United States Patent

Parshad

[15] **3,665,106**

[45] **May 23, 1972**

[54] INTERCOMMUNICATION SYSTEM

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[73] Assignee: **Research Corporation,** New York, N.Y.

[22] Filed: **Apr. 28, 1970**

[21] Appl. No.: **32,529**

[52] **U.S. Cl.** .....**179/1 FS,** 179/1 A
[51] **Int. Cl.** **H04m 1/20**
[58] **Field of Search** .....179/1 FS, 1 HF

[56] **References Cited**

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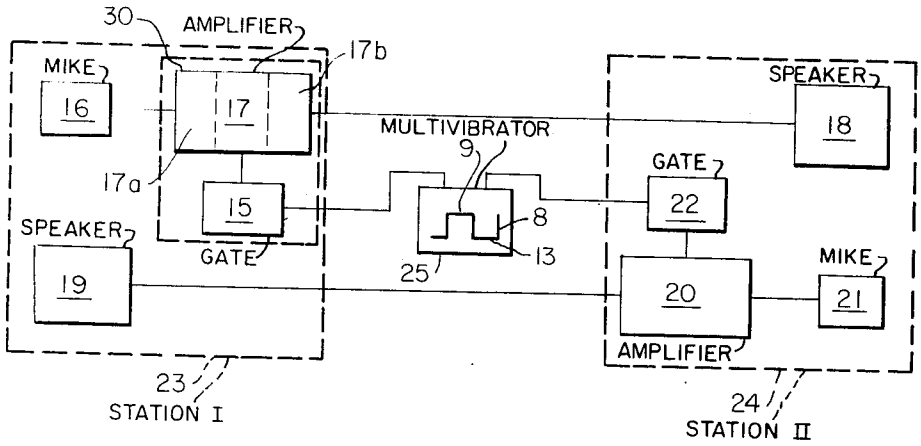
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Primary Examiner—Kathleen H. Claffy
Assistant Examiner—Horst F. Brauner
Attorney—Stowell & Stowell

[57] **ABSTRACT**

An intercommunication system is provided having loudspeakers at each sending and receiving end with means which will permit interrupting of the speaker without acoustic positive feed back in the system which normally would result in howling noises.

13 Claims, 8 Drawing Figures



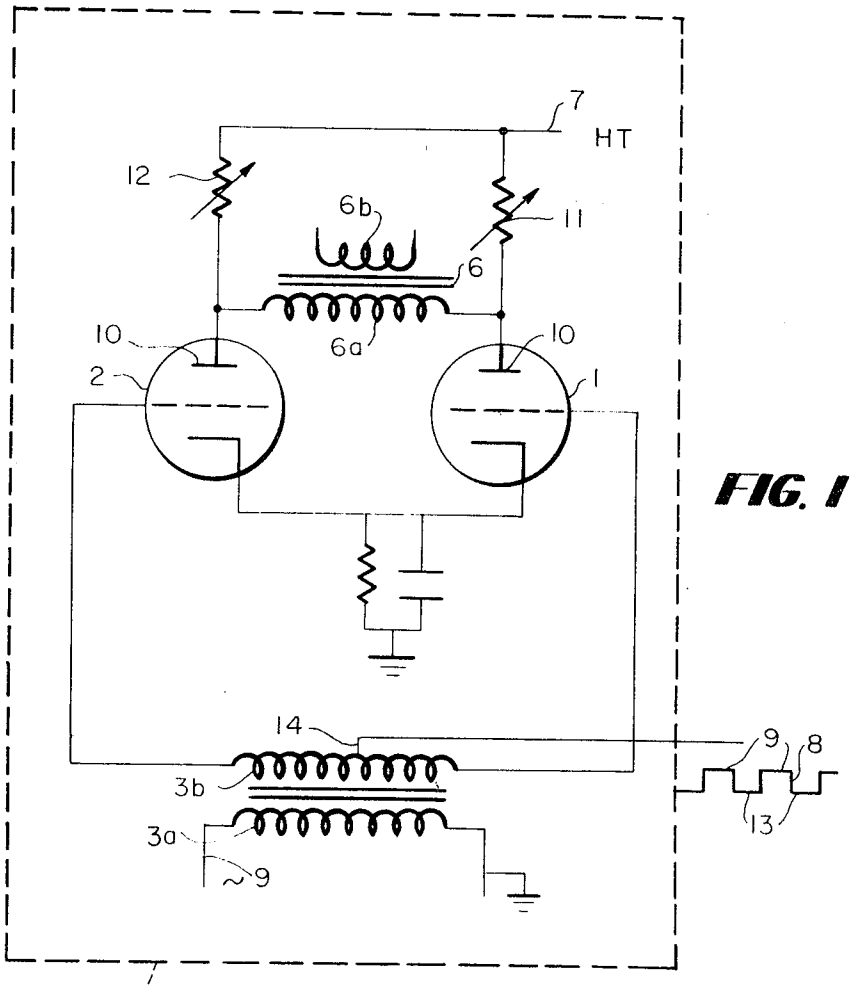


FIG. 1

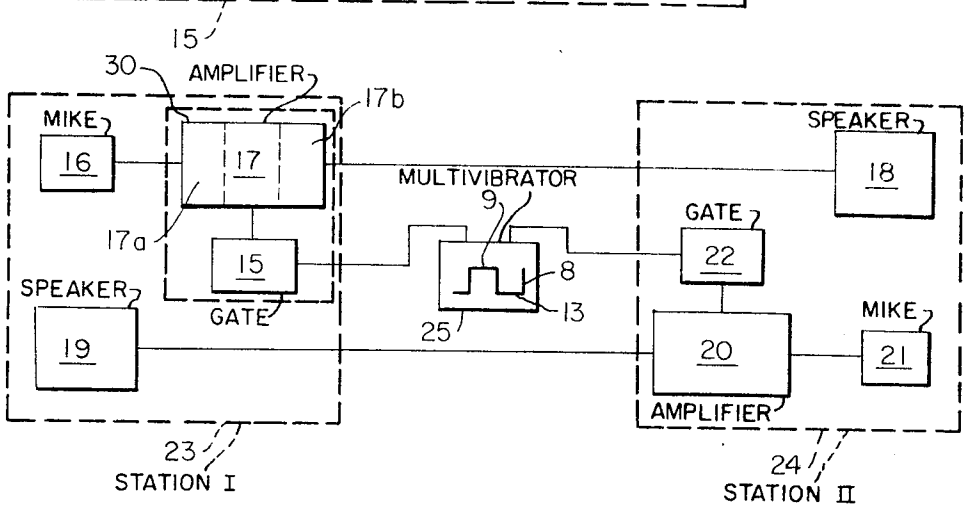


FIG. 2

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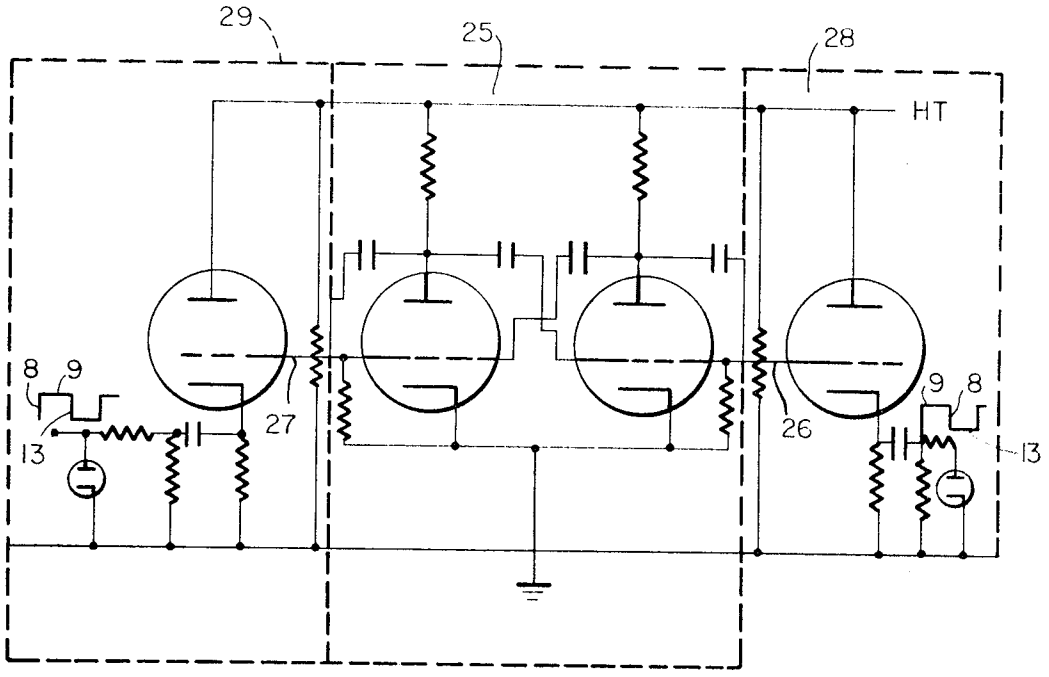


FIG 3

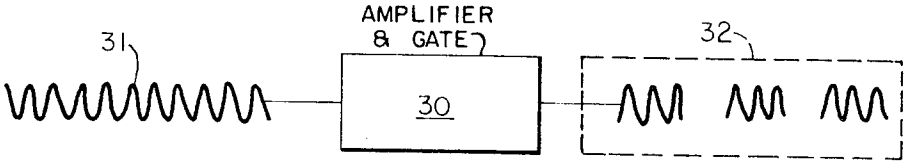


FIG 4

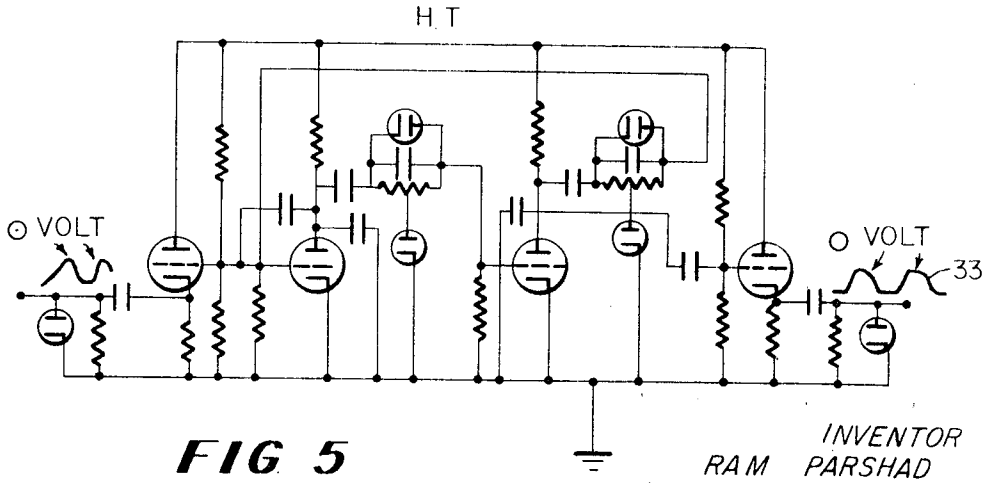


FIG 5

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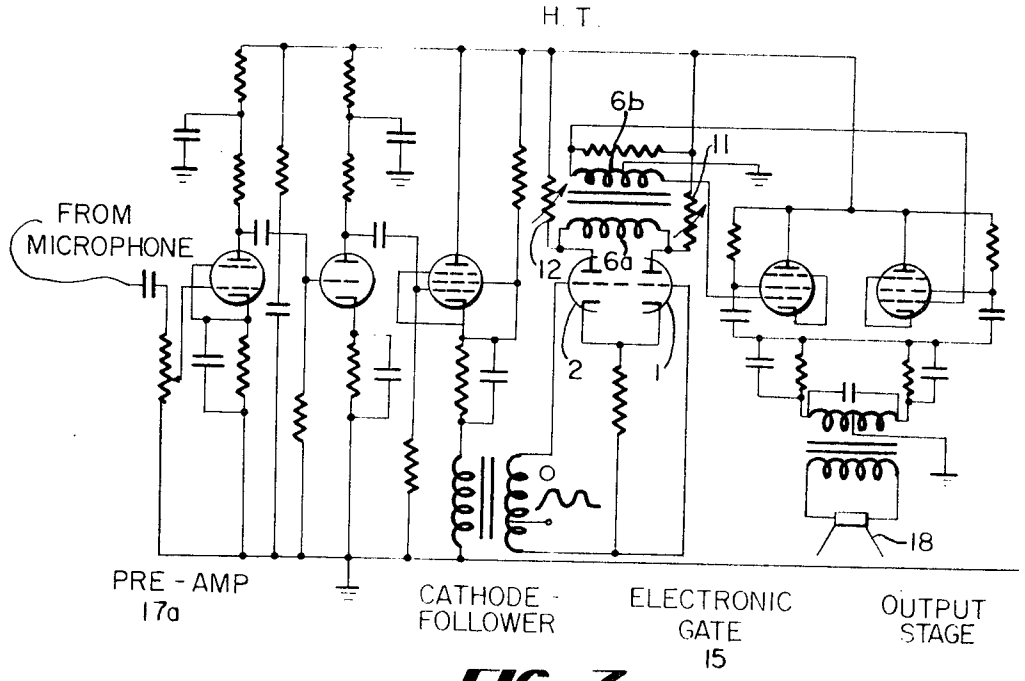


FIG. 7

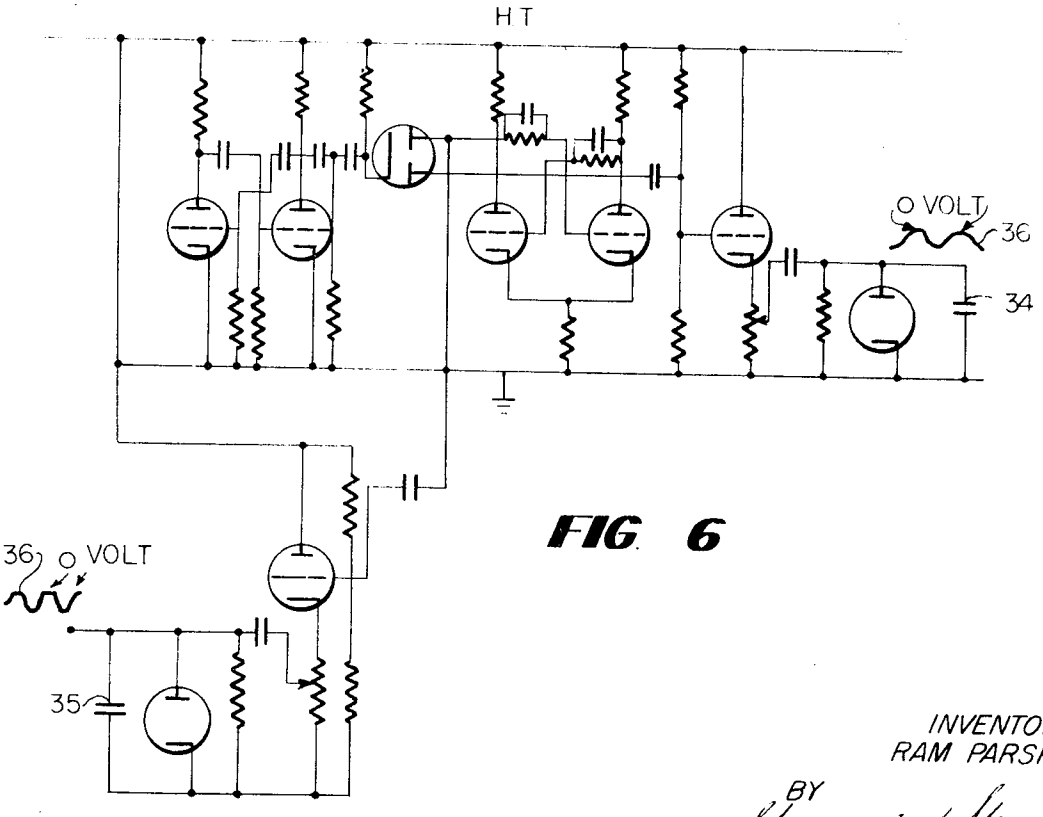


FIG. 6

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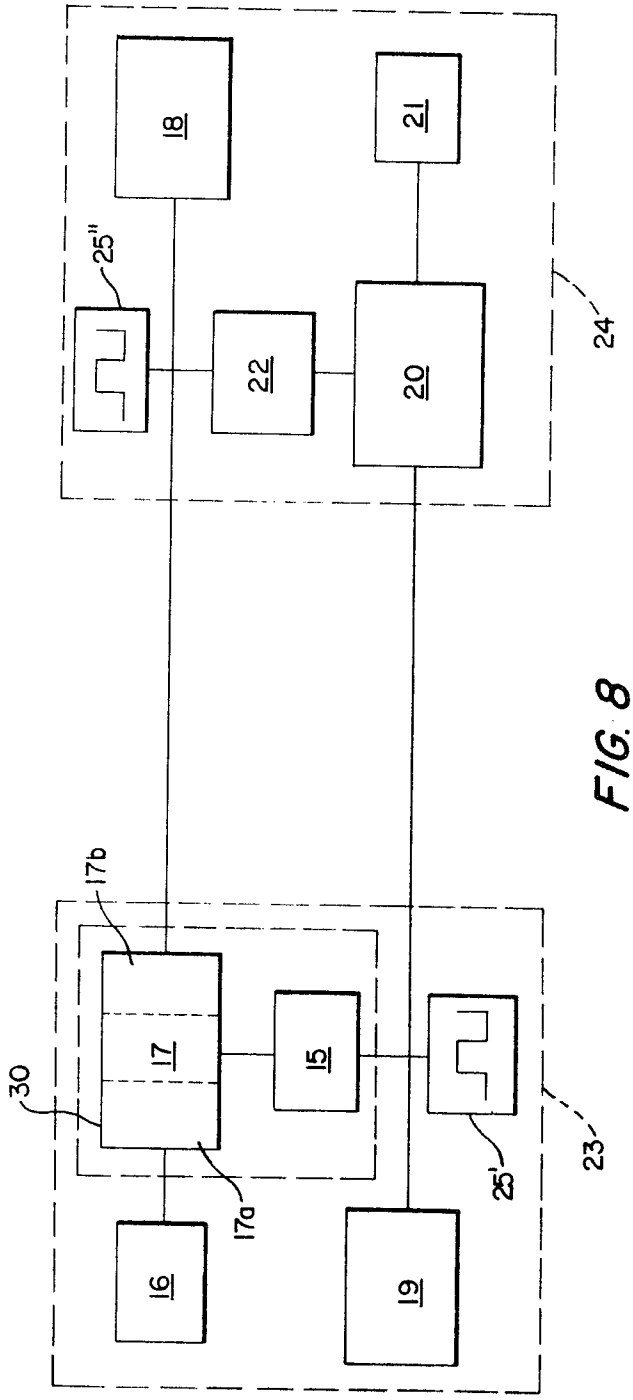


FIG. 8

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INTERCOMMUNICATION SYSTEM

This invention relates to an intercommunication system of the type comprising two speech system.

The hitherto known intercommunication systems are open to the objection that the listener cannot interrupt the speaker. This leads to constrained speaking and loss of speaking time due to manual switching involved.

The object of the present invention is to evolve an intercommunication system whereby the listener can interrupt the speaker at will. This is an entirely new concept with reference to use of loudspeakers at both ends. For instance, a telephone is a simultaneous intercommunication system but does not use loudspeakers at both ends. The difficulty of use of loudspeakers for simultaneous intercommunication is due to the existence of acoustic positive feed back resulting in howling noises and singing.

A conventional system using two units of the microphone amplifier-loudspeaker combination cannot be used for simultaneous intercommunication because there will be a positive acoustic feed back in the system resulting in oscillations and howling noises and singing.

It has been found that by providing an electronic gate on the two amplifiers, the amplifiers can be worked in succession so that 50 percent of the speech content spoken into any microphone comes out at the corresponding loud speaker, thereby making it possible to avoid the positive feed back and yet keep the intelligibility to a satisfactory stage if the switching frequency is in a suitable range. The positive feed back is eliminated because when one amplifier is operating, the other is switched off and vice versa.

It has also been found that the quality of the interrupted speech can be further improved if each amplifier is made to operate for more than 50 percent by using an electronic gate. Though the two amplifiers work simultaneously for some common time in the switching cycle, this interval is not great enough to give appreciable positive feed back to invalidate the simultaneous intercommunication system.

According to the present invention the simultaneous intercommunication comprises:

i. a microphone at one station which is spoken into, an amplifier which amplifies the output from the microphone, a loudspeaker at a second station which reproduces the sound;

ii. a second microphone at the second station which is spoken into, an amplifier which amplifies the output from the microphone, a loudspeaker which reproduces the sound at the first station; and

iii. an electronic gate which switches the two amplifiers on and off in succession.

Thus, by utilizing 50 percent of speech for either channel of communication the two amplifiers will be off and on in succession so that when one amplifier is on, the other is off and vice versa. For utilizing more than 50 percent of speech either way, the two amplifiers will be on together for some portion of the switching cycle (e.g. they may be on together for 20 percent of the switching cycle). The two amplifiers can also be switched on and off periodically with the switching of one amplifier randomly related to the switching of the other.

The invented system enables the listener to interrupt the speaker at will even when loudspeakers are being used, the conversation thus being natural like that between two persons speaking in the same room.

The electronic gate circuit by means of switching pulses, switches the two amplifiers off and on in quick succession, without producing disturbing switching noise.

The switching pulses can either be square-waves or non-square-waves. For obtaining 50 percent of speech content, square-waves can be used, and for obtaining more than 50 percent of speech content, non-square-waves or overlapping square-waves can be employed. The switching pulses used may have steep sides or non-steep sides. The latter are preferable as they produce less switching noise.

The invention will be more particularly described in reference to the accompanying drawing wherein:

FIG. 1 is a circuit diagram of an electronic gate for use in the system of the invention;

FIG. 2 is a block diagram of a system of the invention;

FIG. 3 is a diagram of a suitable square-wave source;

FIG. 4 illustrates diagramatically the production of interrupted speech by means of the electronic gate;

FIGS. 5, and 6 illustrate further circuits for producing wave forms for the gates of the system of the invention; and

FIG. 7 illustrates typical circuit for the audio amplifiers for the system of the invention;

FIG. 8 is a block diagram of the system of the invention showing separate switching pulse sources.

The following is the description of the simultaneous intercommunication system utilizing 50 percent of speech content for either channel of communication.

In FIG. 1 the electronic gate is illustrated and includes two triodes 1 and 2, which are connected in the form of a differential amplifier. The input signal 9 is directed to the two tubes 1 and 2 by means of the input transformer 3*a* – 3*b*. The center top 14 of the secondary 3*b* of the input transformer is connected to a source of square-waves 8. The tops 9 of the square-waves 8 are fixed at 0 volts. The plates 10 of the two tubes 1 and 2 are connected to the H.T. (high tension or high voltage) supply 7 through plate load resistors 11 and 12, which are made variable. The plates 10 are connected to each other through the primary 6*a* of the transformer 6. The output is drawn from the secondary 6*b* of the output transformer 6.

Due to the square-waves 8, the tubes 1 and 2 conduct on and off in quick succession, at the frequency of the incoming square-waves 8. During the time the center tap 14 of the secondary 3*b* input transformer 3*a*–3*b*, is at 0 volts, the tubes 1 and 2 conduct, and amplify the input signal 9'. This signal appears at the output 6*b*. As the center tap 14 takes the negative voltage of bottom 13 of the square-waves 8, the tubes 1 and 2 are off and no signal appears at 6*b*, though the input signal 9' exists. Thus the output signal will be interrupted at the frequency of the square-waves 8. As shown in FIG. 7, the audio signal corresponding to the input from the microphone is applied as input signal 9' across primary winding 3*a*.

Before applying the audio signal to the electronic gate the switching noise is reduced by adjusting-the relative values of resistors 12 and 11. The switching noise can be monitored by either listening to it in the output loudspeaker or by use of a magic eye tube.

The invention is not restricted to the particular embodiment of the electronic gate, herein illustrated in FIG. 1, which is by way of a typical example. The main design feature of the electronic gate is on the one hand to interrupt the speech periodically and at the same time to produce the minimum switching noise in the act of the periodic switching on and off of the audio amplifier.

FIG. 2 illustrates the operation of the simultaneous intercommunication system between two stations 23 and 24.

When a person speaks into the microphone 16 of station 23, the output of this microphone is amplified by the pre-amplifier stage 17*a*, passes through the electronic gate 15, made as a part of the amplifier 17, and finally to the output 17*b*, which produces the sound in the loud speaker 18, at the other station 24.

Correspondingly the speech spoken at station 24 into the microphone 21 comes to the loud speaker 19 at station 23.

The source of the square-wave 8 may consist of multi-vibrators 25 producing square-waves which are fed to the input 26 and 27 of the cathode followers 28 and 29 respectively.

The source of the square-waves 8 may also consist of multi-vibrators and cathode followers of FIG. 5, and a multi-vibrator coupled to a binary flip-flop and cathode followers of FIG. 6.

FIG. 5 is a specially developed circuit for producing good square-waves with steep edges because apart from the conventional circuitry it uses combination of resistors, capacitor, diodes in the plate to grid coupling circuit of the multi-vibrator for squaring the wave-shapes. For producing wave-shapes with rounded edges (of the shape of switching pulses 33 shown

in FIG. 5), capacitors can be connected between plate and ground of multi-vibrators in FIG. 3 (not shown), FIG. 5 (shown) and in FIG. 6 between plates and ground of flip-flops in FIG. 6 (not shown). For still greater rounding of switching pulses and also converting them into approximate triangular shape for passing more than 50 percent speech, capacitors (either singly or in addition to capacitors already used for rounding the edges) can be used between the output and ground at the output side of cathode-followers in FIG. 5 (not shown) and FIG. 6 (condenser 34 and 35). Thus switching pulses 36 of the required non-square shape (approaching triangular shape) would be produced (FIG. 6). The cathode followers in FIGS. 2, 5 and 6 are used for reducing the impedance of switching pulses as it is found that switching noise is the least when the impedance of the source of switching pulses is reduced.

The following describes the system of simultaneous intercommunication utilizing more than 50 percent speech content.

The switching pulses are made small enough and of an approximately triangular shape by means of circuit of FIGS. 3, 5 and 6 in the way described earlier (example switching pulse 36 in FIG. 6). By applying these pulses 36 instead of pulse 8 to the electronic gate of FIG. 1, the following takes place.

As a blocking switching pulse is applied to the electronic gate, its blocking voltage is, due to the approximately triangular nature of the wave form, decreasing with time during a part of the cycle. Hence large amplitude signals can pass through while small signals cannot during this part of this switching cycle. Thus when one amplifier is passing the speech content fully, the other amplifier is also partially passing the speech content. Thus effectively more than 50 percent of speech passes through each channel, resulting in increased intelligibility and improvement of quality.

Although the two amplifiers operate together for a period of the switching cycle, this simultaneous operation is not enough to produce sufficient positive accoustic feed back to produce howling noises and instability. Instead of the use of non-square switching wave-forms of the type of 36 in FIG. 6, overlapping rounded square-waves can be also used so that the amplifiers are permitted to operate simultaneously during the part of the switching cycle, when the switching pulses are overlapping.

Another way of operating the simultaneous intercommunication system is as follows:

Each communication station is provided with its own source of square-waves for operating its amplifier off and on in succession. For example, station 23 may be provided with a multivibrator 25' and station 24 may be provided with a multivibrator 25'' as shown in FIG. 8. Due to the random phase relation of the square-waves from the two sources, one in each communication station, there will not be enough sustained interval during which the two amplifiers will be on at the same time for accoustic positive feed back to occur for howling noises and instability to occur.

This arrangement of each communication station having its own source of switching pulses randomly related to the production of the switching pulses at the other station, has the advantage of doing away with a central control of the switching of the amplifiers involving the use of long leads laid from the source of switching pulses to each station.

The circuits of FIGS. 1, 2, 3, 5 and 6 may use vacuum tubes, transistors or both.

In the conventional system of intercommunication, the whole portion of the speech wave is utilized. But in the invented device, about 50 percent or more of the speech content is utilized, 50 percent of the speech content being sufficient for good intelligibility. The use of interrupted speech can avoid the positive feed back because the two amplifiers of the two stations can, by means of the switching pulses and electronic gates, be operated in succession, so that when one amplifier is on, the other is off. Thus there will be no positive feed back because when one loud speaker is working and its sound is falling on the adjacent microphone, the speech picked up by the microphone will not go to the other end because the amplifier for this microphone is in the switched off state.

In the case when the two amplifiers are allowed to operate simultaneously in the switching cycle, (for obtaining more than 50 percent speech or for use of independent switching pulse generators at the two communication stations, sufficient positive feed back is not developed thereby to produce howling noises, singing and instability. The amount of positive feed back which can be tolerated also depends upon how close the microphone and loud speaker are at each station.

In the above simultaneous intercommunication system, the optimum frequency of interruption of speech can be determined by trial and is generally in the neighborhood of 150 cycles per second and 2,500 cycles per second. Mainly the lower frequency is preferred. It was found that the least switching noise is produced in the loud speaker, when the audio input to the electronic gate is at low impedance. For this purpose the input audio is applied to the electronic gate from a cathode follower.

FIG. 7 shows a representative circuit of the audio amplifier for simultaneous intercommunication. For the best working of the amplifier for simultaneous intercommunication, the amplifier should be of high quality and low noise.

The advantage of the invented system of simultaneous intercommunication system is that two people at two stations using loud speakers can converse simultaneously, or in other words, the listener can interrupt the speaker at will, which facility is not available in the conventional intercommunication system, where the listener can speak back only when the speaker, after he has finished his speech, has operated a push button switch, thereby converting his transducer which was up till now being used as a loudspeaker, into a microphone. Correspondingly the listener for speaking back, has to operate a push-button switch, converting his transducer from a microphone to a loudspeaker. Only at this stage can the listener speak back.

I claim:

1. An intercommunication system for simultaneous communication between opposite stations comprising a first station and a second station, said first station including a microphone adapted to receive a spoken message and an amplifier connected to said microphone for amplifying the spoken message, a loudspeaker at said second station connected to receive the amplified spoken message from the first station establishing a first communication channel, said second station including a microphone adapted to receive a spoken message and an amplifier connected to said microphone for amplifying the spoken message at the second station, a loudspeaker at said first station connected to receive the amplified spoken message from said second station establishing a second communication channel, each said amplifier including electronic gate means for switching the two amplifiers on and off in timed succession such that only a portion of the spoken message is transmitted between stations in each direction thereby minimizing the effects of positive accoustic feedback.

2. An intercommunication system is set forth in claim 1 wherein said timed succession is such that said amplifiers are switched alternately and approximately 50 percent of the spoken message is transmitted in each communication channel.

3. An intercommunication system as set forth in claim 1 wherein said timed succession is such that said amplifiers are switched on together for a portion of the switching cycle.

4. An intercommunication system as set forth in claim 3 wherein said portion is 20 percent of the switching cycle.

5. An intercommunication system as set forth in claim 1 wherein the switching of one amplifier is randomly related to the switching of the other amplifier.

6. An intercommunication system as set forth in claim 1 including means for providing switching pulses to each gate for controlling the switching of said amplifiers.

7. An intercommunication system as set forth in claim 6 wherein said means is common to both communication channels.

8. An intercommunication system as set forth in claim 6 wherein said means includes a separate source of switching pulses connected to an associated gate of the separate communication channels.

9. An intercommunications system as claimed in claim 1 wherein the switching pulses to the electronic gate are applied from a source of low impedance.

10. An intercommunications system as claimed in claim 1 wherein the input speech to the electronic gate is drawn from a source of low output impedance.

11. An intercommunications system as claimed in claim 1 wherein the switching pulses for the electronic gate have rounded edges.

12. An intercommunications system as claimed in claim 1, wherein the switching pulses for the electronic gate are of triangular shape.

13. An intercommunications system as claimed in claim 1 wherein the two amplifiers overlap in time during a portion of the switching cycle.

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