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(54) **Improvements in or relating to control systems for automatic change-over between transmission and reception of communication devices**

(57) A control system is provided for changing automatically between transmission and reception states in a two-way communication device. Output signals of an ear microphone 1 to be transmitted by a transmitter 3A are shorted by a relay 8 for a limited time immediately before the transmission state is changed to the reception state to prevent the occurrence of malfunction caused by noise signals which frequently occur when such a change-over operation is performed.

FIG. 1

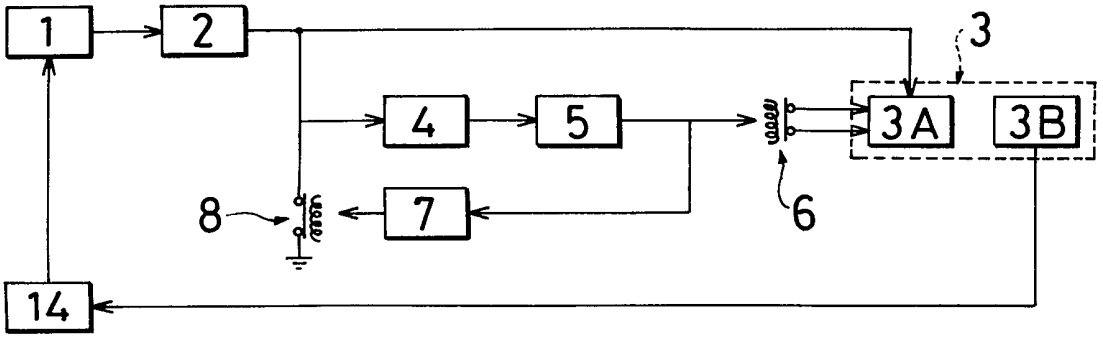

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FIG. 1

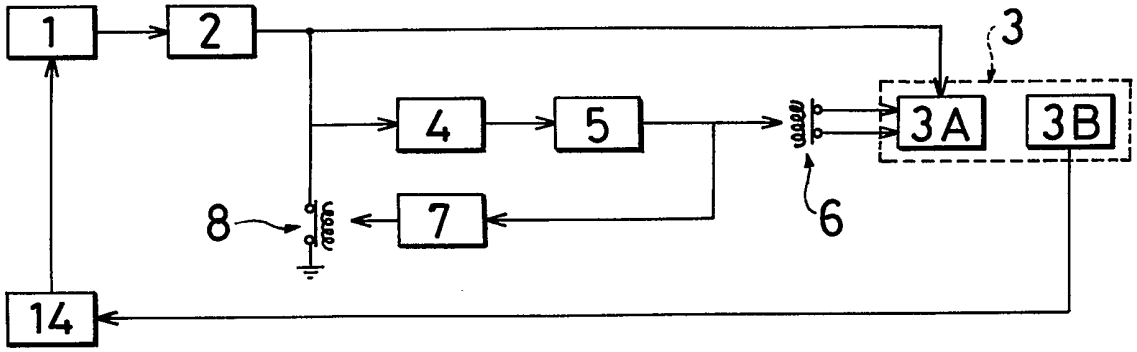


FIG. 2

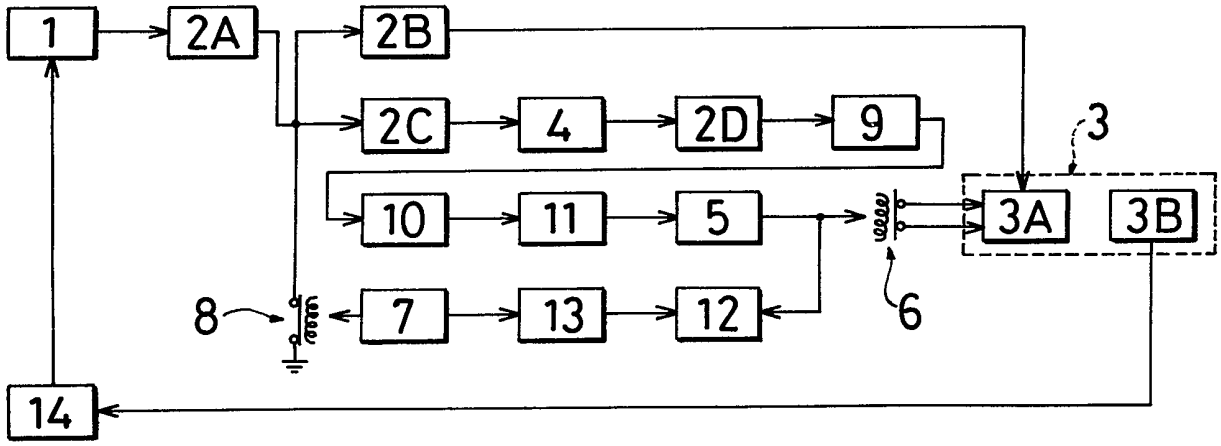


FIG. 3

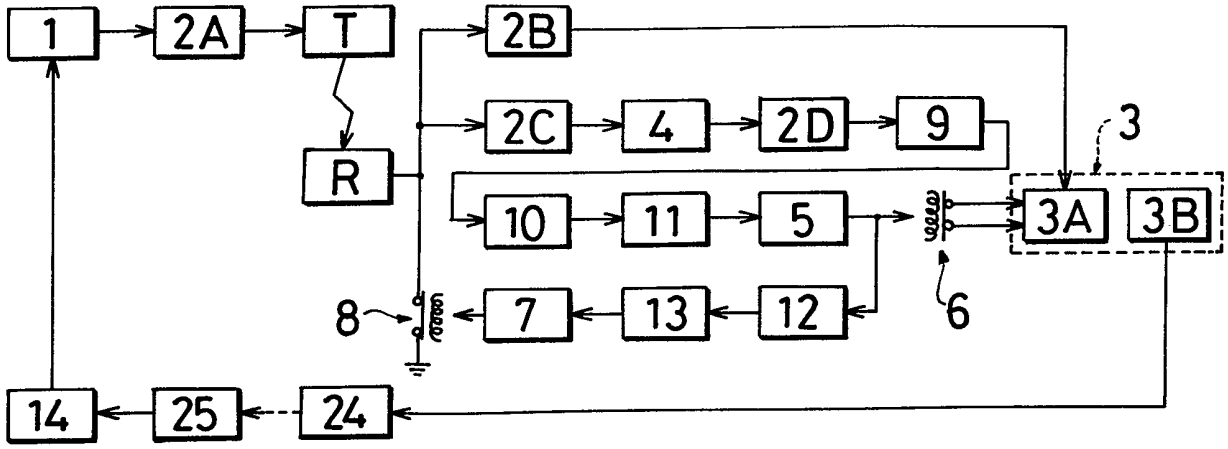


FIG. 4

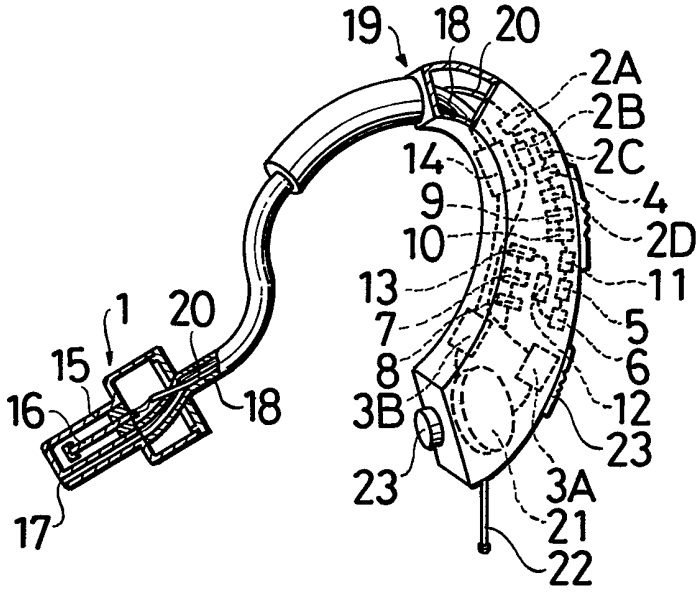


FIG. 5

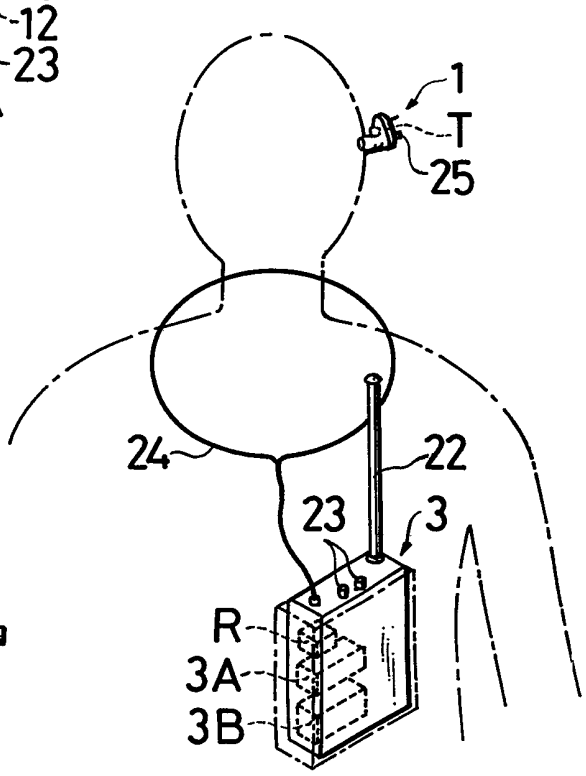
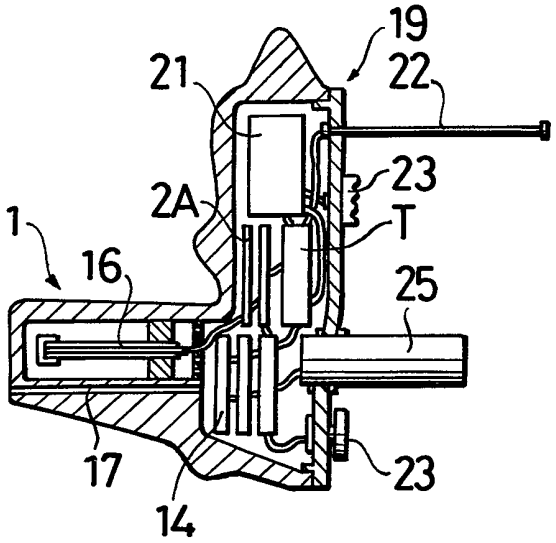


FIG. 6



SPECIFICATION

Improvements in or relating to control systems for automatic change-over between transmission and reception of communication devices

The present invention relates to a control system for switching between transmission and reception states in a two-way communication device, in which a vibration pick-up type ear microphone is used for a transmission system. Such a control system can be used to change between transmission and reception states while preventing the occurrence of malfunction induced mainly by noise signals which occur when the transmission and reception states are changed over.

A vibration pick-up type ear microphone (which will hereinafter be referred to as an ear mic) is inserted into the external auditory canal of one ear of a user, and serves to pick up voice signals (vibrations) conducted through his temporal bones around the external auditory canal wall. Such a known ear mic can be combined with a speaker such as the usual sound pressure type ear microphone or the like.

An ear-insert member comprising an ear mic and a sound pressure type speaker has been combined with a conventional single-band transceiver, which has transmitting and receiving circuits and can be switched between the transmission and reception states by a conventional press-to-talk system, for transmitting and receiving. As a result, it was possible to transmit and receive effectively.

In this known arrangement, since the ear-insert member to be connected to the transceiver is inserted into the external auditory canal of one ear of the user and the transceiver is made pocketable, the user's hands are free for doing anything he wants. It is desirable for switching between the transmission and reception states to be performed without hand operation by the user, by using a control system for automatic change-over.

In order to satisfy this requirement a conventional automatic change-over system has been tested in a very noisy environment. As a result, it was found that feedback or "houl-round" were frequently induced by noise signals when the transmission state was changed to reception. Moreover, it was found that the occurrence of noise signals was based on unbalance of electricity-consumption when switching between the transmission and reception states.

According to the invention, there is provided a control system for changing automatically between transmission and reception states according to output signals of a microphone of a two-way communication device, comprising an ear-insert member for insertion into one ear canal of a user including a vibration pick-up type ear microphone combined with a speaker, change-over operation means for changing between the transmission and reception states automatically in response to output signals of the ear microphone, and means for inhibiting the output signals of the ear microphone immediately before change-over from the transmission state to the reception state for a limited time so as to prevent the occurrence of malfunction caused by noise signals.

It is thus possible substantially to prevent the occurrence of howl-round to provide a control system for changing between transmission and reception states in a two-way communication device, satisfying following requirements (1) to (5).

(1) By using the ear mic in the transmitting system of the device, noise can be excluded so as to transmit clear speech sounds when used in a very noisy environment.

(2) By combining the ear mic with the speaker used in the receiving system of the device, communication i.e. simultaneously talking and listening, can be achieved through one ear of the user leaving his hands free for doing anything he wants.

(3) Malfunction of the device is substantially prevented even if electrical noise occurs when the transmission state is changed to the reception state.

(4) An otherwise conventional single-band radio set of compact type can be used as the wireless system employed in the transmitting and receiving system.

(5) While the user is talking and listening, his ears are not closed up completely so that he can listen to sounds around for his safety; in this case, an ear-insert member comprising the ear mic and speaker is inserted into one ear canal, but the canal is not closed up completely.

In a preferred control system for changing between transmission and reception states in a two-way communication device, the user's talking and listening is done through one of the user's ears, into which an ear insert member is inserted, the member comprising a vibration pick-up type ear microphone in the transmitting system, and a sound pressure type speaker in the receiving system. Change-over between transmission and reception states is controlled automatically by output signals of the ear mic and malfunction of the device induced by electrical noise which occurs when the transmission state is changed to the reception state is prevented effectively by a short-circuit, whereby the output signals of the ear mic to be transmitted to the amplifier or other means are shorted immediately before the tranmission state is changed to the reception state.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of a basic embodiment of the present invention;

Figures 2 and *3* are block diagrams showing further embodiments of the present invention;

Figure 4 is an isometric view, partly cut away, of an ear hanging type arrangement;

Figure 5 is an isometric view showing a preferred device in use; and

Figure 6 is a sectional view of an ear-insert member shown in Figure 5.

In a preferred embodiment of the present invention change-over between the transmission and reception states is controlled automatically by output signals of an ear mic transmitted through a band-pass filter.

In another embodiment of the present invention,

output signals transmitted through the band-pass filter are supplied through an integration circuit to a time delay circuit, change-over between the transmission and reception states being controlled by the output signals of the time delay circuit.

Figure 1 is a diagram of a basic arrangement constituting a first embodiment which is applied to wireless system, wherein output signals of the ear mic 1 are amplified by an amplifier 2 and supplied to a wireless radio set 3 such as a single-band FM transceiver to be broadcast by a transmitting circuit 3A. The output signals of the ear mic 1 also supplied to a band-pass filter 4 which supplies Vox signals, for example, in the frequency 100 to 500 Hz, to a PTT relay driving circuit 5.

The transmission of output signals through the band-pass filter 4 actuates a PTT relay 6 for switching between the transmitting circuit 3A and a receiving circuit 3B, so that the transmission state is changed to reception. The signals supplied to the PTT relay 6 are also supplied to an INST relay driving circuit 7 to drive an INST relay 8. The output signals of the ear mic 1 are thus shorted for a limited time immediately before the transmission state is changed to reception. Therefore, a common malfunction which occurs frequently in known devices when the transmission state is changed to reception, can be substantially prevented.

A preferred embodiment of the present invention is illustrated in Figures 2 and 4. The output signals of the ear mic 1 are amplified by Pre-EQ-amplifier 2A and a buffer amplifier 2B, and are supplied to the wireless radio set 3. The output signals of the ear mic 1 are also supplied to the cascade connected circuit comprising a buffer amplifier 2C, a band-pass filter 4, a second amplifier 2D, an integration circuit 9, a time delay circuit 10, and a duration circuit 11, whose output signals are supplied to the PTT relay driving circuit 5 to drive the PTT relay 6. Immediately before the PTT relay 6 is driven, signals to drive the relay 6 are detected by a PTT detector 12, and the detected signals are supplied to an INST relay driving circuit 7 through a duration circuit 13. When the INST relay 8 is actuated by the output signals of the INST driving circuit 7, the output signals of the ear mic 1 supplied to the amplifiers 2B, 2C are shorted for a limited time while noise signals occur when the transmission state is changed to the reception state.

In addition to the above, in the receiving system, output signals of the receiving circuit 3B continue to be transmitted to the speaker 14 while the wireless radio set 3 is in use.

The transmitting and receiving device may be of one-ear-hanging type, ear-insert type, or helmet like type or may be housed in a spectacle frame.

An ear hanging-type embodiment of the present invention is shown in Figure 4. Reference numeral 1 represents the ear mic inserted into the external auditory canal of one ear of the user, and comprising a case 15 having a sound path 17 and a vibration pick up member 16 such as a piezoelectric element. The ear mic 1 is connected by an ear hanging member 19 by a tube 18 in which leads 20 are housed for transmitting output signals of the vibration pick up member 16 to electrical circuits housed in the ear hanging member 19.

In Figure 4, numeral 21 represents an electrical power source, 22 an antenna, 23 a switch, and other numerals shown in this Figure refer to the same parts as in Figure 2.

Although there have been described embodiments applied to a wireless system, the invention can also be applied to a wire transmitting and receiving system.

The ear-insert member can be connected through wireless system without using the tube and leads shown in Figure 4 to a portable housing unit, and such an embodiment is shown in Figures 3, 5 and 6.

In the transmitting system of this embodiment, output signals of the ear mic 1 housed in the ear-insert member 19 are transmitted in the ear-insert member 19, and the signals transmitted by the transmitter are received by a receiver R housed in a portable housing unit such as the wireless radio set 3 by which voices of the user are transmitted to another user. In the receiving system, voice signals from the other user are received by a receiving circuit 3B in the portable housing unit 3, and the received signals are transmitted to the ear-insert member 19 through an inductive system comprising a loop antenna 24 fixed to a portable housing unit 5 and an induction coil 25 fixed to the ear-insert member 19, the received voice signals being transduced to audible sound by the sound pressure type speaker 14. The audible sounds are passed into the external auditory canal of the user through the sound path 17.

With this embodiment, transmitting and receiving operation in high power level can be applied, and it may be used for remote communication. Moreover, the user has freedom of movement. Because there are no leads or the like to connect the ear-insert member to the portable housing unit, the ear mic does not pick up electrical noise which might otherwise be picked up by such leads.

It is thus possible effectively to change automatically between the transmission and reception states. While the ear mic 1 continues to pick up Vox signals, the transmitting circuit 3A operates and the receiving circuit 3B does not operate. When there are no input signals to the ear mic 1, the receiving circuit 3B operates and the transmitting circuit 3A does not operate. Moreover, the output signals of the ear mic 1 are shorted for a limited time when the transmission state is changed to reception.

It is thus possible to prevent noise signals, which occur during change-over between transmission and reception states, from being passed to the receiving circuit, by shorting output signals of the ear mic for a limited time.

Moreover, by employing the band-pass filter to pass voice signals in the frequency band 100-500 Hz as input signals to the control ciruits in the device, it is possible to prevent the occurrence of malfunction even if the device is used in a noisy environment, and the input sound level of the ear mic is too loud.

Moreover, the combination of the integration circuit and the time delay circuit can be employed as a type of filter to prevent the occurrance of malfunction because of noise signals.

CLAIMS

1. A control system for changing automatically between transmission and reception states according to output signals of a microphone of a two-way communication device, comprising an ear-insert member for insertion into one ear canal of a user including a vibration pickup type ear microphone combined with a speaker, change-over operation means for changing between the transmission and reception states automatically in response to output signals of the ear microphone, and means for inhibiting the output signals of the ear microphone immediately before change-over from the transmission state to the reception state for a limited time so as to prevent the occurrence of malfunction caused by noise signals.

2. A control system as claimed in claim 1, wherein a bandpass filter is connected to the input of the change-over operation means for filtering the output signals of the ear microphone supplied thereto.

3. A control system as claimed in claim 2, wherein the output of the band-pass filter is conneted to an intergration circuit whose output is connected to a time delay circuit, the change-over operation means being connected to the output of the time delay circuit.

4. A control system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

5. A two-way communication device including a control system as claimed in any one of the preceding claims.

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