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# United States Patent [19]

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Bruno et al.

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[54] **POSITION ENHANCED COMMUNICATION SYSTEM INCLUDING SYSTEM FOR EMBEDDING CDMA NAVIGATION BEACONS UNDER THE COMMUNICATIONS SIGNALS OF A WIRELESS COMMUNICATION SYSTEM**

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[51] **Int. Cl.<sup>6</sup>** ..... H04B 15/00; H04K 1/00;  
H04L 27/30

[52] **U.S. Cl.** ..... 375/200; 375/206; 370/335;  
370/527; 379/63; 455/38.3

[58] **Field of Search** ..... 375/200, 205,  
375/206; 370/110.4; 379/59, 63; 342/57,  
88; 455/33.1, 38.3, 54.1, 56.1

## [57] ABSTRACT

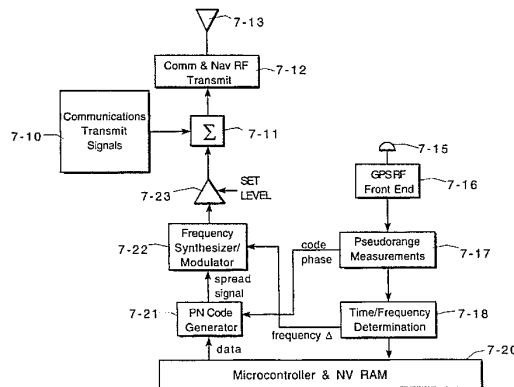
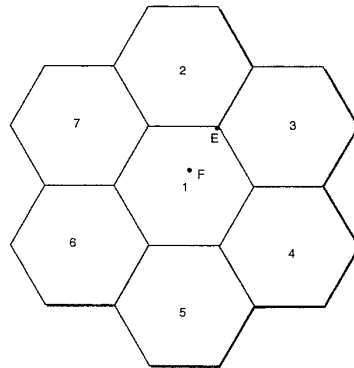
A cellular telephone system having three or more cell sites with each cell site having a source of cellular communication signals and an RF transmitter and antenna for broadcasting the cellular communication signals. A direct sequence spread spectrum waveform carrying navigation signals is embedded in the cellular communication signals, including controlling the signal strength of the navigation signals so that the combined energy of the navigation signals from all cell sites at any location is at least a predetermined energy level below the energy level of the cellular communication signals. Each cell site includes timing for the operation of a GPS receiver. An RF signpost system comprising a plurality of low powered RF broadcast stations, one each at a plurality of scattered geographic locations, each low powered RF broadcast station broadcasting a direct sequence spread spectrum digital RF waveform and a modulator to modulate the digital RF waveform with location information identifying the geographic locations, respectively.

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8 Claims, 11 Drawing Sheets



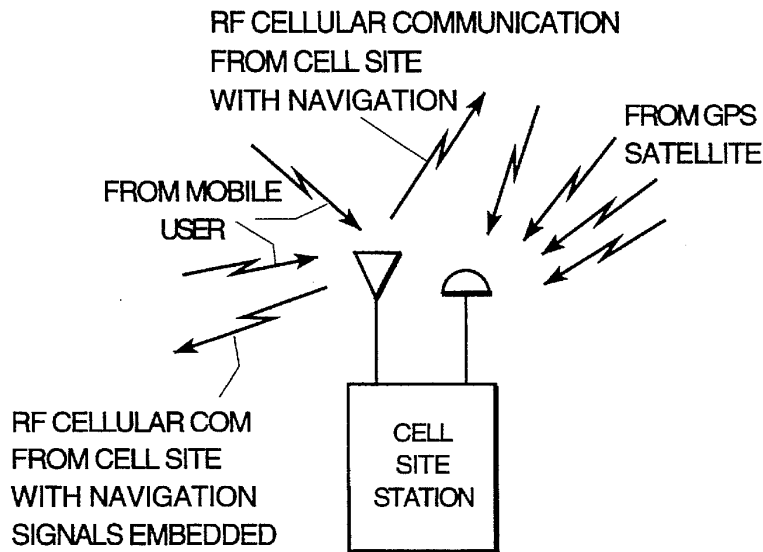


FIG. 1

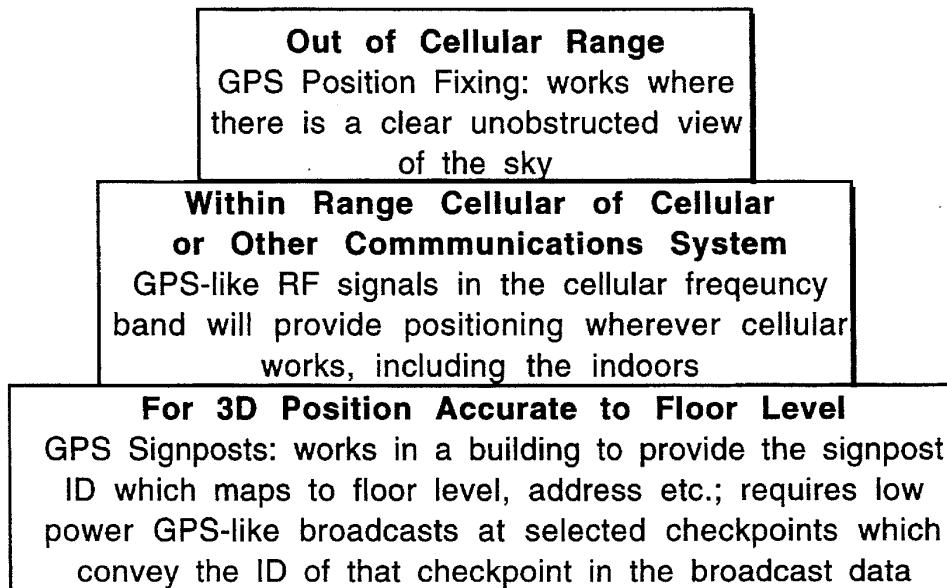


FIG. 2

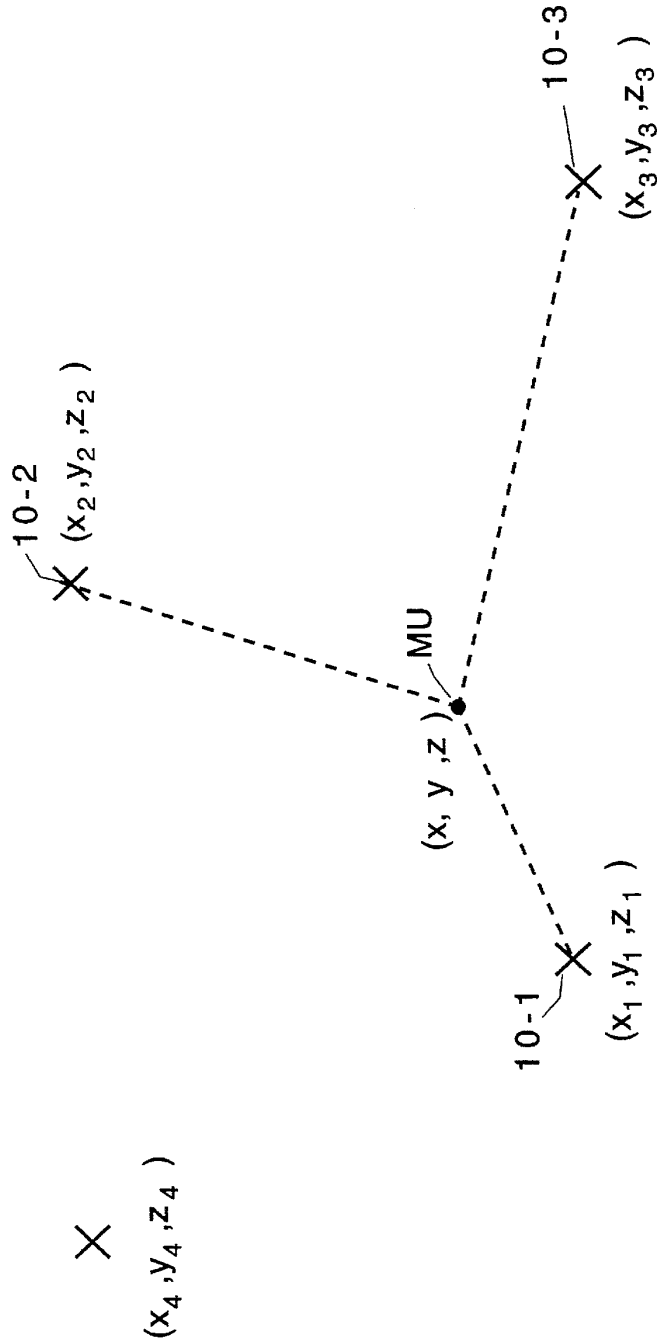
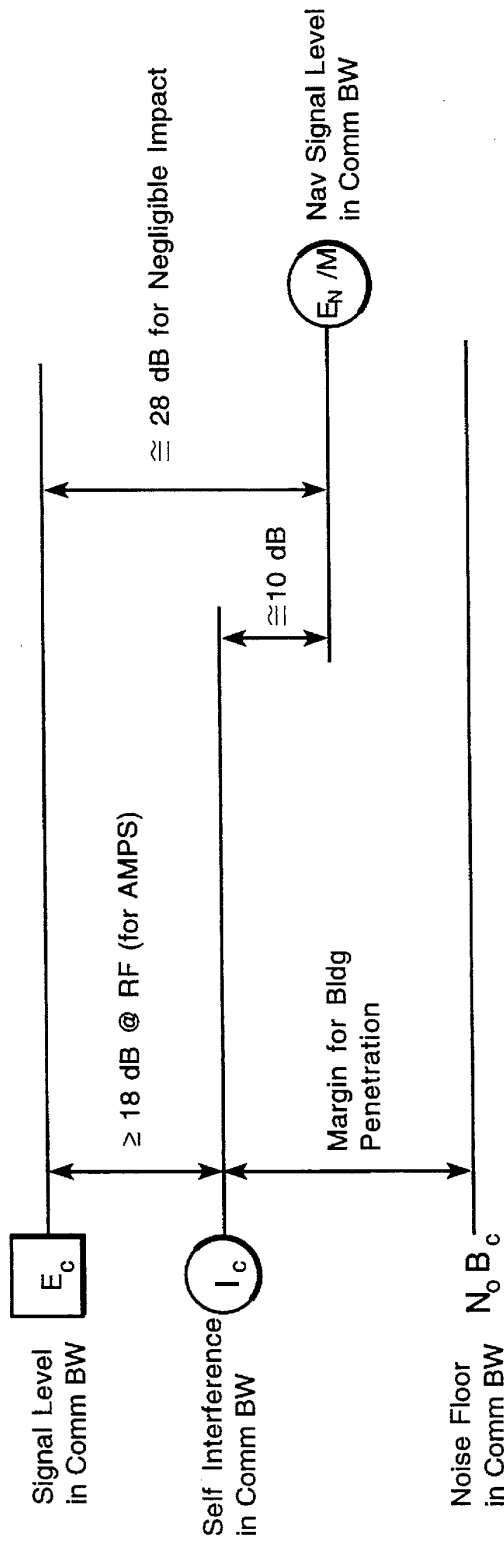


FIGURE 3

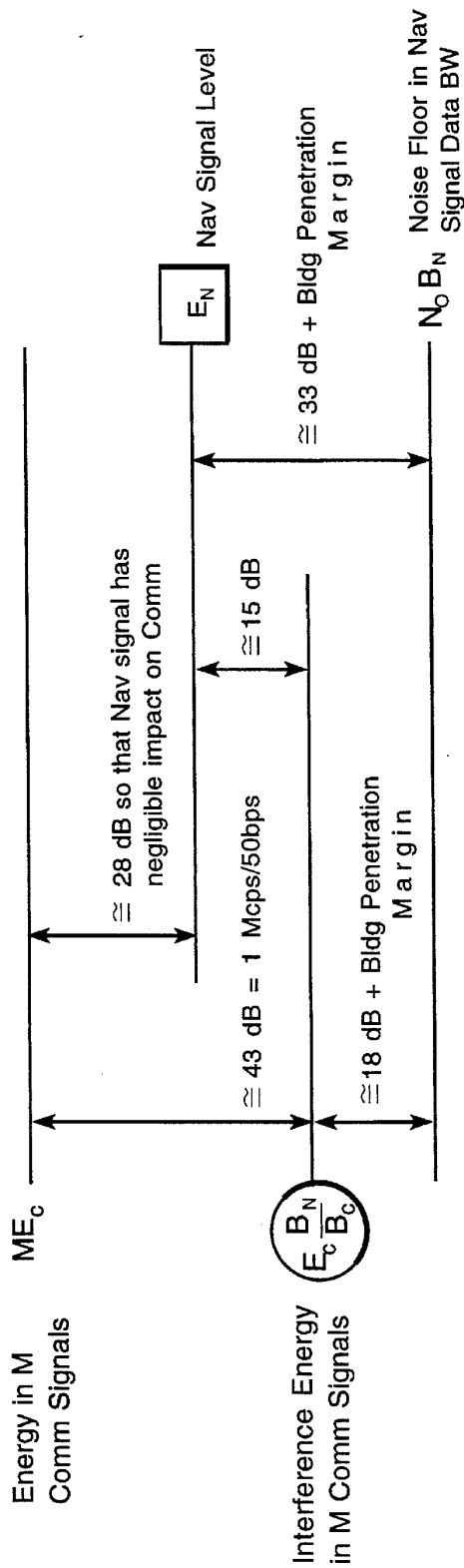
Assumption: Comm and Nav Signals are Broadcast from the Same Location



Note: Signals are enclosed in  $\square$ ; Interferers are enclosed in  $\circ$

FIGURE 4A

Assumption: Comm and Nav Signals are Broadcast from the Same Location



Note: Signals are enclosed in ; Interferers are enclosed in

FIGURE 4B

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