Dec. 13, 1966 C. E. McCULLOUGH 3,291,911

TWO-WAY INTERCOMMUNICATION SYSTEM

Filed April 1, 1963 2 Sheets-Sheet 1

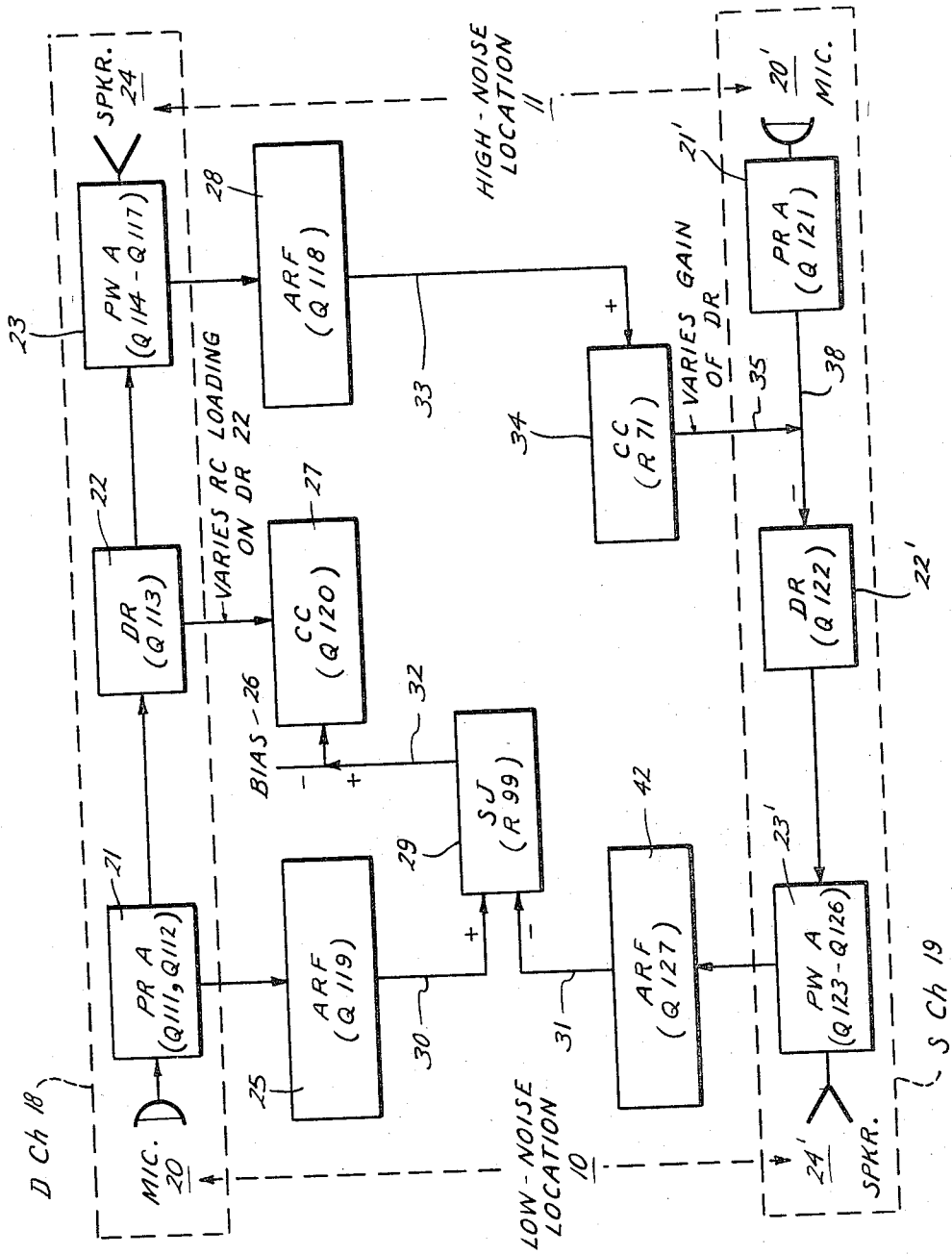



Fig. 1

Charles E. McCullough
INVENTOR.

BY Arnold and Roylance

ATTORNEYS

Dec. 13, 1966 C. E. McCULLOUGH 3,291,911

TWO-WAY INTERCOMMUNICATION SYSTEM

Filed April 1, 1963 2 Sheets-Sheet 2

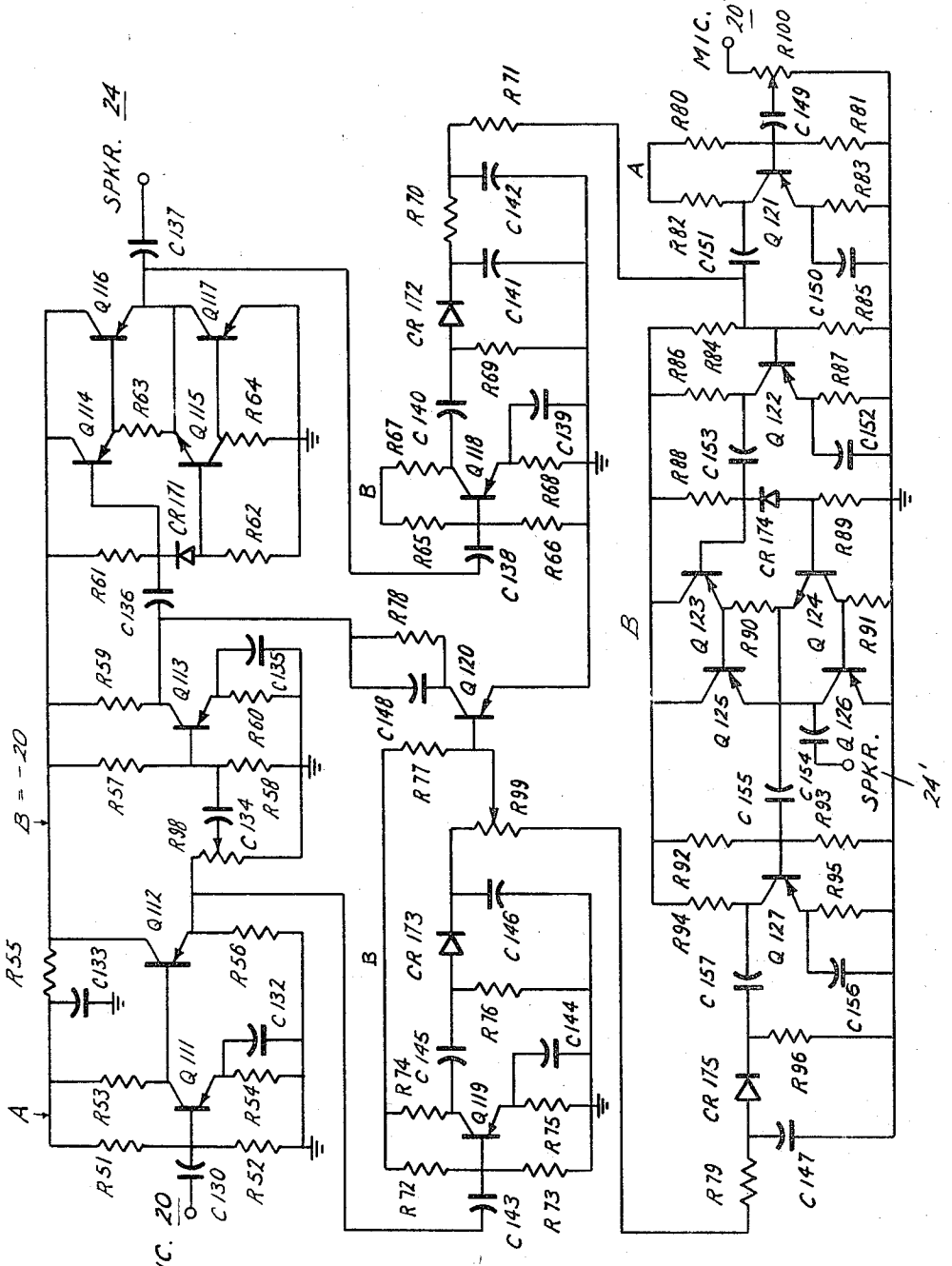



Fig. 2

Charles E. McCullough
INVENTOR.

BY Arnold and Roylance

ATTORNEYS

United States Patent Office 3,291,911 Patented Dec. 13, 1966



3,291,911

# TWO-WAY INTERCOMMUNICATION SYSTEM

Charles E. McCullough, Austin, Tex., assignor to Kaman Aircraft Corporation, Bloomfield, Conn., a corporation of Connecticut

Filed Apr. 1, 1963, Ser. No. 269,408
9 Claims. (Cl. 179—1)

This invention relates to a two-way intercommunication system for operation between two locations. More particularly, the invention relates to a novel two-way system which is capable of operation without harmful and annoying feedback. While the system is useful in a situation where background noise at the two locations is about equal, it is particularly useful in those situations where one of the microphone locations is subjected to a heavy concentration of audible background noise. The invention further relates to a completely automatic installation in which either station may transmit without the necessity for manual switching.

Harmful feedback is that characteristic high-pitched squeal oftentimes heard over loud speakers at public gatherings and the like, which often proves very annoying to the person talking and is quite uncomfortable to the listening audience. Most prior art two-way systems have not been completely successful in two channel operations for a number of reasons, but particularly so because of two important reasons. First, most systems have used voice-operated switches or relays to activate the desired channel, which channel has previously been *completely muted,* but some delay is inherent. As a result, the beginning of speech occurs before operation of the switch can activate the communicating channel. This can severely limit the intelligibility of communications, especially in short, single-word transmissions.

A second big disadvantage of many systems is that they operate in such a way that the channel not in use, or the channel carrying the *smallest* signal is *blocked or muted.* This means that the person talking the loudest would dominate. Although such a system will definitely eliminate feedback, its operation is particularly unsatisfactory if one station is located in a noisy environment, such as a bank drive-in teller station, since the noise tends to keep the opposite channel (i.e., the channel having the microphone located in the low noise area) muted at all times. This undesirable situation may occur in any system in which it is possible for *either* of the two channels to mute the other.

United States patents which are representative of the state of the art include: Hoard, 2,205,142; Jeanlin, 2,545,466; Jeanlin, 2,545,467; Levy, 2,545,476; Levy, 2,545,477; Hardy, 2,694,749; Jeanlin, 2,743,314; and Laurence, 2,878,314.

Briefly stated, the invention herein is a two-way intercommunication system having two channels, one of which is arranged to be the dominating channel, but which dominating channel is partially muted, i.e., has reduced gain and/or reduced high frequency response (preferably both) when it is not transmitting a voice communication. There is a second channel which is designed to operate at full gain and high frequency response at all times, except when there is communication through the dominating channel. Each of the channels has a microphone and a speaker with audio amplifier means connected therebetween. In addition, there are appropriate control circuits which normally and automatically partially mute the dominating channel but which automatically permit the dominating channel, when voice communication originates at its microphone, to have increased gain and/or high frequency response and thereby dominate (i.e., partially mute) the second channel. For convenience the condition which exists when the dominating channel is operating at increased gain and/or increased high frequency response will sometimes be referred to as increased sensitivity. These control circuits are so arranged to also prevent harmful feedback.



It is an object of this invention to provide a two-way intercommunication system which will operate automatically without "clipping" part of the speech or give the sensation of cutting on and off.

It is another object of this invention to provide a system which is useful between two locations which have about equal background noise levels.

It is an object of this invention to provide a two-way communication system which can operate successfully where one of the locations has a high background noise level.

It is a further object of this invention to provide a system which will operate automatically without harmful feedback.

Yet another object is to provide a system where neither channel is completely muted, but in which the gain of each may be reduced to avoid the "dead" mike sensation.

A still further object is to provide a communication system for automatic communication between two or more locations without harmful feedback, without the sensation of a dead microphone, and without "clipping" portions of speech transmissions.

These and other objects of the invention will be apparent by a fuller description of the invention by reference to the drawings wherein:

FIG. 1 is a block diagram showing one embodiment of the invention, and

FIG. 2 is a detailed diagram of the circuit arrangement of the system shown in FIG. 1.

For convenience in designating the various parts in the figures and in presenting the description herein, the following abbreviations may from time to time be used:

R—resistor
Q—transistor
CR—crystal diode or rectifier
C—capacitor
Mic—microphone
Spkr—speaker
Dr—driver
PrA—pre-amplifier
PwA—power amplifier
ARF—amplifier, rectifier, filter circuit
CC—control circuit
SJ—sum junction
+—positive voltage
——negative voltage
A—indicates a common connection with other elements so similarly designated
B—indicates a common connection to a power source
D Ch—dominating channel
S Ch—second channel
RC—resistance capacitance

More specifically, the invention to be described overcomes the foregoing short-comings of the prior art with respect to apparent switching or "dead" microphone effect, by simply partially muting, i.e., limiting the gain and/or the high frequency response (but preferably both), of one of the channels instead of muting it completely when it is not in use. Thus, limiting either the overall gain or the high frequency response (preferably both) will limit the gain over the frequency range where harmful feedback ordinarily occurs, but will still allow enough signal to pass at the lower (voice) frequencies at all times so that the sensation of switching is less or non-apparent.

The problem with respect to high audible background noise at one of the stations is overcome by allowing only

one channel, i.e., the dominating channel, to have control of the gain of the opposite channel, i.e., the second channel, rather than permitting either channel to control the other. This desired result is accomplished by a circuit means in the form of a negative feedback system between the dominating channel and the second channel, whereby when the dominating channel is operating at increased gain and/or high frequency response, i.e., increased sensitivity, which would ordinarily be caused by a communication originating at the microphone of the dominating channel, there is a negative feedback to the second channel which performs two functions.

First, this negative feedback system partially mutes, i.e., reduces the gain and/or high frequency response of the second channel, whenever the dominating channel is in use, i.e., when communication is *originating* at the microphone of the dominating channel. Second, it eliminates the possibility of regenerative feedback by automatically partially muting, i.e., reducing the gain and/or high frequency response of the second channel whenever feedback starts to occur. Thus, the desired mode of operation is obtained when the input to the second channel is from the station in the noisy environment, since noise into the second channel cannot block or mute the dominating channel.

Reference to the drawings will explain the preferred operation of the system in greater detail. FIG. 1 shows a first channel or dominating channel as D Ch **18** and a second channel as S Ch **19**. D Ch **18** has a first microphone, Mic **20** and a first speaker, Spkr **24**. Mic **20** and Spkr **24** are connected by audio amplifier means in the form of a pre-amplifier indicated as PrA **21**, a driver as Dr **22**, and a power amplifier as PwA **23**.

S Ch **19** is similarly arranged with Mic **20'**, PrA **21'**, Dr **22'**, PwA **23'**, and Spkr **24'**. If one of the locations to be communicated between is relatively high in audible background noise, then Spkr **24** and Mic **20'** would be located as shown at high-noise location **11**, and Mic **20** and Spkr **24'** would be positioned as shown at low-noise location **10**.

It is obvious that if the communication system consisted of no additional control circuits, sound could travel from Mic **20**, through D Ch **18** to Spkr **24** to adjacent Mic **20'** and similarly back to Mic **20**, which would result in harmful regenerative feedback. With the additional control circuits which are provided, this cannot occur.

Thus, there is provided appropriate control circuits, which in the preferred form utilize transistors, but vacuum tubes could be employed. Each of the Q numbers designated in the various components shown on FIG. 1 correspond to transistors shown in FIG. 2, and the single letters R likewise refer to resistors.

As shown in FIG. 2, power is supplied in the form of a common direct current to those portions of the circuit indicated by B. Both PrA **21** and PrA **21'** are connected to a decoupling filter comprising R **55** and C **133** by leads (not shown) joined at points indicated by the letter A in FIG. 2.

D Ch **18** is automatically controlled so as to be normally, partially muted, i.e., to operate at reduced gain and/or reduced high frequency response, when no communication is originating at Mic **20**, by a first means in the form of an electrical control circuit shown as CC **27**, which takes some of the signal from Dr **22**, i.e., places an extra electrical load on Dr **22**, which in the form shown, is done by varying the RC load thereon, as will be explained hereinafter.

A second means is also provided for cutting off or deactivating CC **27** when communication is originating at Mic **20**, but not when communication is originating only from Mic **20'**, which means takes the form of a second electrical control circuit comprising ARF **25**, ARF **42**, SJ **29**, and lead **32** to CC **27**.

A third means for automatically reducing the gain of S Ch **19** when D Ch **18** is operating at increased gain conveniently takes the form of a third electrical circuit comprising ARF **28** and CC **34**, which varies the gain of Dr **22'**, as will be explained hereinafter.

Operation of the system will now be described in five phases as follows:

(1) No signal present at either Mic **20** or Mic **20'**,
(2) Input signal only to D Ch **18** at Mic **20**,
(3) Input signal only to S Ch **19** at Mic **20'**,
(4) Noise input only to S Ch **19** at Mic **20'**, and
(5) Input signal to both channels at Mic **20**, **20'** simultaneously.

(1) No signal present at either Mic **20** or Mic **20'**: When no signal is present at either Mic **20** or Mic **20'**, which condition will be referred to as normal operation, S Ch **19** will be operating at full gain and fidelity and/or frequency response. However, D Ch **18** will be partially muted, i.e., operating at reduced gain and reduced high frequency response, because of the operation of CC **27**. Bias **26**, in the form of a negative voltage created by R **77** is placed on the base of Q **120**, which places a parallel RC load (in the form of C **148** and R **78**) on Dr **22**, which then reduces the value of the signal PwA **23**. Since there is no signal at either Mic **20** or Mic **20'**, CC **27** is controlled only by bias **26**. Regenerative feedback cannot occur since any increased sensitivity, i.e., increased gain and/or high frequency response in D Ch **18** would produce a signal that would be transmitted to S Ch **19** by a third electrical circuit means in the form of ARF **28**, where the signal would be amplified, rectified and filtered to produce a *positive* voltage which would automatically, through CC **34**, reduce the gain of S Ch **19** by varying the bias on Dr **22'**.

ARF **28** and CC **34** are so arranged that they are not responsive to the reduced gain and low frequency responses communicated by D Ch **18** during normal operation, but are responsive to increased gain and/or higher frequencies, i.e., increased sensitivity, which occurs when communication originates at Mic **20**. Thus, a positive voltage is applied to Dr **22'** only when D Ch **18** is operating at increased sensitivity.

(2) Input signal only to D Ch **18** at Mic **20**: Since the gain and high-frequency response of D Ch **18** are normally reduced as long as no input signal is present at Mic **20**, CC **27** must increase these to a higher level before a signal can be transmitted at full volume and fidelity. This is accomplished by a first rectifier or connecting circuit in the form of ARF **25**, which takes the signal at PrA **21** caused by communication originating at Mic **20**, and amplifies, rectifies and filters the signal to produce a *positive* signal which is applied to SJ **29**. SJ **29** is in the form of a potentiometer which is adjustable to be in balance when receiving equal and opposite voltage contributions from ARF **25** and ARF **42**, which balance would only occur when communication is originating only at Mic **20'**. Therefore, when a positive voltage is supplied to SJ **29** from ARF **25**, as in the present case, it will not be balanced by a voltage from ARF **42**, hence a positive voltage is supplied to CC **27** via lead **32**, which voltage is arranged to overcome bias **26**, at which point Q **120** can no longer conduct and the RC load on Dr **22** is removed, permitting D Ch **18** to operate at increased gain and high frequency response. When communication is no longer originating at Mic **20**, D Ch **18** will return to normal operation.

The values of C **148** and R **78** which place the RC load on Dr **22** are selected to control the gain and to control the high frequency response of D Ch **18**, but also to provide enough residual gain and low-frequency response so that the sensation of switching or turning on and off is not noticeable.

Regenerative feedback cannot occur since, as described above, when the gain and high frequency response of D Ch **18** is increased, a positive voltage is transmitted to Dr **22'** via ARF **28**, lead **33**, CC **34**, and lead **35**. The resulting decrease in negative bias on Dr **22'** decreases the gain of S Ch **19** to prevent feedback.

(3) Input signal only to S Ch **19** at Mic **20'**: Since S Ch **19** normally operates at full gain and fidelity, any input signal applied to S Ch **19** via Mic **20'** could pass directly to Spkr **24'**. However, if it were not for a second rectifier or connecting circuit in the form of ARF **42**, the sound from Spkr **24'** would enter Mic **20** and cut off CC **27**, thereby increasing the gain on D Ch **18**, which would permit a signal to go to ARF **28** and be applied to Dr **22'**, with the resulting undesirable effect being a reduction in the gain of S Ch **19**, while it should be at normal full gain to carry the communication originating at Mic **20'**.

To overcome this difficulty, the signal from PwA **23'** is amplified, rectified and filtered by ARF **42**, to provide a *negative* voltage which is applied to SJ **29**, which is a variable resistor, as described above, and which may be adjusted for the optimum relative positive and negative contributions from ARF **25** and ARF **42**, and thus be in balance when communication is originating only at Mic **20'**. As the output signal from S Ch **19** increases, the output voltages from ARF **25** and ARF **42** increase in approximately the same proportion, hence there will be no output voltage from SJ **29** to CC **27** and therefore the sound originating from Spkr **24'** will have no effect on the gain of S Ch **19**.

(4) Noise only input to S Ch **19** at Mic **20'**: The operation of the system with noise input to S Ch **19** at Mic **20'** is essentially the same as for a communication signal into S Ch **19** as described in phase (3) above. It is important to the operation of the system that SJ **29** be balanced, i.e., properly adjusted so that the voltage from ARF **25** into CC **27** resulting from sound originating in Spkr **24'** is exactly cancelled at SJ **29** by the opposite polarity voltage from ARF **42**. Thus, whenever the sound into Mic **20** is from Spkr **24'**, CC **27** maintains the RC load on Dr **22**. However, additional sound into Mic **20**, in the form of a communication originating at Mic **20** will produce an increased output voltage from ARF **25** which is not cancelled by ARF **42**, and CC **27** will then increase the gain and high frequency response of D Ch **18**, which will then be the dominating channel and will reduce the gain of S Ch **19**. Hence, the noise into Mic **20'** is audible in Spkr **24'**, but does not interfere with normal automatic operation of the two-way system.

(5) Input signal to both Mic **20** and Mic **20'**: When there is communication originating at Mic **20** and Mic **20'** simultaneously, D Ch **18** will, of course, dominate just as described above in phase (4) when noise is originating at Mic **20'**. The gain of S Ch **19** will be reduced until communication ceases at Mic **20**.

Thus, there is provided a two-way intercommunication system which works automatically without impairing speech transmission and without the "dead" microphone effect, which operates wtihout troublesome feedback, and which is useful particularly where one location is subject to high background noise.

There are, of course, many variations which are possible with this invention. Variable resistors R **98** and R **100** are provided so as to establish the desired volume controls. The values of the various components would vary from installation to installation, depending on the particular circumstances of each. For example, Q **120**, R **77**, C **148** and R **78** are selected so as to place the desired load on Dr **22**. Also, C **147**, C **146**, R **79** and R **99** are selected to provide the desired speed at which SJ **29** is to function.

As shown in FIG. 2, CC **34** reduces only the gain of S Ch **19**. It could be arranged to also limit the high frequency response of S Ch **19** by the addition of another transistor, in much the same manner as CC **27**. For convenience, the condition which exists when S Ch **19** is operating at reduced gain and/or reduced high frequency response sometimes will be referred to as partially muted.

Other amplifier means, such as amplifiers utilizing electronic tubes, could be used as well as the transistor amplifiers shown.



The system is useful in a variety of situations where two-way communication is necessary between two locations separated by a sound barrier. It is particularly useful where one station has a high audible noise level since the system operates without harmful feedback as described above.

The positive voltage applied to Dr **22'** by CC **34** when D Ch **18** is operating at increased gain could, of course, be taken from SJ **19**, which provides a positive voltage only when there is communication originating at Mic **20**. However, the design shown is preferred because of the more uniform signal received from PwA **23** via ARF **28**.

The system could be operated as a multi-channel system by providing D Ch **18** with an additional speaker at a third location and S Ch **19** with an additional microphone located at the third location, thus providing an additional location which could be in communication with the dominating channel.

The novel arrangement of the system and the positive control on feedback has presented the art with a highly successful two-way intercommunication system. There are actually two controls on feedback in that the electrical circuit formed by ARF **28** is one means of control and the operation of SJ **29**, when properly adjusted, acts as another control. Further, there is no noticeable squeal coming over the speakers when not transmitting communications.

Modifications may be made in the invention as particularly described without departing from the scope of the invention. Accordingly, the foregoing description is to be construed illustratively only and is not to be construed as a limitation upon the invention as defined in the following claims.

I claim:

**1.** In an intercommunication system capable of two-way voice communication without regenerative feedback, the combination comprising:

a dominating channel having a first microphone located at a first location, a first speaker located at a second location, and audio amplifier means connected therebetween,

a second channel normally operating at full gain and having a first microphone located at said second location, a second speaker located at said first location, and audio amplifier means connected therebetween,

a first electrical circuit means automatically, partially muting said dominating channel when there is no communication originating at said first microphone,

a second electrical circuit means automatically deactivating said first means during the time when communication is originating at said first microphone, and

a third electrical circuit means automatically, partially muting said second channel when said dominating channel is operating at increased sensitivity, muting of said second channel being responsive only to communication originating at said first microphone.

**2.** In an intercommunication system capable of two-way voice communication without regenerative feedback for operation between a low audible noise location and a relatively high audible noise location, the combination comprising:

a dominating channel having a first microphone located in said low noise location and a first speaker located in said high noise location and audio amplifier means connected therebetween,

a second channel normally operating at full gain and having a second microphone located in said high noise location and a second speaker located in said low noise location and audio amplifier means connected therebetween,

a first electrical means automatically and normally maintaining said dominating channel in a partially muted state,

a second electrical means automatically deactivating said first means during the time when there is communication originating at said first microphone,

a third electrical means automatically reducing the gain of said second channel when said dominating channel is operating at increased sensitivity, and

a fourth electrical means connecting said second channel with said second electrical means for transmitting a signal from said second channel to said second electrical means for automatically keeping said second electrical means from deactivating said first electrical means until communication originates at said first microphone.

3. In an intercommunication system capable of two-way voice communication without regenerative feedback, the combination comprising:

a dominating channel having a first microphone located at a first location, a first speaker located at a second location, and audio amplifier means connected therebetween,

a second channel normally operating at full gain and having a second microphone located at said second location, a second speaker located at said first location, and audio amplifier means connected therebetween,

a first electrical circuit connected to said dominating channel and automatically, partially muting said dominating channel when there is no communication originating at said first microphone,

a second electrical circuit connected between said dominating channel and said first circuit and automatically deactivating said first circuit during the time when communication is originating at said first microphone,

a third electrical circuit connecting said dominating channel and said second channel and partially muting said second channel when said dominating channel is operating at increased sensitivity, muting of said second channel being responsive only to said dominating channel at increased sensitivity.

4. A communication system for communicating between two locations separated by a sound barrier comprising:

a dominating channel having a first microphone located at a first location, a first speaker located at a second location, and audio amplifier means connected therebetween,

a second channel normally operating at full gain and fidelity and having a second microphone located at said second location, a second speaker located at said first location, and audio amplifier means connected therebetween,

a first electrical means connected to said dominating channel and automatically and normally partially muting said dominating channel,

a second electrical means connecting said dominating channel and said first electrical means and automatically deactivating said first electrical means when communication is originating at said first microphone,

a third electrical means connecting said dominating channel and said second channel and automatically transmitting a signal to said second channel when said dominating channel is operating at increased sensitivity, which said signal partially mutes said second channel, muting of said second channel being responsive only to communication originating at said first microphone, and a fourth electrical means connecting said second channel with said second electrical means for automatically keeping said second electrical means from deactivating said first electrical means until communication originates at said first microphone.

5. In an intercommunication system capable of two-way voice communication without harmful regenerative feedback for operation between a low audible noise level location and a relatively high audible noise level location the combination comprising:

a dominating channel having a first microphone located in said low noise location, a first speaker located in said high noise location and an audio amplifier means connected therebetween,

a second channel having a second microphone located in said high noise location, a second speaker located in said low noise location, and audio amplifier means connected therebetween,

a first control circuit connected to said dominating channel automatically and normally reducing the gain and high frequency response of said dominating channel,

a second control circuit automatically transmitting a first signal from said dominating channel to said first control circuit when communication is originating at said first microphone, which first signal is adapted to cut off said first control circuit,

a third control circuit transmitting a second signal from said dominating channel to said second channel when said dominating channel is operating at increased gain and high frequency response, which said second signal controls the gain of said second channel, the gain of said second channel being controlled only in response to a signal originating in said dominating channel, and a third signal from said second channel to said second control circuit to negative transmission of signal from said second control circuit to said first control circuit until communication originates at said first microphone.

6. In an intercommunication system capable of two-way voice communication without harmful regenerative feedback for operation between a low audible noise location and a relatively high audible noise location, the combination comprising:

a dominating channel having a first microphone located in said low noise location, a first speaker located in said high noise location, and audio amplifier means connected therebetween.

a second channel normally operating at full gain and fidelity and having a second microphone located in said high noise location, a second speaker located in said low noise location, and audio amplifier means connected therebetween,

a first control circuit connected to said dominating channel and automatically and normally partially muting said dominating channel,

a second control circuit comprising:

a first rectifier circuit connecting said dominating channel and a sum junction,

a second rectifier circuit connecting said second channel and said sum junction, said sum junction being adjusted to be in balance when communication is originating only at said second microphone, and

a circuit means between said sum junction and said first control circuit and automatically transmitting a signal therebetween only when communication is originating at said first microphone, which said signal cuts off said first control circuit,

a third control circuit automatically transmitting a signal from said dominating channel to said second channel when said dominating channel is operating at increased sensitivity, which said signal partially mutes said second channel.

7. In an intercommunication system capable of two-way communication without harmful regenerative feedback for operation between a low audible noise location and a relatively high audible noise location, the combination comprising:

a dominating channel having a first microphone located in said low noise location, connected with a pre-amplifier, a driver, a power amplifier, and a first speaker, which said first speaker is located in said high noise location,

a second channel having a second microphone located in said high noise location, connected with a second pre-amplifier, a second driver, a second power ampli-

fier and a second speaker, which said second speaker is located in said low noise location,

a first control circuit connected to said first driver and automatically placing an extra electrical load thereon, which load partially mutes said dominating channel,

a second control circuit comprising:

a first rectifier circuit connecting said first preamplifier and a sum junction,

a second rectifier circuit connecting said second channel and said sum junction, said sum junction being adjusted to be in balance when communication is originating only at said second microphone, and

a circuit means automatically transmitting a signal from said sum junction to said first control circuit when said sum junction is unbalanced by a communication originating at said first microphone, which said signal is adapted to remove said load from said first driver, and

a third control circuit automatically transmitting a signal from said dominating channel to said second channel when said dominating channel is operating at increased sensitivity, which said signal controls the gain of said second channel.

8. A communication system for communicating between two locations separated by a sound barrier comprising:

a dominating channel having a first microphone located at a first location, a first speaker located at a second location, and audio amplifier means connected therebetween,

a second channel normally operating at full gain and having a second microphone located at said second location, a second speaker located at said first location, and audio amplifier means connected therebetween,

a first electrical control circuit connected to said dominating channel and automatically and normally causing said dominating channel to be partially muted,

a second electrical control circuit comprising:

a first connecting electrical circuit connecting said dominating channel and a sum junction and transmitting a first signal therebetween when communication is originating at said first microphone,

a second connecting electrical circuit connecting said second channel and said sum junction and transmitting a second signal originating at said second microphone, said sum junction being adjusted to be in balance when communication is originating only at said second microphone, and

a lead connecting said sum junction and said first control circuit for transmitting a signal therebetween, which said signal cuts off said first control circuit,

a third electrical control circuit connecting said dominating channel and said second channel for automatically communicating a signal therebetween, which said signal partially mutes said second channel.



9. A communication system for communicating between at least two locations separated by a sound barrier comprising:

a dominating channel and a second channel, each of said channels comprising a microphone, audio amplifier means and a speaker connected together,

a first electrical control circuit connected to said dominating channel and automatically and partially muting said dominating channel when communication is not originating at said microphone connected to said dominating channel,

a second electrical control circuit comprising

a first amplifier, rectifier, filter circuit connecting said dominating channel and a sum junction, and transmitting a signal to said sum junction when said dominating channel is receiving an audio signal,

a second amplifier, rectifier, filter circuit connecting said second channel and said sum junction, and transmitting a signal to said sum junction when said second channel is transmitting a communication, said sum junction being adjusted to be in balance when communication is originating at the microphone of said second channel,

an electrical lead transmitting a signal from said sum junction to said first electrical control circuit when said sum junction is unbalanced, which signal deactivates said first electrical control circuit when communication is originating at the microphone of said dominating channel, and

a third electrical control circuit comprising an amplifier, a rectifier, and a filter, which said third electrical control circuit transmits a signal from said dominating channel to said second channel when said dominating channel is operating at increased sensitivity, which said signal partially mutes said second channel.

**References Cited by the Examiner**

UNITED STATES PATENTS

3,113,181 12/1963 Soderbaum ------ 179—170.8 X

KATHLEEN H. CLAFFY, *Primary Examiner.*

ROBERT H. ROSE, *Examiner.*

S. J. BOR, *Assistant Examiner.*

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,291,911 December 13, 1966

Charles E. McCullough

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 9, for "19" read -- 29 --; column 8, line 22, for "a third signal" read -- a fourth control circuit automatically transmitting a third signal --.

Signed and sealed this 22nd day of April 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents