

Jan. 20, 1959

N. R. DE GRAAF
CALLING SYSTEM

2,870,435

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2 Sheets-Sheet 1

FIG. 1

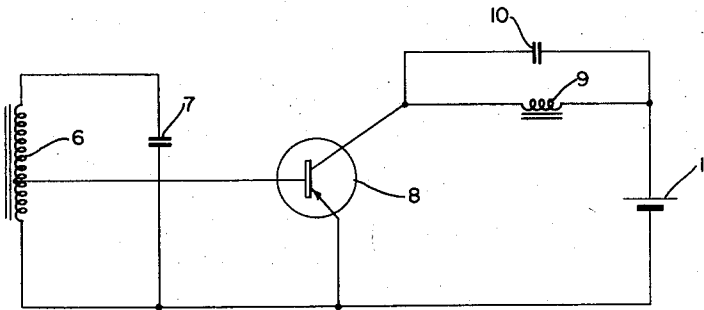
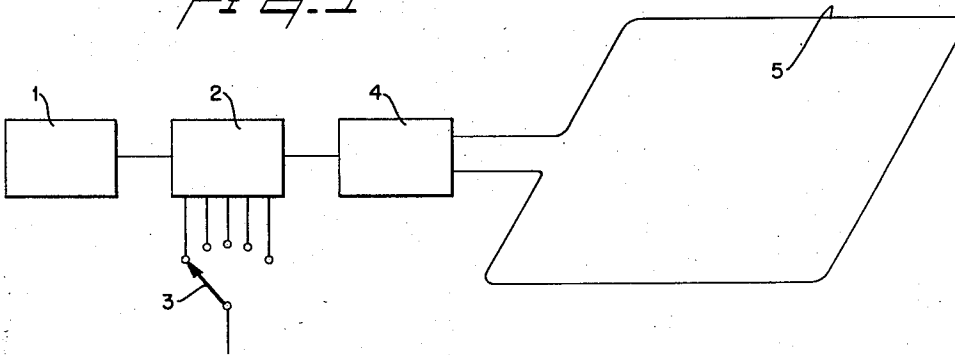


FIG. 2

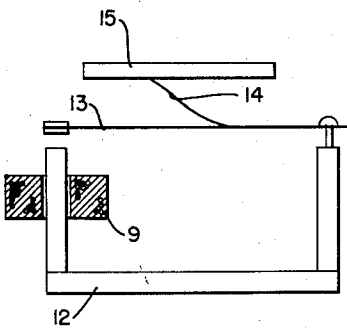


FIG. 3

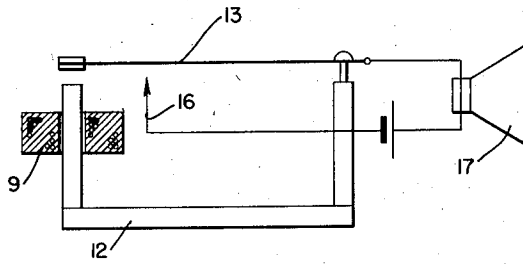


FIG. 4

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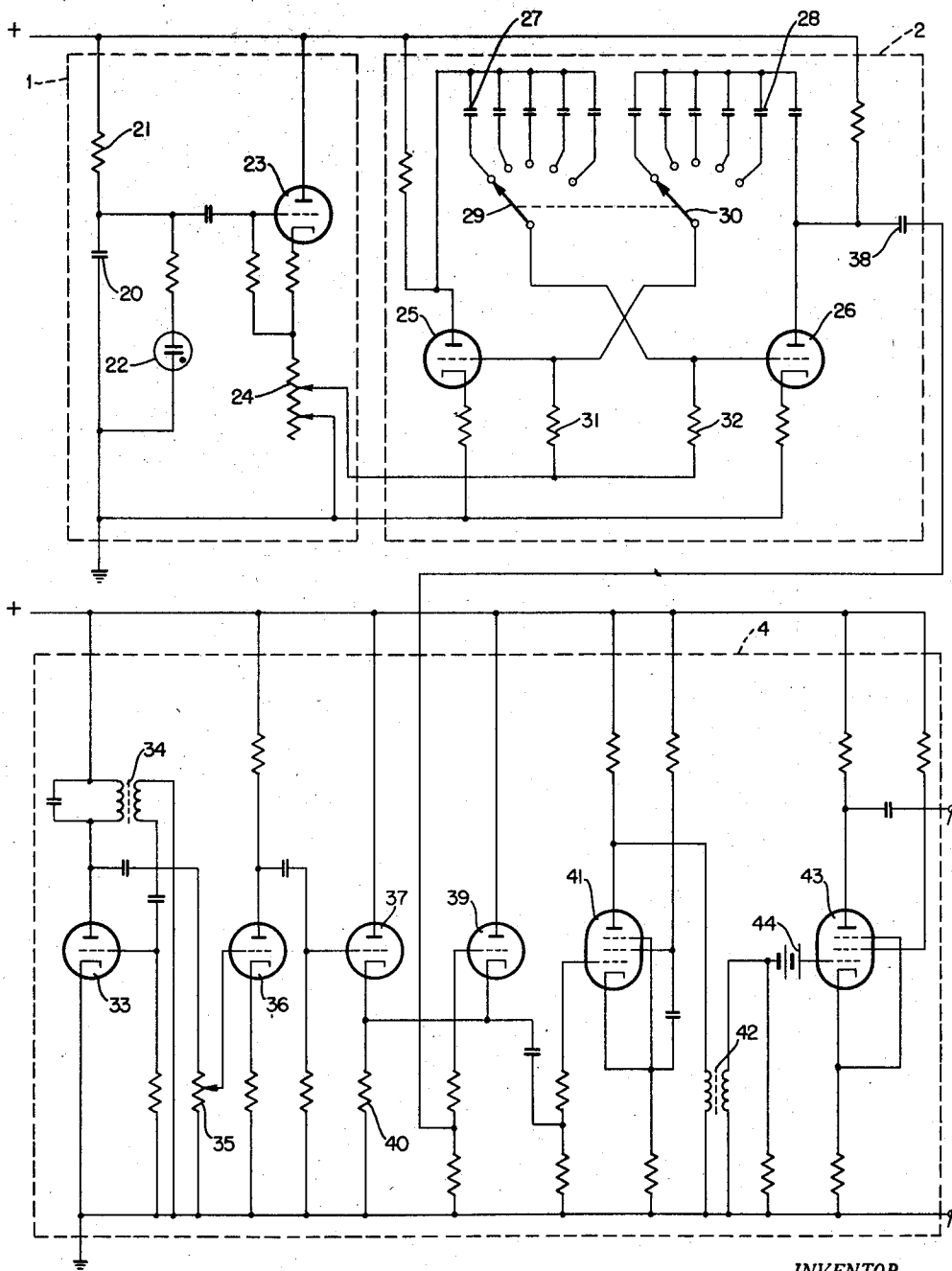


FIG. 5

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CALLING SYSTEM

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7 Claims. (Cl. 340—312)

This invention relates to a system for selectively calling or paging individuals in a building, or in a plurality of adjacent buildings. This building, or plurality of buildings will be denoted by the term area hereinafter.

Call systems are known in which use is made of acoustic signals. For instance, means may be provided for producing Morse signals characteristic for a person being called, or a loudspeaker system may be used for broadcasting the name of a person called. In many cases, for instance in hospitals or schools, the noise produced by these acoustic calling systems is inadmissible.

Calling or paging systems making use of visual signaling means, such as lamp panels, have the disadvantage that it often takes a considerable time before the individual being paged observes the call signal.

It is an object of the invention to provide a call or signaling system wherein the disadvantages of the above-mentioned known systems have been avoided.

A further object of the invention is to provide a call system wherein an individual being paged immediately receives a clearly perceptible signal without disturbing others in the vicinity.

Still another object of the invention is to provide a call system needing only a minimum of wiring.

The system according to the invention comprises a high frequency circuit within said area, a transmitter adapted to supply high frequency energy to said circuit, a generator adapted to produce a plurality of low frequencies each characteristic for one of the individuals to be called or paged, a selecting device by means of which one of the said low frequencies may be selected, means for modulating said high frequency energy by the low frequency produced by said generator and selected by means of said selecting device, and a plurality of individual pocket receivers each adapted to be carried by the persons to be contacted. Each receiver comprises means for receiving and detecting the said high frequency energy, an electromagnetic oscillating system mechanically tuned to the low frequency characteristic for the person called and adapted to produce an audible signal upon excitation, and means to supply the detected high frequency energy to said oscillating system.

Thus, if the modulating frequency characteristic for a wanted person is selected by means of the selecting device, the oscillating system in his pocket receiver will be caused to operate, so that he will perceive an audible signal which does not cause any disturbance in his surroundings whatever. By the use of a mechanical resonance in the oscillating system of each pocket receiver, it is made possible to choose the characteristic modulating frequencies very near to each other, so that a great many persons may be selectively called.

Preferably, the said high frequency circuit is formed as a closed ring surrounding the area. A ring circuit of this kind has the advantage that there is practically no field outside the ring, so that there is only a small danger of interference in buildings not belonging to the area,

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whereas a substantially uniform field is obtained within the ring.

As the voltage in the ring circuit increases with frequency, it is preferred to use a transmitting frequency which is not too high. It is very suitable to transmit the high frequency energy with a frequency between 20,000 and 50,000 cycles; in particular, very good results have been obtained with a transmitting frequency of about 40,000 cycles.

In order to save as much energy as possible and to reduce the chance of interference to a minimum, it is of advantage to generate the high frequency energy by means of a transmitter which gives off energy only if it is modulated. Thus, the transmitter is only in operation if a person has to be called, and no energy is supplied to the circuit in the interval between calls.

As stated hereinbefore, the use of a mechanical resonance in the pocket receivers leads to a very high selectivity. This has the disadvantage, however, that the electromagnetic oscillating system of the receiver carried by the person called is not excited if the transmitted characteristic frequency differs slightly from the normal value due to variations of temperature or the like, or if the resonance frequency of the electromagnetic oscillating system is shifted somewhat by similar causes. In order to avoid this disadvantage, it is proposed to modulate the characteristic frequencies by a still lower frequency. For instance, a characteristic frequency of 50 cycles may be wobbled in such manner that it varies slowly between 49 and 51 cycles. Now, if the modulating frequency or the resonance frequency of the oscillating system changes slightly, the oscillating system is still put into operation. As soon as the system oscillates, it may be kept oscillating by a frequency slightly different from the resonance frequency. In addition to the increased reliability of the system, which is due to the wobbling of the modulating frequencies, it has also been found that the wobbling leads to an increased strength of the signal produced by the electromagnetic oscillating system. This phenomenon is presumed to be due to the fact that the resonance frequency of the oscillating system changes slightly as soon as the system is brought into operation. It appears that the frequency variation brought about by the wobbling corresponds to some extent with said change of the resonance frequency.

Preferably, the characteristic modulating frequencies are generated by a multivibrator, in which various frequency determining resistors and/or condensers may be inserted by means of the selecting device.

The individual pocket receivers used in the present system may have about the same shape and the same dimensions as the usual hearing-aid amplifiers, so that they may easily be carried along in a pocket, a bag or the like. As the receivers must be operative during the whole working time, it is of the utmost importance that their power consumption is as small as possible, as otherwise, the reliability of the system would be greatly decreased in view of the possibility that the batteries would be exhausted. This condition may be satisfied by using as detecting and amplifying elements in each receiver one or more transistors, preferably transistors of the so-called junction type, which do not need any bias voltage. Thus the receivers do not consume any power as long as no call signal is transmitted, and during the transmission of a signal, they use only a very slight current, so that the life of the battery may be very long, for instance of the order of one year. It is an additional advantage that the receiver need not contain a switch for switching the battery on and off, so that there is no danger that the person being called does not report for his message because he has forgotten to switch on his battery.

Special attention must be paid to the interception of

the high frequency energy by the pocket receivers. An external aerial cannot be used, in general hence, it is preferred to use an inductance with an iron core, inserted in the tuned input circuit of the receiver, as an aerial. However, this makes it necessary that the receiver is always carried in a predetermined position, which may be ascertained by providing the receivers with a clip or a similar fastening device, for instance of the kind used in fountain pens and pocket pencils, by means of which they may be attached to the edge of a pocket in a fixed position.

In order to obtain a powerful audible signal, it is preferred to provide the electromagnetic oscillating system in the pocket receivers with a closed magnetic circuit having a rectangular shape, wherein one of two opposite limbs of this circuit carries the exciting coil, and the two other limbs consist, respectively, of a permanent magnet, and of a resilient blade mechanically tuned to the characteristic frequency of the person carrying the receiver. A further increase of the sound volume may be obtained by electrically tuning the oscillating system to the characteristic frequency with the aid of a condenser connected in parallel with the exciting coil.

Preferably, a second spring blade is attached to the resilient blade of the electromagnetic oscillating system; this second blade strikes against a sound board when the system is brought into oscillation so as to produce an audible sound. It has been found that a more intense sound is obtained in this manner than if the resilient blade of the oscillating system strikes against a sound board itself. Alternatively the resilient blade of the electromagnetic oscillating system, or a second blade attached thereto, may be used as a switch for switching a sound producing device, such as a bell or a loudspeaker, on and off.

The invention will now be further explained by reference to the accompanying drawing, in which

Fig. 1 shows a block diagram of the transmitter, and the ring circuit connected therewith,

Fig. 2 shows a circuit diagram of the receiver, and

Fig. 3 schematically shows the construction of the electromagnetic oscillating system in the receiver.

Fig. 4 shows a modification of the construction shown in Fig. 3.

Fig. 5 is a schematic diagram of the transmitter shown in Fig. 1.

The circuits and constructions shown in the drawing are only to be considered as examples, and may be modified in many ways within the scope of the invention.

In Fig. 1, 1 indicates a generator producing a very low frequency, for instance of the order of one cycle per second, which is used for wobbling the modulating frequencies. For instance, the said low frequency may control an electronic tube, of which the internal resistance constitutes a part of the frequency determining resistance in a multivibrator which generates the modulating frequencies.

The said multivibrator is shown at 2. By means of a selecting device 3, schematically shown as a selector switch, various frequency determining resistances may be inserted in this multivibrator, so that various characteristic modulating frequencies may be generated according to the position of the selecting device. The selecting device may be operated, for instance, by means of a dial or a key board.

Due to the fact that use is made of a mechanical resonance in the receiver, the characteristic modulating frequencies generated by the multivibrator 2 may be very near to each other, for instance with a relative frequency difference of only 2.5%; thus, about 25 different calling frequencies may be accommodated in the frequency band from 50 to 300 cycles. If the modulating frequencies are wobbled through a relatively large frequency range in order to obtain an intermittent signal in the receivers, the number of calling frequencies to be accommodated in said frequency band is slightly smaller. If a greater

number of persons are to be called, it is preferable to provide the transmitter with a second oscillator, producing a second carrier frequency. If there is a danger that the low frequency bands assigned to the various persons overlap each other due to the wobbling of the modulating frequencies, means may be provided to switch off the oscillator 1 after a short starting period, so that only the electromagnetic oscillating system of the receiver carried by the person being called is permanently excited.

The modulating frequency generated by the multivibrator 2 and determined by the position of the selecting device 3 is supplied to the transmitter 4 which is constructed in such a manner that energy is generated only in the presence of a modulating voltage. This may be realised, for instance, by operating the transmitting tube, or each transmitting tube, as a class-C amplifier. The carrier frequency generated by the transmitter 4 is preferably about 40,000 cycles. If two oscillators are required, because a very great number of persons are to be called, the second oscillator may have a lower frequency, for instance of the order of 25,000 cycles. In general, the best results are obtained with transmitting frequencies between 20,000 and 50,000 cycles.

The transmitter 4 is connected with a ring circuit 5, surrounding the area in which the persons are to be called. Preferably, this ring circuit is arranged on the outside of the building or buildings, because the costs of installation are decreased thereby.

In order to keep the various frequencies as constant as possible, it is preferred to stabilise the supply voltages of the various generators by means of glow discharge tubes.

Fig. 2 shows the circuit diagram of one of the pocket receivers carried by the individuals to be called. The input circuit, which is tuned to the high frequency carrier wave, consists of an iron core coil 6 and a condenser 7. The coil 6 also serves as an aerial. The core may consist advantageously of ferroxcube; however, in view of the relatively low carrier frequency, it would also be possible to use ordinary iron.

The input electrode of a transistor 8 is connected with a tap of the coil 6; the tapping ratio may be 1/30 or 1/40, for instance. The output circuit of the transistor 8 contains the exciting coil 9 of an electromagnetic oscillating system, which is tuned to the characteristic frequency of the person carrying the receiver by means of a parallel condenser 10, and connected in series with a battery 11, having a terminal voltage of 4.5 volts, for instance.

The receiver must be carried along in a vertical position, so that the core of coil 6 is always at least approximately vertical; for this purpose, the receiver may be provided with a clip which forces the user to carry the receiver vertically in his pocket.

The electromagnetic oscillating system of a receiver is separately shown in Fig. 3. The exciting coil 9 is arranged on one of the short limbs of a rectangular closed magnetic circuit, of which the long limbs consist, respectively, of a permanent magnet 12, and a resilient blade 13. The blade 13 is mechanically tuned to the characteristic frequency of the person carrying the receiver, and is provided with a spring blade 14 for striking against a sound board 15. As soon as the blade 13 is brought into oscillation, the blade 14 produces a clearly audible sound, which does not cause any disturbance in the surroundings however.

In the modification shown in Fig. 4, the blade 13 controls a contact 16, through which a miniature loudspeaker 17 is fed. This has the disadvantage, of course, that the power consumption is increased, but it leads to an amplification of the sound produced. In general, however, the sound obtained by means of the arrangement shown in Fig. 3 is sufficiently powerful.

While certain of the components of the invention have been heretofore broadly described Fig. 5 shows the circuit of the transmitter of Fig. 1 in detail. The wobbling frequency generator, generally indicated by reference 1, com-

prises a condenser 20, connected with the positive terminal of a voltage source (not shown) through a resistor 21. A discharge tube 22 is connected in parallel with condenser 20. Parts 20 to 22 constitute a saw-tooth oscillator of known construction. Condenser 20 is charged through resistor 21 until the voltage across condenser 20 reaches the ignition voltage of tube 22, after which the condenser is discharged through tube 22. The saw-tooth voltage generated by this mechanism is supplied to the grid of a vacuum tube 23. The cathode circuit of this tube comprises a resistor 24 partially inserted in the grid circuits of the tubes of multivibrator 2.

The multivibrator 2 comprises tubes 25 and 26. The anode of tube 25 may be connected with the grid of tube 26 through any one of a set of condensers 27, and the anode of tube 26 may be similarly connected with the grid of tube 25 through any one of a set of condensers 28. By means of switch arms 29 and 30, which are mechanically coupled with each other as indicated by the dotted line, a selection may be made out of condensers 27 and 28, so as to tune the multivibrator circuit to the desired characteristic frequency. The grids of tubes 25 and 26 are connected through resistors 31 and 32 with resistor 24 in the cathode circuit of tube 23. Thus, the frequency generated by the multivibrator is influenced by the saw-tooth voltage appearing across resistor 24, i. e. the characteristic frequency is wobbled in the rhythm of the saw-tooth voltage produced by generator 1.

The transmitter proper, generally indicated by reference 4, comprises a carrier frequency oscillator tube 33, having its anode circuit coupled with the grid circuit by means of the usual tuned transformer 34. The carrier oscillations generated by tube 33 are supplied by means of a potentiometer 35 to the grid of an amplifier tube 36. The amplified carrier voltage appearing at the anode of tube 36 is supplied to the grid of a first modulator tube 37.

The wobbled modulating frequency generated by multivibrator 2 is supplied through a coupling condenser 38 to the grid of a second modulator tube 39. Tubes 37 and 39 have a common cathode resistor 40, and due to the combined action of tubes 37 and 39, a carrier voltage modulated by the wobbled multivibrator frequency appears across resistor 40. This voltage is supplied to the grid of a driver tube 41, having its anode circuit coupled by means of a transformer 42 with the grid circuit of a class C power amplifier tube 43. A suitable bias voltage for class C operation is supplied to tube 43 by means of a voltage source, schematically shown as a battery 44. The anode of power amplifier 43 is connected with an output terminal 45, a second output terminal 46 being connected to ground. The ring circuit 5 (Fig. 1) is connected with terminals 45 and 46.

The operation of the above-described system is as follows. If a certain person is to be called, the characteristic frequency of the person being called is selected by means of the selecting device 3, so that the generators 1, 2 and 4 are made operative, and a high frequency signal modulated by the characteristic frequency is supplied to the ring circuit. This signal is received and detected in the receivers of each individual carrying one, however only in the receiver of the particular person being called is the electromagnetic oscillating system brought into operation, so that this person alone perceives an audible sound. Upon receiving the call signal he reports by telephone, or goes to a predetermined place.

Since in the system according to the invention no wiring need be provided except for the ring circuit, this system turns out to be cheaper than acoustic or visual call systems. Due to the great simplicity of the receivers used,

the system is also very reliable and cheap in maintenance. I claim:

1. A personal call system for selectively calling a plurality of persons individually in an area comprising, a closed circuit surrounding said area, a transmitter adapted to supply a modulated carrier having a frequency between 20 and 50 kilocycles per second to said circuit, a generator adapted to produce a plurality of low frequencies each characteristic for one of the persons to be called, means for wobbling each of the low frequencies produced by said generator, a selecting device by means of which one of the said low frequencies may be selected, means for modulating said carrier by the wobbled low frequency produced by said generator and selected by means of said selecting device, and a plurality of portable receivers each adapted to be carried by one of the persons to be called, each receiver comprising means for receiving and detecting the signal supplied to said closed circuit, an electromagnetic oscillating mechanism mechanically tuned to respond to the low frequency characteristic for the individual being called so as to generate an audible signal, and means to supply the detected signal to said electromagnetic oscillating system.

2. A system according to claim 1, in which said electromagnetic oscillating mechanism operates in a selected frequency range and in which the wobbling means is adapted to wobble the low frequencies produced by said generator through a frequency range greater than said selected operating range of said electromagnetic oscillating mechanism.

3. A system according to claim 1, in which said transmitter comprises means permitting it to transmit only in the presence of a modulating voltage.

4. A system according to claim 1, in which said generator is a multivibrator circuit comprising a plurality of frequency determining impedances, said selecting device being connected for permitting said impedances to be selectively connected and disconnected to said multivibrator circuit.

5. A system according to claim 1, in which said means for receiving and detecting the signal supplied to said closed circuit includes transistor means connected as a detecting and amplifying element.

6. A system according to claim 1, in which each receiver comprises an input circuit tuned to the modulated carriers, a coil having an iron core connected in said input circuit, said core comprising an aerial for responding to said modulated carrier, means for maintaining the aerial in a selected position while the portable receiver is being carried.

7. A system according to claim 1, in which each of said receivers comprises a battery constantly providing power to said receiver and said receiver being free of a switch for cutting off said power, whereby said receiver is in constant readiness for receiving said modulated carrier.

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