April 15, 1969 J. E. WARD 3,439,320

PERSONNEL LOCATION SYSTEM

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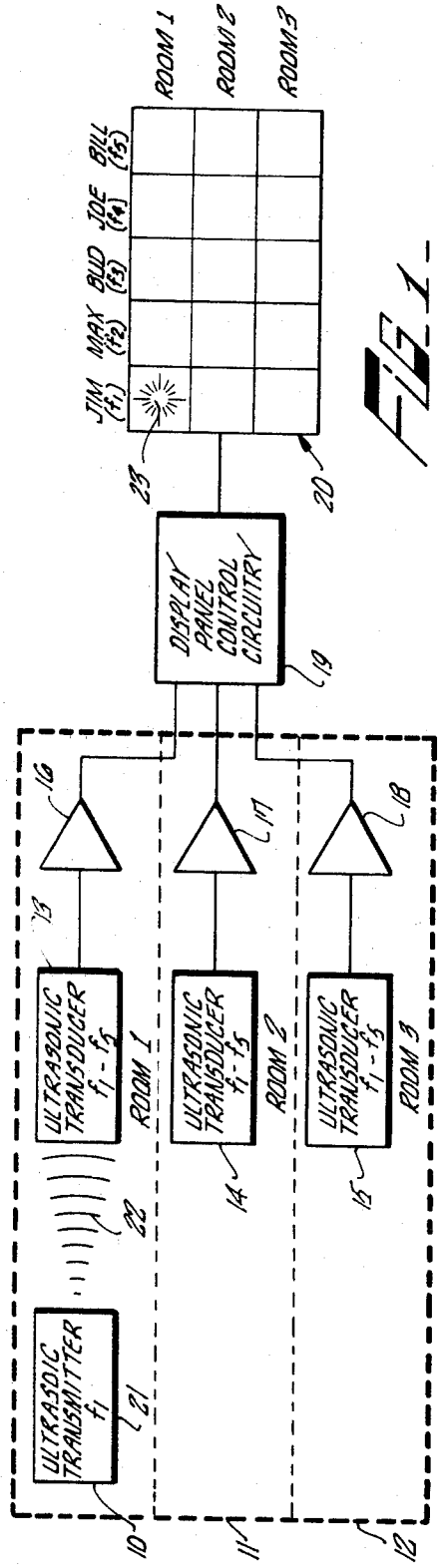

FIG 1

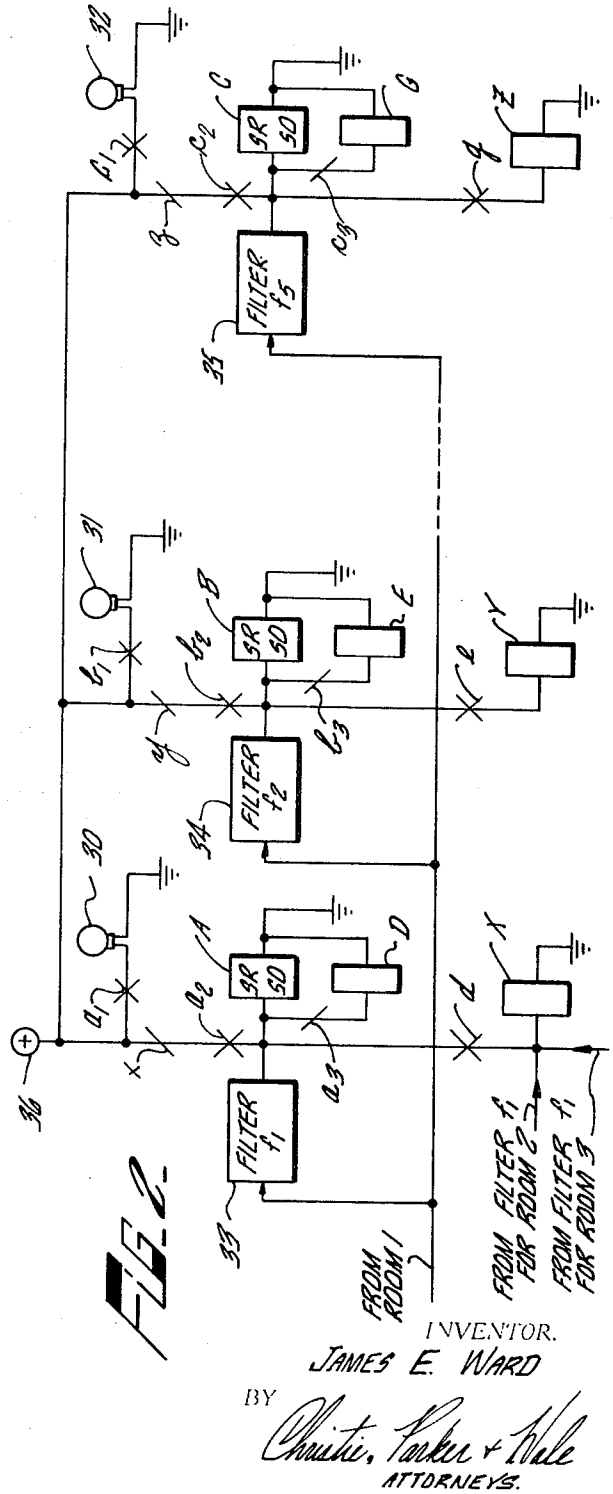

FIG 2

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PERSONNEL LOCATION SYSTEM

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U.S. Cl. 340—16 7 Claims

ABSTRACT OF THE DISCLOSURE

Each of a plurality of persons whose location is to be ascertained carries a transmitter that produces an ultrasonic sound signal having a unique frequency. Each room or area to be designated has an ultrasonic receiver or transducer capable of sensing any of the unique frequencies within its range. The ultrasonic transducers in the different areas are all coupled to a display panel capable of indicating the designated areas and each person to be located. When a person actuates his transmitter in one of the areas, an indication is given on the control panel of the location of this person at a designated area. Preferably, the indication is maintained until the person moves to a different area and actuates his transmitter there.

Background of the invention

This invention relates to communication between a plurality of persons and a central point and, more particularly, to an indication system for locating personnel at a large facility.

At large business establishments, hospitals, construction sites, and other extended areas of activity, provision must be made for communicating with personnel that move about the area in the course of their work. Most known systems for accomplishing this type of communication have disadvantages of one sort or another that must be taken into consideration and weighed when selection of a particular system is made. For the most part, the person sought is paged in one way or another.

Probably the most commonly employed paging system is a public address network in which the name of the person sought is announced over loudspeakers distributed throughout the entire facility. Communication in this type of system is not selective, i.e., the pages are heard by everyone within the facility regardless of whether or not a person is affected by the announcement being made. Continual paging over such a public address network often disturbs the personnel and therefore reduces the efficiency of their activities.

Other paging systems are selective and therefore do not disturb personnel who are not concerned with the page. These systems employ one or more radio frequency transmitters distributed throughout the facility. The transmitters are capable of producing one of a plurality of different frequencies. Each person to be paged has in his possession a radio receiver tuned to a unique one of these frequencies. To communicate with a person, his unique frequency is broadcast by all the transmitters, thereby producing only in his receiver an audible indication that can be heard by him. This type of system requires a portable source of electrical energy in each receiver on which a current drain is continually imposed as long as the receiver is in a stand-by condition. When the energy source is expended, it must be replaced or recharged in order to maintain its operation.

Summary of the invention

In contrast to a paging system, the invention is based on the concept that personnel are located in response to signals sent out by them each time they move to a different

designated area at a facility. Specifically, each person has in his possession a transmitter capable of producing a locating signal having a unique frequency. Each area or room at the facility to be designated is provided with a transducer or receiver capable of sensing all the unique frequencies assigned to the personnel. The transducers are all coupled to a centrally located display panel capable of indicating the designated area in which each person is located. When a person actuates his transmitter, thereby sending a locating signal to the transducer in the area or room in which he is located, control circuitry determines which unique frequency is being received at the central location and which transducer is sensing this unique frequency. An indication of the location of the person sending the signal at one of the designated areas is then produced on the display panel responsive to the control circuitry. Most advantageously, this indication is maintained on the display panel until the person sends out a signal from his transmitter in a different designated area, at which time a new indication replaces the original one.

Preferably, the locating signals are produced by ultrasonic sound transmitters. In such case, the system produces no audible sounds that may disturb other personnel, and no portable sources of electrical energy are required for the units in the possession of the person to be located. The energy for actuating the ultrasonic transmitter could be provided by the person operating the transmitter in the form of a hammer blow on an ultrasonic resonant tuning fork or the like.

Brief description of the drawing

The features of a specific embodiment of the invention are illustrated in the drawing, in which:

FIG. 1 is a schematic diagram in block form of a communication system incorporating the principles of the invention; and

FIG. 2 is a circuit schematic diagram of a portion of the display panel control circuitry of FIG. 1.

Description of a specific embodiment

In connection with FIG. 1, a personnel location system is described that indicates the location of five persons designated JIM, MAX, BUD, JOE, and BILL at one of three areas of a facility designated ROOM **1**, ROOM **2**, and ROOM **3**. Each person is provided with a transmitter capable of producing an ultrasonic sound signal having a unique frequency. The ultrasonic frequencies are designated f_1, f_2, f_3, f_4, and f_5. Preferably, the ultrasonic transmitters are of the type that produce ultrasonic signals in response to a hammer blow so that no portable source of electrical energy is required in the transmitters. Such ultrasonic transmitters are in common use to control remotely commercial television receiver sets in the home. Instead, a portable power source could be used to give a constant signal or a selectively intermittent signal. The areas encompassed by ROOM **1**, ROOM **2**, and ROOM **3** are represented schematically in FIG. 1 by blocks **10**, **11**, and **12**, respectively. Ultrasonic transducers or receivers **13**, **14**, and **15**, which each have a band width sufficiently wide to sense all of the frequencies f_1 through f_5, are provided in ROOM **1**, ROOM **2**, and ROOM **3**, respectively. Transducers **13**, **14**, and **15**, which convert ultrasonic sound energy to electrical energy, are coupled through amplifiers **16**, **17**, and **18**, respectively, to centrally located display panel control circuitry **19**. A display panel **20** in the form of a grid with rows and columns of indicators, such as lamps, is also provided at the centrally located point. Each indicator on display panel **20** is situated in a square area of the grid. One horizontal row of indicators is provided for each room to be designated,

and one vertical column of indicators is provided for each person to be identified.

When a person enters a room, he actuates his transmitter, thereby sending an ultrasonic signal to display panel control circuitry **19**. This is illustrated in FIG. 1 by an ultrasonic transmitter **21** in ROOM **1** that produces an ultrasonic sound signal at frequency f_1 assigned to JIM. The ultrasonic sound signal is represented at **22**. Display panel control circuitry **19** senses which one or more of the frequencies f_1 through f_5 is being sent and which transducer is receiving this frequency. On the basis of this information, the location of the person involved at a designated area is determined and indicated on display panel **20** responsive to control circuitry **19**. Following the assumption that transmitter **21** is actuated in ROOM **1**, a lamp is lit in the upper left-hand square on display panel **20**, designated **23**. The lamp remains lit in square **23** until transmitter **21** is actuated in a different room, at which time a new indication replaces the indication in square **23**. The central operator can then inform interested people as to JIM's precise whereabouts or can communicate directly with him without disturbing anyone other than the occupants of his room.

In FIG. 2, a schematic circuit diagram of that portion of display panel control circuitry **19** associated with ROOM **1** is shown. The same circuitry would be repeated for ROOM **2** and ROOM **3**. Lamps corresponding to each of the five squares in the row for ROOM **1** are energized under the control of relays. The control coil of each relay is designated by a capital letter, and its contacts are designated by small letters corresponding to the capital letters with different subscripts where plural contacts are involved. In accordance with well-accepted practice, normally open contacts are designated by a cross and normally closed contacts are designated by a slash. Relay coils A, B, and C are labeled SR and SO to designate that they are slow operating and slow releasing relays. The remaining relays are assumed to operate and release instantaneously. Three out of the five indicator lamps for ROOM **1**, designated **30**, **31**, and **32**, and the associated control circuitry are shown in FIG. 2. Identical circuitry would be employed for the other lamps associated with ROOM **1**. The output of amplifier **16** (FIG. 1) is connected through a filter **33** to relay coil A, through filter **34** to relay coil B, and through filter **35** to relay coil C. Filters **33**, **34**, and **35** are selective filters having narrow bands that will pass only the frequency assigned to the person identified by the corresponding column of display panel **20**, namely frequencies f_1, f_2, and f_5, respectively. On the application of a signal at frequency f_1, relay coil D operates immediately to complete a circuit through contact d to relay coil X. As described in detail below, the operation of relay coil X serves to deenergize any other lamps in the column of display panel **20** identifying JIM's location. After a short delay, relay coil A operates. Consequently, contact a_3 opens to interrupt the energizing circuit for relay coil D, so that relay coil X releases. Contact a_1 closes to complete a circuit from a source **36** of positive potential to lamp **30**. Contact a_2 closes to complete a latching circuit from source **36** to relay coil A. As a result, relay coil A remains latched after the signal received from ROOM **1** terminates. Relay coil A remains latched and indicator lamp **30** remains lit until transmitter **21** (FIG. 1) sends an ultrasonic signal to the transducer in a different room.

The outputs of the filters corresponding to filter **33** that select the frequency f_1 from the transducers leading from the other rooms are also connected to relay coil X through a normally open contact controlled by a coil corresponding to coil D. As in the case of lamp **30** and relay coil A, relay coil X has a normally closed contact in the latching circuit for the lamp energizing the relay coils for ROOMS **2** and **3**. Whenever a signal at frequency f_1 is received from the transducers in any of the rooms, relay coil X is energized for a short period of time as described above, thereby opening the latching circuit for the lamps in the corresponding column. Accordingly, any previously energized lamp in the column is extinguished and the lamp in the row corresponding to the transducer from which the signal is being received becomes lit.

The control circuitry associated with the lamps in the other columns operates in the same manner. Relay coils B and C correspond to relay coil A; relay coils E and G correspond to relay coil D; and relay coils Y and Z correspond to relay coil X.

What is claimed is:

1. A communication system comprising:
- a plurality of portable transmitters each generating a unique signal;
- a plurality of fixed receivers positioned to cover different areas at a facility, each receiver being capable of sensing any of the unique signals generated by the transmitters;
- a display capable of individually indicating the receivers and the transmitters; and
- means connected between the plurality of receivers and the display for indicating on the display which receivers are sensing signals and which transmitters are producing the signals sensed by the respective receivers.

2. The communication system of claim **1**, in which the transmitters each generate an ultrasonic sound signal and the receivers are ultrasonic transducers capable of converting ultrasonic sound energy into electrical energy.

3. The communication system of claim **1**, in which the transmitters each generate a signal having a unique frequency and the receivers are capable of sensing signals having the frequencies of all the transmitters.

4. The communication system of claim **1**, in which the indicating means retains an indication that a receiver is sensing the unique signal produced by a transmitter until another receiver senses the unique signal produced by the same transmitter, causing the indicating means to indicate that the other receiver is sensing the unique signal.

5. The communication system of claim **1**, in which the display has a plurality of indicators equal in number to the product of the number of transmitters and the number of receivers and the indicating means comprises control circuitry that energizes the indicator corresponding to the receiver sensing a signal and the transmitter sending the sensed signal.

6. The communication system of claim **1**, in which the display forms a grid having a number of areas equal to the product of the number of transmitters and the number of receivers, an indicator being located in each area, and the indicating means energizes the indicator corresponding to the receiver sensing the signal and the transmitter sending the sensed signal.

7. The communication system of claim **1**, in which the display forms a grid of areas arranged in rows and columns, the grid has a column corresponding to each transmitter and a row corresponding to each receiver, an indicator is located in each area, and the indicating means energizes the indicator in the area where the row that corresponds to the receiver sensing a signal and the column that corresponds to the transmitter generating the sensed signal intersect.

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