/988, 989, 992, 994, 995, 425.5; 815.55, 815.78

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,281,326	7/1981	Anderson	342/41
4,466,068	8/1984	Degré et al.	364/461
4,590,569	5/1986	Rogoff et al.	364/452
4,623,966	11/1986	O'Sullivan	364/461
4,692,869	9/1987	King et al.	364/448
4,893,127	1/1990	Clark et al.	342/386
5,179,385	1/1993	O'Loughlin	342/176
5,268,844	12/1993	Carver et al.	364/443

OTHER PUBLICATIONS

Fix et al., "Advance Reference System Cockpit Display Project", IEEE 1990, pp. 338–342.
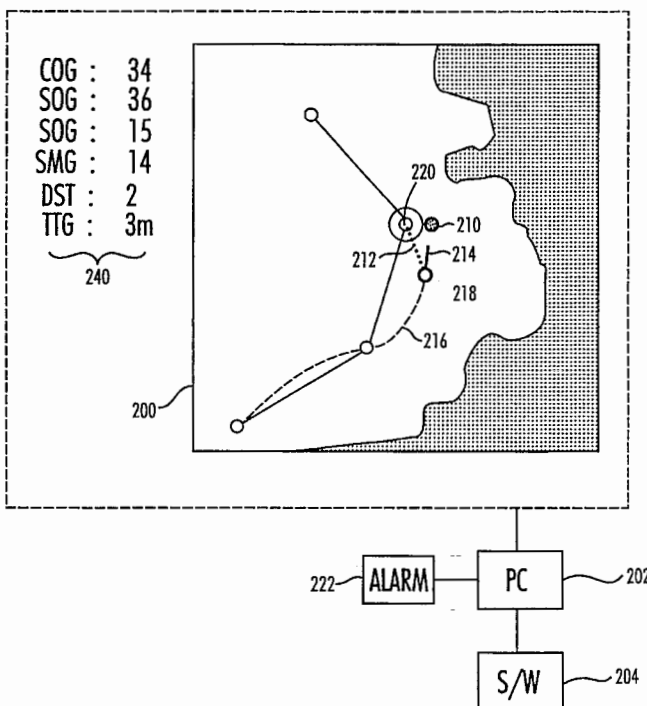Ranson, "Navigating Between Computer Displays in Power Plants" IEEE 1993, pp. 273–277.

Rogoff, "Electronic Charts as the Basis for Integrated Marine Navigation", IEEE 1992, pp. 256–260.

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[57] **ABSTRACT**

A navigation and guidance system which directs a user toward a desired destination. Position and steering information are integrated into a single display to allow the user to immediately determine whether the correct course is being traveled, and to inform the use of any directional changes which may be necessary to be directed toward the desired destination waypoint. The user's position and course are determined by a navigation system and indicated on the display as a directional pointing icon, such as a line or arrow. The destination is displayed as a point. The user's Point of Closest Approach (PCA) can then be calculated according to current position, course, and the position of the desired destination. As the use's course gets closer to the bearing of the destination waypoint the PCA indicator can correspondingly shift with the user's movements. By superimposing the PCA over the destination waypoint, the user may precisely steer his or her craft to the desired destination.
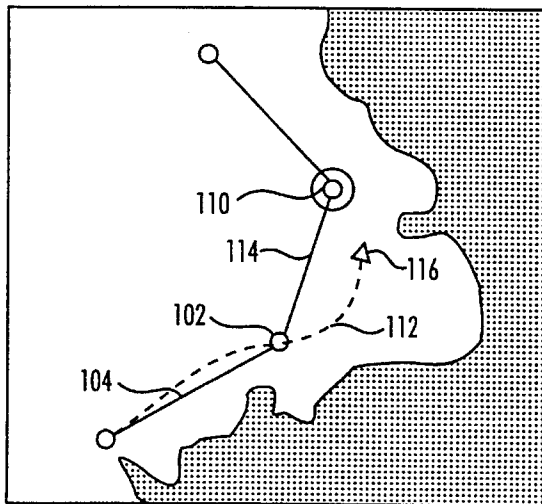
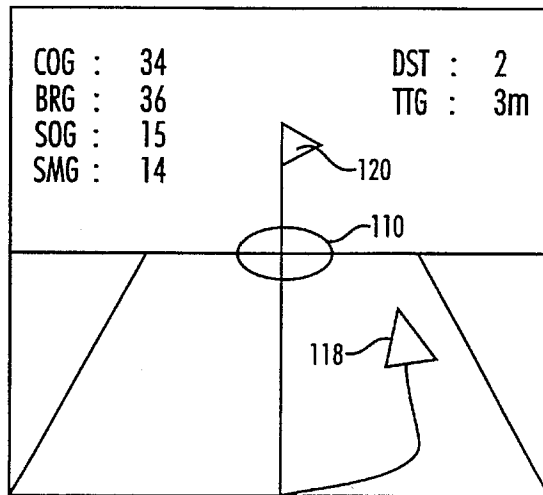**17 Claims, 3 Drawing Sheets**

FIG. 1a
PRIOR ART

COG :	34	DST :	2
BRG :	36	TTG :	3m
SOG :	15		
SMG :	14		

FIG. 1b
PRIOR ART

COG : 34
SOG : 36
SOG : 15
SMG : 14
DST : 2
TTG : 3m

240

220
210
212
214
218
216
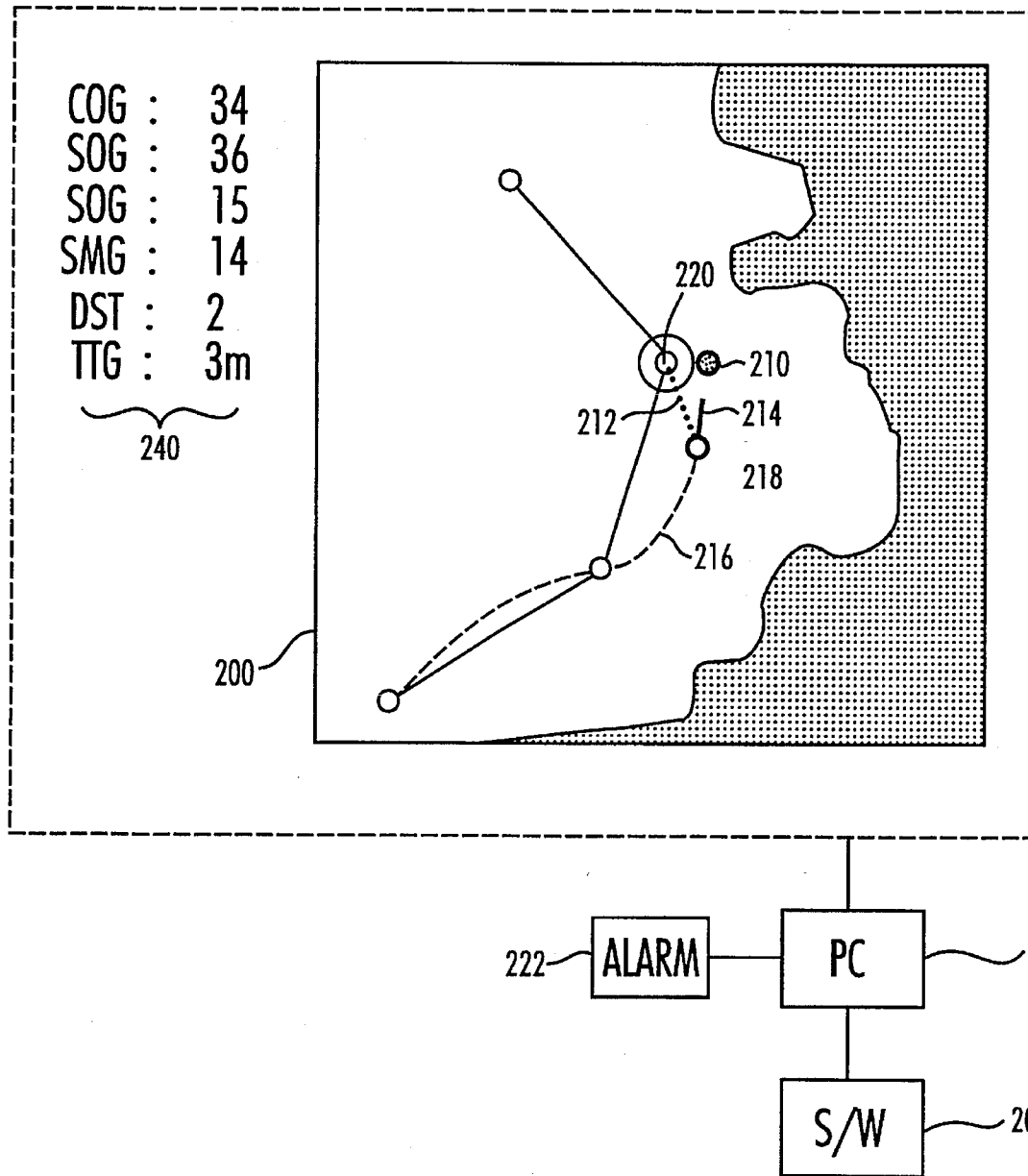200

222 — ALARM   PC ~ 202
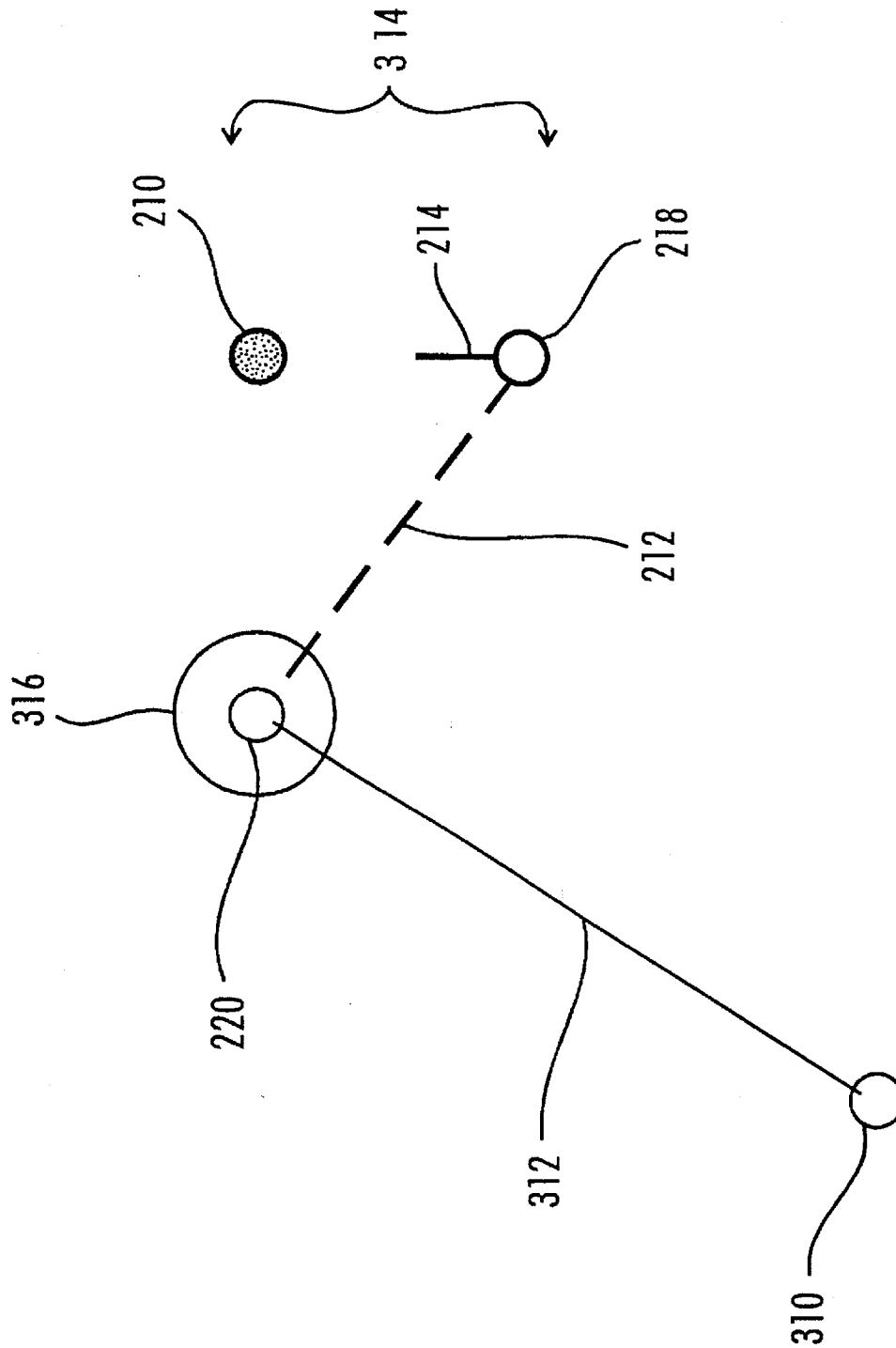
S/W ~ 204

FIG. 2

FIG. 3

DIRECTIONAL STEERING AND NAVIGATION INDICATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to navigation and steering schemes for use in marine, land, and air directional control. More particularly, the present invention relates to the display and expression of position and navigation information in a simple and direct format for immediate identification of the user's present location relative to a desired location.

2. Description of Related Art ·

Advances in data storage and display technologies have made electronic charts a necessary means to efficiently and accurately assist users in determining their positions relative to a desired destination. For example, when electronic charts are integrated with a positioning system such as the global positioning system (GPS), the user's position can be displayed in real time on a chart depicting the user's area. Such information is particularly useful for operators of marine, land, and air vehicles who continuously need to know of their positions around the earth. However, simply knowing one's position on a chart is generally not sufficient. It is also particularly helpful to know whether the present course of direction is correct. That is, users typically need to know if their present course will take them where they want to go. The desired destination could be the next waypoint on the route or some other location on the chart.

Current commercially available electronic chart display implementations typically indicate relevant geographic features, routes and waypoints, the user's position, and the user's track. However, such displays do not include integrated steering information informing the user whether (1) the user's current course is properly directing the user towed the desired destination, and (2) any course corrections are needed to ensure the user arrives at this destination. Rather, in conventional chart display schemes, a separate display medium must be implemented. However, to review the additional course information, the user must switch between a position display and a steering correction display for a complete understanding of the total navigation situation.

For example, FIG. 1(*a*) shows the current implementation in most commercial systems. A desired route with dotted waypoints **102** is indicated by the straight lines **104** which comprise the intended track **114**. The destination waypoint is shown as a circled dot **110**, and the dotted line **112** indicates the user's actual track. In the example, the arrow **116** at the top end of the dotted line **112** shows the user's position and current heading. However, to retrieve steering data and correction information, the user must refer to FIG. 1(*b*). FIG. 1(*b*) represents a steering screen which is used to correct a current route and, thus, to enable users to steer themselves toward a desired destination waypoint. That is, the object of the steering screen is to point the illustrated arrow **118** toward the flag **120**. When the arrow **118** points at the flag **120**, the course-over-ground indication (COG) will match the bearing indication (BRG).

However, to reach the point where the user is traveling toward the destination waypoint, numerous attempts at directing and redirecting the arrow toward the flag may be required. Consequently, however, the user must switch back and forth from screen-to-screen to determine if the track is correct according to the graphical as well as numerical representation. Because there are no visual or graphical cues

to indicate whether the user is successfully steering toward the desired path, immediate course correction is difficult.

SUMMARY OF THE INVENTION

The present invention is directed to a navigation and guidance system which directs a user toward a desired destination. Position and steering information are integrated into a single display to allow the user to immediately determine whether the correct course is being traveled, and to inform the user of any directional changes which may be necessary to be directed toward the desired destination. The desired destination is displayed on an electronic charting system by a destination waypoint. Several segment waypoints define an optimum route to reach the destination waypoint. Accordingly, the desired destination is represented by a destination waypoint.

The actual track of the user is displayed relative to the segment waypoints such that the user's actual track is superimposed over the optimum route. The user's position and COG are determined by the navigation system and indicated on the display as a directional pointing icon, such as a line or arrow. The user's Point of Closest Approach (PCA) can then be calculated according to several functions: 1) the user's current position; 2) the position of the desired destination; and (3) the user's COG. The PCA is indicated at or near the end of the user's actual pointing icon so that as the user's course gets closer to the destination waypoint bearing, the PCA pointer can correspondingly shift with the user's movements.

Ultimately, the user may precisely direct his or her craft to the destination waypoint by simply overlaying the PCA pointer over the destination waypoint and maintaining that particular course. The overlaid icons represent the directional information relating to the course-over-ground and bearing information. When the two icons are overlaid, the COG will match the bearing to destination value. That is, when the user's actual location coordinates superimpose those of the destination waypoint, such that the icon representing the user or the user's craft is displayed over that of the destination waypoint, it can be determined that the user has arrived at the desired destination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1(*a*) and 1(*b*) show a conventional charting display scheme in which two display screens depict graphical and numerical positioning and correction information.

FIG. **2** is a schematic view of an integrated steering indicator display in accordance with a preferred embodiment of the present invention.

FIG. **3** is an enlarged view of the steering indicator of FIG. **2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following description is of the best presently contemplated mode of carrying out the invention. In the accompanying drawings, like numerals designate like parts in the several figures. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the accompanying claims.

Embodiments of the present invention utilize data retrieved from a variety of navigation systems, such as the global positioning system (GPS), LORAN, inertial naviga-

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