



- [54] **PORTABLE HYBRID LOCATION DETERMINATION SYSTEM**
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- [73] Assignee: **Trimble Navigation Limited**, Sunnyvale, Calif.
- [21] Appl. No.: **08/806,549**
- [22] Filed: **Feb. 25, 1997**

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Related U.S. Application Data

- [63] Continuation of application No. 08/191,984, Feb. 4, 1994, abandoned.
- [51] Int. Cl.<sup>6</sup> ..... **G01S 5/02; G01S 3/02**
- [52] U.S. Cl. .... **342/357; 342/463; 342/457**
- [58] Field of Search ..... 342/357, 457, 342/463, 464, 465

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[57] **ABSTRACT**

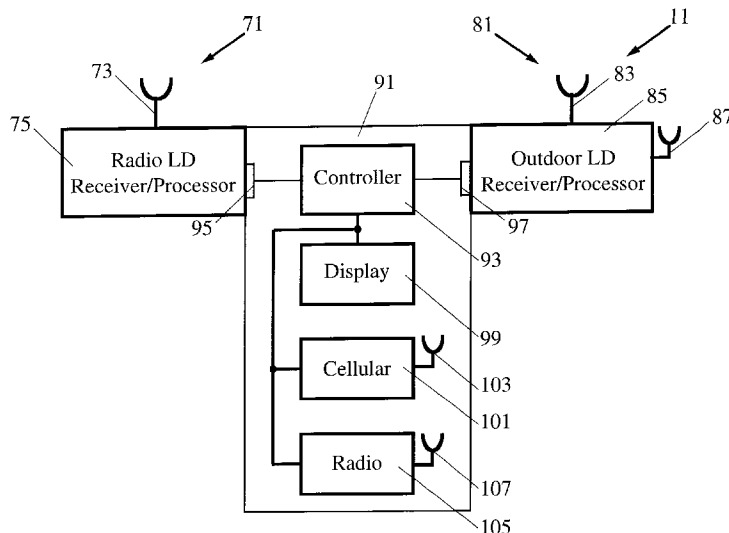
Apparatus and method for determining the present location of a mobile user that carries the apparatus inside or outside buildings and structures within a region R. The apparatus includes a radio location determination (LD) signal module that receives radiowaves from at least three radio LD signal sources, such as FM carrier or subcarrier signals, and an outdoor LD signal module that receives outdoor LD signals from at three other satellite-based or ground-based outdoor LD signal sources, such as GPS, GLONASS or Loran-C signal sources. The radio LD signals and outdoor LD signals are used to (1) determine the location of the radio LD module, (2) determine the location of the outdoor LD module and (3) determine an indicium representing signal strength or signal quality for the radio LD signals and for the outdoor LD signals. The radio LD signal indicium and the outdoor LD signal indicium are compared with threshold values for these indicia, and at most one of the radio LD module location and the outdoor LD module location is selected as the present location of the apparatus user. The radio LD module and the outdoor LD module can be combined in a hybrid portable LD system, or the two modules can be separated from and move independently of each other.

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18 Claims, 8 Drawing Sheets



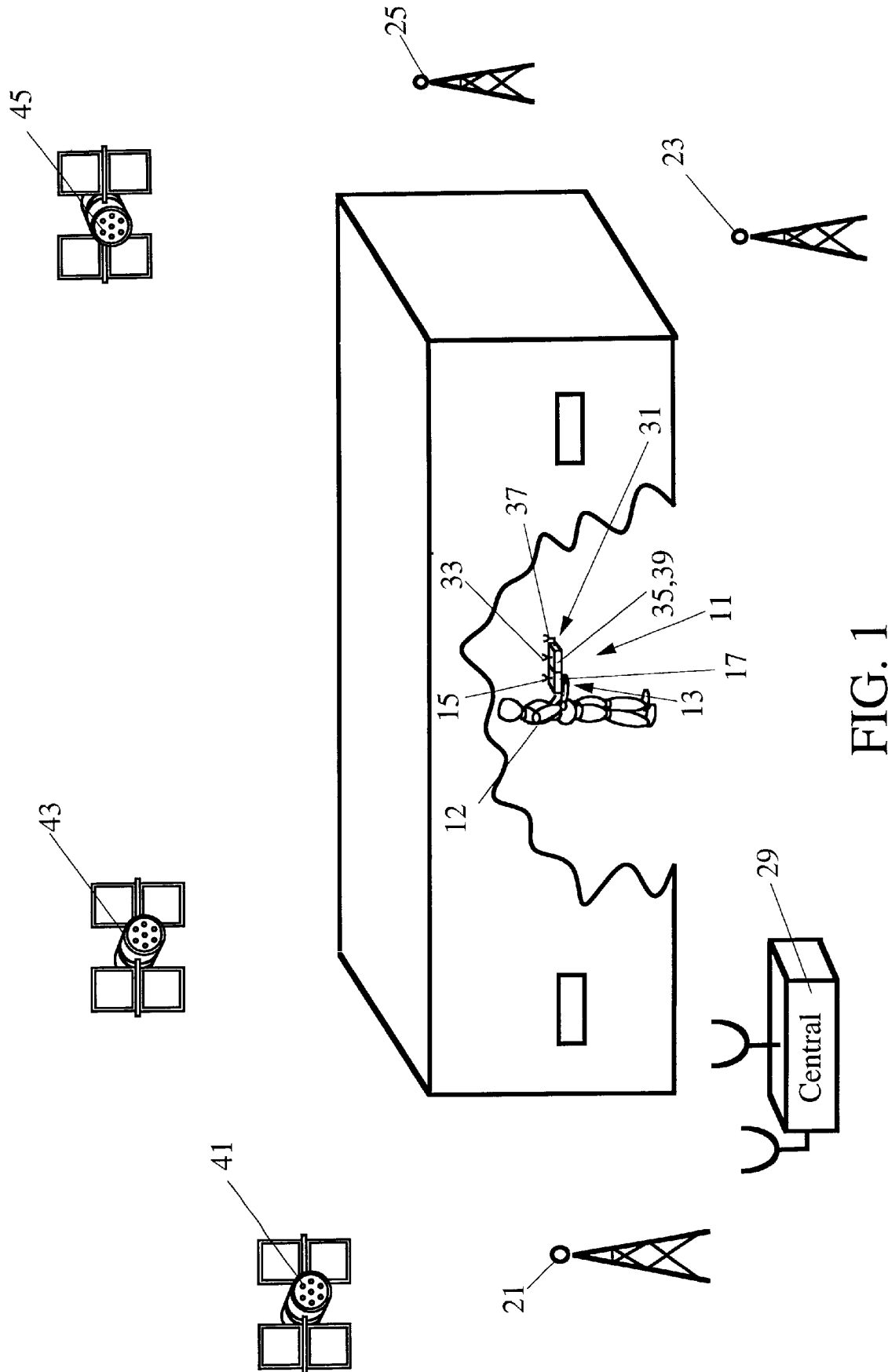


FIG. 1

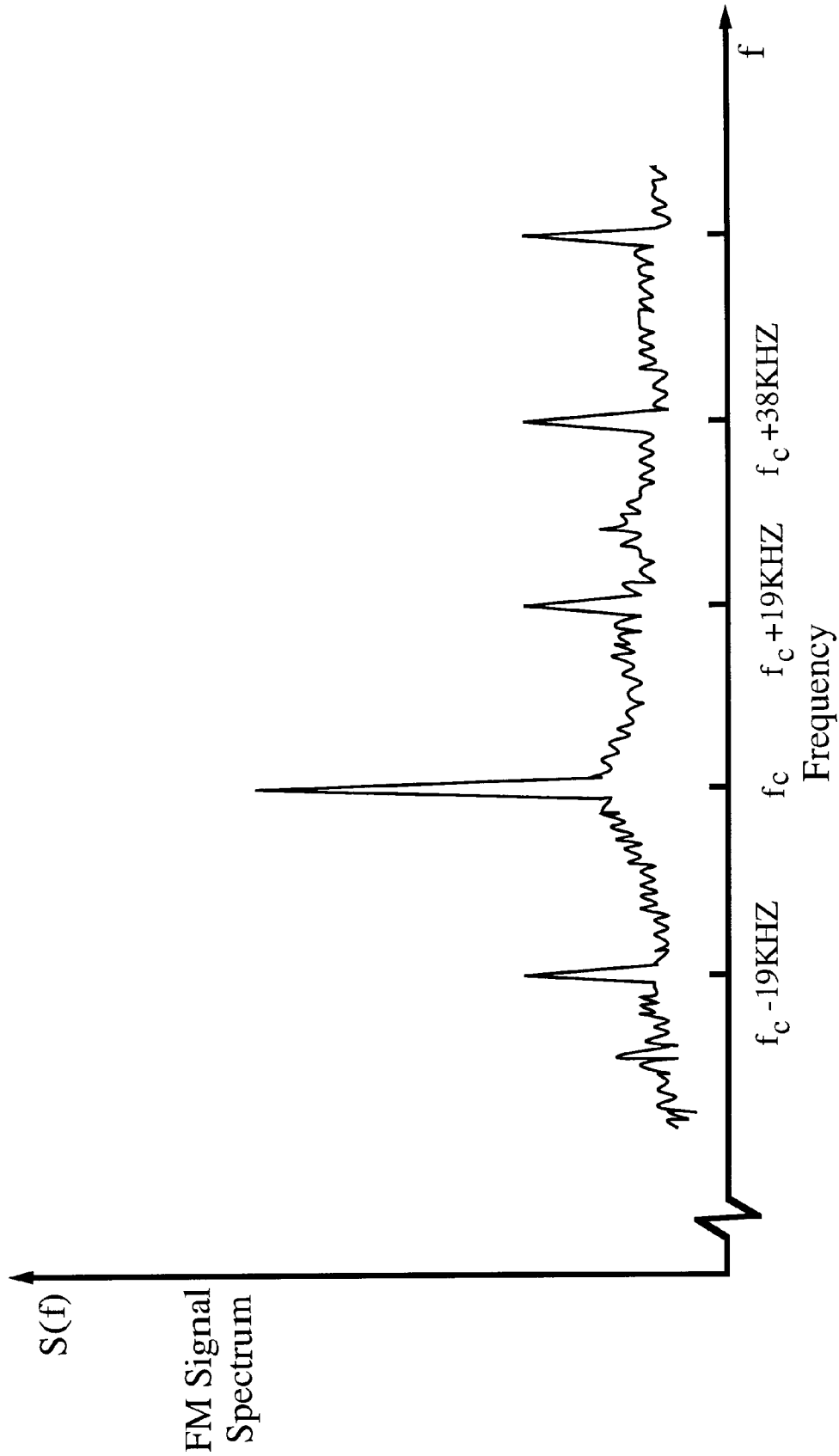
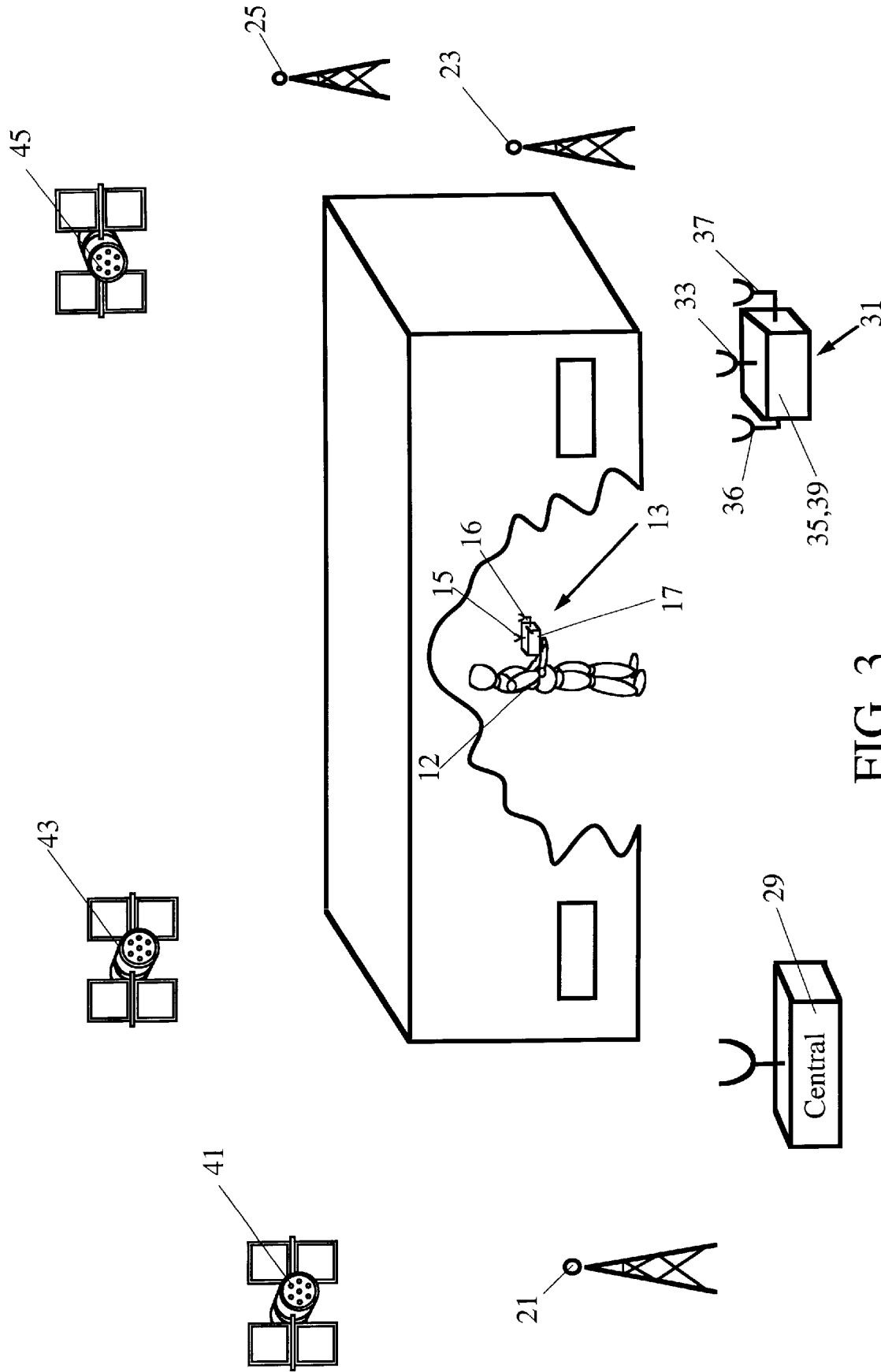


FIG. 2



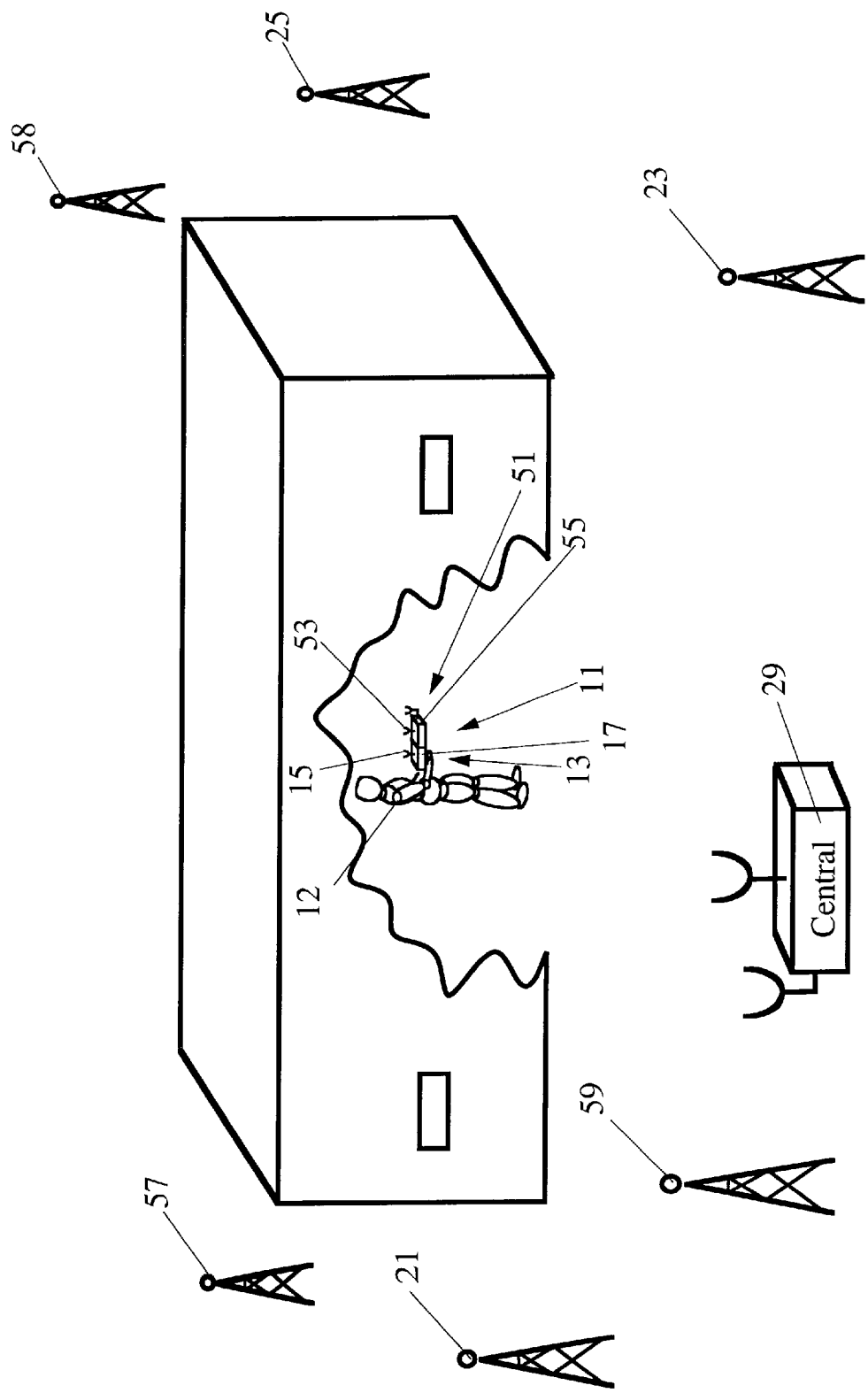


FIG. 4

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