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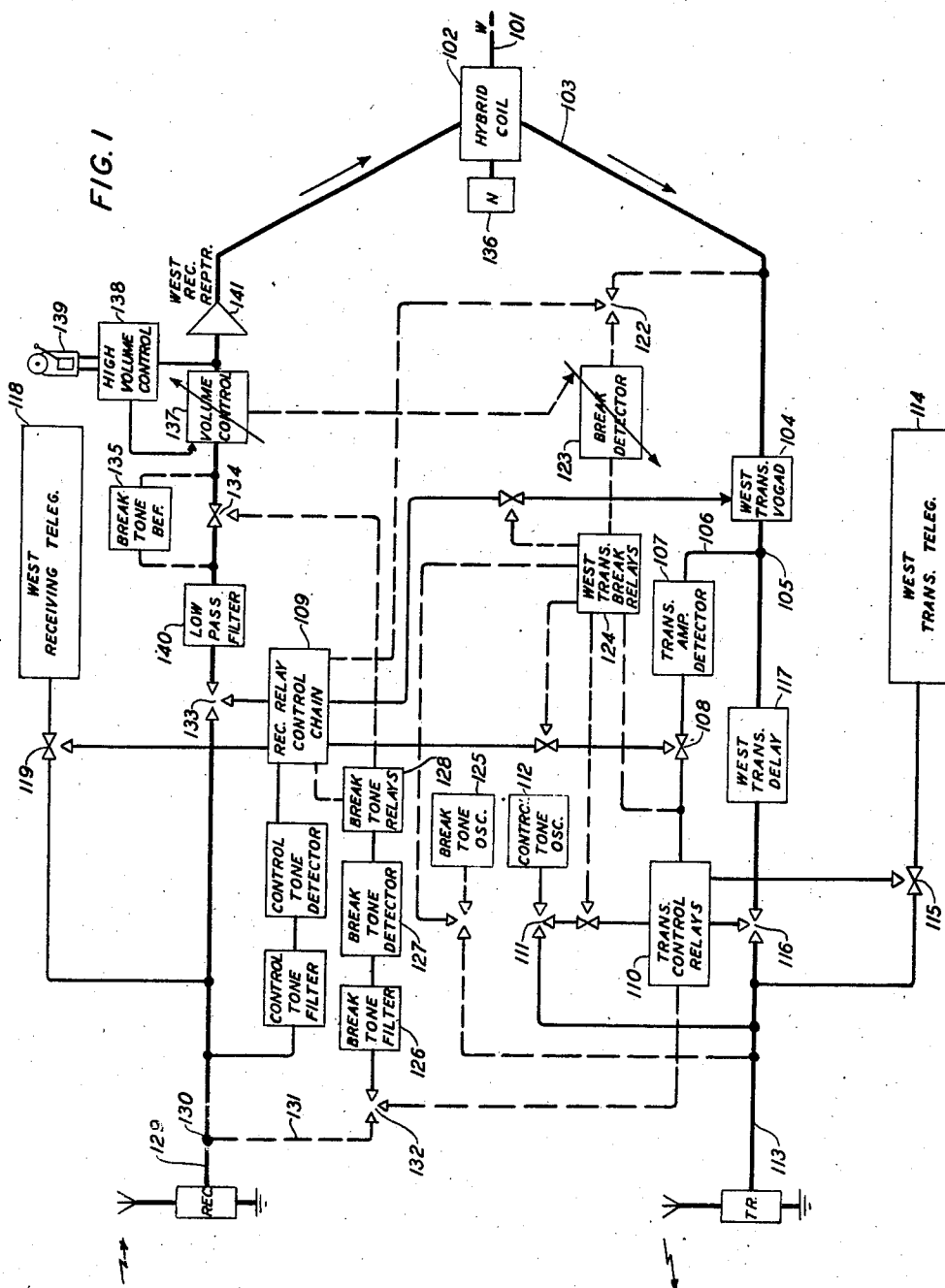
A. E. MELHOSE

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COMMUNICATION SYSTEM WITH VOICE-OPERATED SWITCHING MECHANISMS

Filed July 23, 1941

2 Sheets-Sheet 1



INVENTOR
A. E. MELHOSE
BY
J. W. Schmied
ATTORNEY

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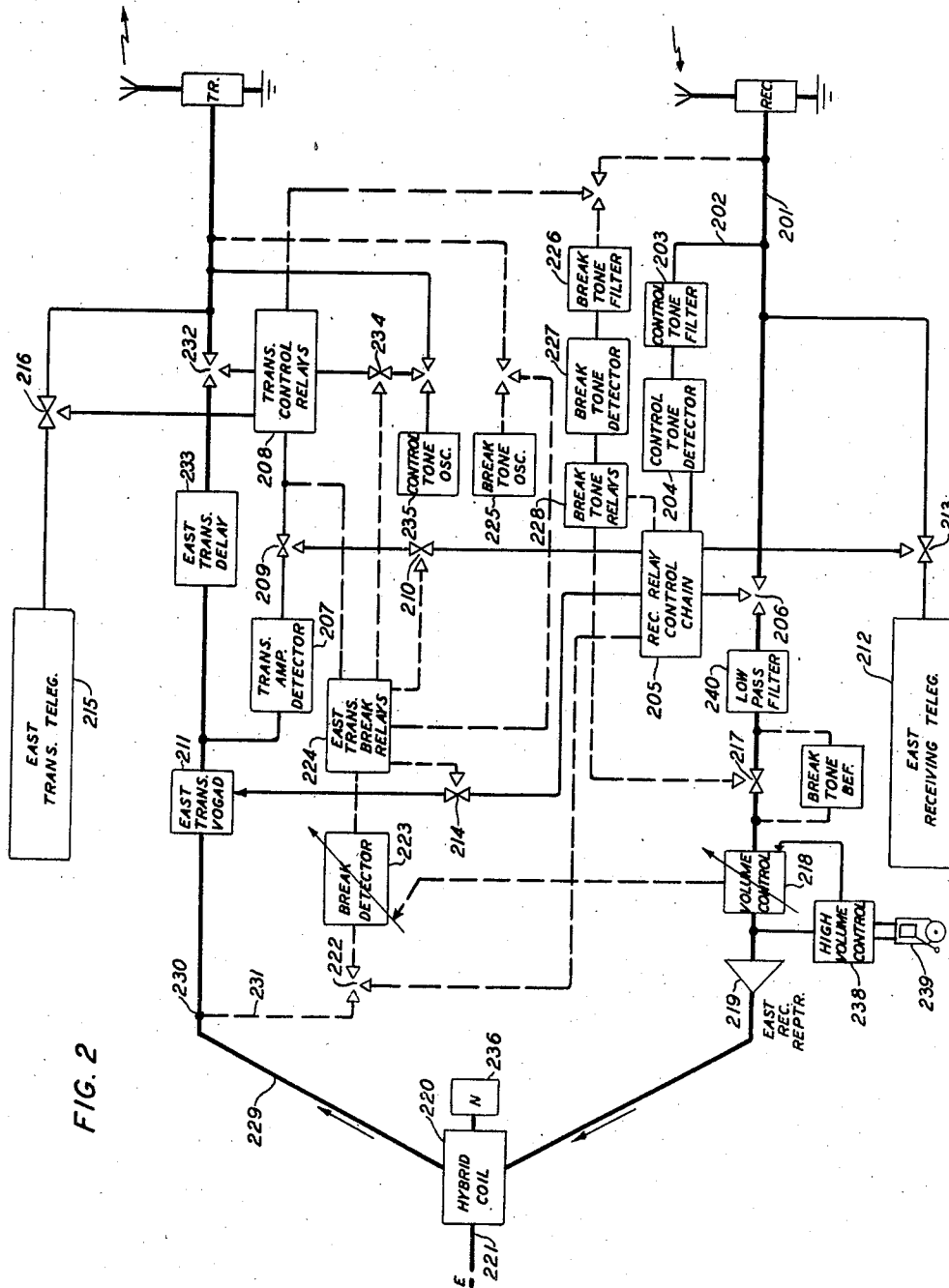
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INVENTOR
A. E. MELHOSE
BY *J. W. Schmied*
ATTORNEY

UNITED STATES PATENT OFFICE

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COMMUNICATION SYSTEM WITH VOICE-
OPERATED SWITCHING MECHANISMS

Alfred E. Melhose, Westfield, N. J., assignor to Bell
Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

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This invention relates to communication systems and particularly to long distance telephone communications systems which include also complementary telegraph communication facilities.

More particularly, this invention is a speech break-in circuit which enables a listener on a long distance telephone circuit, which includes means for interpolating telegraph, to interrupt a distant talker who has obtained control of the circuit.

As is well known by those experienced in the operation of long distance telephone circuits, which include echo suppressors and singing suppressors, it is characteristic of such circuits that once a speaker at one end has obtained control of the circuit for transmission in a particular direction, the circuit is conditioned so that the transmission of speech in the opposite direction is impossible unless special provision is made to permit interruption. Thus, a listener is effectively locked out from his transmission circuit unless the circuit is provided with an interrupting feature or break-in feature as it is known in the art.

While break-in circuits for long distance telephone circuits are known in the art, break-in circuits for long distance telephone circuits on which telegraph signals are interpolated and which make use of control tone to perform switching operations are not presently available.

Long distance radio telephone circuits on which telegraph signaling is interpolated and which use voice currents and control-tone circuits to perform switching operations are described in detail in the patent to I. E. Cole et al., 2,207,720, July 16, 1940. The invention herein is an improvement in the system disclosed in Patent 2,207,720.

The invention herein is designed to provide a break-in feature for a two-way radio telephone circuit, on which telegraph signals are interpolated in one direction while speech is being transmitted in the opposite direction and in the same direction as speech during lulls in the transmission of speech in a particular direction. The circuit includes both control-tone operation of normally disabled receiving suppressors and telegraph switching features by means of a newly devised break-in tone circuit.

It is an object of the present invention to provide a break-in feature for a two-way radio telephone circuit equipped for control-tone operation and telegraph switching features.

The manner in which the present invention

enables a listener to interrupt a speaker on a long distance telegraph circuit equipped with suppressors, on which circuit telegraph is interpolated and which makes use of control tone to perform switching operations may be understood from the following description when read with reference to the associated drawings, in which:

Fig. 1 shows the terminating equipment for a two-way radio telephone circuit, equipped with voice and control current operated switching equipment and interpolated telegraph equipment at what may be assumed to be a western terminal; and

Fig. 2 shows a corresponding circuit for what may be assumed to be the eastern terminal.

In the drawings, apparatus units, the circuit arrangements and functions of which are well known in the art, are indicated by rectangles to obviate unnecessary complication.

Refer to Fig. 1. It will be assumed that the party at the western terminal is talking. Voice currents pass from the two-way telephone line 101, through hybrid coil 102, into line 103 and through the west transmitting voice-operated gain-adjusting repeater device 104 styled vogad. The vogad is a device well known in the art whose function it is to automatically adjust the level of the voice currents so that they pass into the radio transmitter beyond at a uniform level for all speakers. Beyond the vogad, the circuit extends to a point 105, where it forms into two branches. One branch passes through conductor 106 and the transmitting amplifier-detector 107. A portion of the voice currents are diverted through this branch. The rectified voice currents pass through a normally closed switching point 108. This switching point is controlled by a relay in the receiving relay chain 109 to be explained hereinafter. The rectified voice currents energize the winding of the transmitting control relays 110. The transmitting control relays 110 close switching point 111 to connect the output of control-tone oscillator 112 to section 113 of the main transmitting path. The frequency of the control-tone current is outside the speech frequency band.

The transmitting control relays 110 function to open switching point 115 in order to disconnect the telegraph apparatus 114 from the transmitting path. Transmitted suppressor 116 is controlled by transmitting control relays 110 to close the main transmitting circuit. During this interval, speech currents in the main transmitting path, in proceeding to the left of point 105, are retarded by the effect of the transmitting

time delay device 117. This insures that the suppressor 116 will have been conditioned to permit the voice currents to pass by the time the voice currents arrive at transmitting suppressor 116 and permits the control-tone currents to precede the speech currents. The speech currents together with the preceding and accompanying control-tone currents pass through branch 113 which is connected by a radio link to the receiving branch 201 of Fig. 2 at the eastern terminal.

At the eastern terminal the major portion of the control-tone current passes through conductor 202 and control-tone filter 203 to the control-tone detector 204. The rectified control-tone currents operate the receiving relay control chain 205. The receiving relay control chain disconnects the telegraph receiving apparatus 212 at switching point 213. The receiving relay control chain 205 also conditions the receiving suppressor 206 so that it will pass the voice currents when they arrive at the suppressor. The receiving relay control chain 205 also disconnects the path connecting the transmitting amplifier-detector 207 to the transmitting control relays 208 at switching point 209. This disables the normal transmitting speech path at the eastern terminal.

During the interval since speech was last transmitted through the east transmitting branch the telegraph transmitter 215 has been connected through switching point 216 to the east-west radio link. These signals are received by telegraph receiver 118 through a switching point 119. The manner in which the telegraph apparatus is controlled at each station so that telegraph transmission may proceed in the same direction in which speech is being transmitted during lulls in the transmission of speech in a particular direction and while speech is being transmitted in the opposite direction is explained in detail in I. E. Cole Patent 2,207,720 July 16, 1940. The switching circuit which disconnects the transmitting amplifier 207 from the associated control relays 208 extends through a switching point 210. The reason for this will also be made clear hereinafter.

The receiving relay control chain 205 also disables the vogad 211 while maintaining its setting, which is adjusted for the voice of the eastern speaker. The receiving relay control chain circuit which disables the vogad extends through switching point 214. The reason for this will be made apparent below.

After the various switching functions have been performed, the speech currents pass through the receiving suppressor 206 and the low-pass filter 240 which is designed to suppress the control-tone current. It then passes through switching point 217, added per this invention for reasons to be explained. Then it proceeds through the volume control 218, the east receiving voice current amplifier 219 and the hybrid coil 220 to the two-way telephone line 221, which extends to the eastern speaker's station. The volume control 218 is equipped with a well-known regulator 238 for limiting its maximum volume for reasons to be explained hereinafter. Connected to this control is an alarm device 239 to provide an indication when a fixed maximum permissible volume is attained.

In accordance with this invention, the receiving relay control chain performs a new function. It closes a switching point 222 which connects a break-in circuit to the transmitting circuit at the eastern terminal, so that while speech is be-

ing received at the east, the listener at the east may interrupt the western speaker.

It was pointed out above that while speech was being received through the receiving branch at the eastern terminal, the receiving control relay chain 205 disconnects the eastern transmitting amplifier-detector 207 from its associated transmitting control relays 208. The transmitting control relays 208 at the eastern terminal perform the same functions at the eastern terminal as described for the transmitting control relays 110 at the western terminal. One of these functions, as explained for the western terminal, was operating the transmitting suppressor element 116 so as to permit speech currents to pass. With switching point 209 opened at the eastern terminal, while speech currents are passing through the eastern receiving branch, the transmitting control relays 208 thereat cannot function to perform the corresponding operation by means of rectified voice currents from the transmitting amplifier-detector 207, if the eastern party were to attempt to interrupt. It is necessary, therefore, to control the eastern transmitting control relays by another means for this condition to permit interruption.

In order to permit interruption, in accordance with this invention, in addition to the usual transmitting amplifier-detector means, such as 107 or 207, for energizing the transmitting control relays 110 or 208, there is provided at each terminal a break detector which controls a group of transmitting break relays and a break-tone oscillator, 123, 124 and 125, respectively, at the west terminal and 223, 224 and 225 at the east terminal. Complementary facilities comprising a break-tone filter, a break-tone detector and a break receiving relay chain 126, 127 and 128, respectively, at the western terminal and 226, 227 and 228, respectively, at the eastern terminal are also required. The manner in which these elements function to permit the interruption of a distant speaker will now be described.

It will be assumed that the western party continues to speak and that the eastern party interrupts. The voice currents of the eastern party will pass over the two-way telephone line 221, through the hybrid coil 220 and the east transmitting branch 229 to junction point 230. A portion of the voice currents will be diverted through path 231. Switching point 222 is closed while speech currents are passing through the eastern receiving branch as described above. The diverted speech currents are rectified in the break-in detector 223 and energize the transmitting break relays 224 which perform a number of functions as follows. They energize the transmitting control relays 208. They connect the output of the break-tone oscillator 225 to the path to the east radio transmitter. The break tone may be any desired frequency in the speech band, say 900 cycles per second.

While speech is being received, say in the eastern receiving branch, an effect known as echo effect due to unbalance between the two-way line 221 and the transmitting network 236, is observable. A portion of these echo currents pass through hybrid 220 and into the east transmitting branch. If they were permitted to pass through the east transmitting branch and be retransmitted to the western terminal, they would cause difficulty. In order to prevent their passage, a relay in the receiving relay control chain 205, known as the receiving echo hold-over relay controls the path interconnecting the transmit-

ting amplifier-detector 207 and the transmitting control relays 208 to prevent the energization of the transmitting control relays 208 for an interval sufficiently long after the passage of each train of speech currents so that the echo currents cannot energize the transmitting control relays 208. The transmitting break relays 224 open the energizing path of the receiving echo control relay at switching point 210 so as to close the path between the transmitting amplifier 207 and the transmitting control relays 208 even though speech currents are passing through the east receiving branch. The energization of the transmitting control relays results in the disconnection of the east telegraph transmitter 215 by the opening of switching point 216. The transmitting control relays 208 also condition the transmitting suppressor 232 in the main speech transmitting path at the east terminal so that the voice currents will be passed, after they have been adjusted to the proper level by the eastern voice-operated gain-adjusting device, or vogad 211, and have passed through the eastern transmitting delay device 233. The transmitting break relays 224 also open a control point 234 in the circuit connecting the transmitting control relays 208 and the control-tone oscillator 235 so that the regular control-tone currents are not connected to the transmitting path for this operation. The transmitting break relays 224 also enable the transmitting vogad 211 at switching point 214.

As a result of these operations, an interruption by the eastern party enables current of a frequency within the speech band, from break-tone oscillator 225, to precede and accompany speech instead of current from control-tone oscillator 235, which corresponds to control-tone oscillator 112 at the western terminal. The control-tone frequency is, as mentioned above, outside the frequency range of speech. Control-tone currents of a particular frequency or specified frequencies outside the frequency range of speech currents precede and accompany ordinary speech, while break-tone currents of a particular frequency or plurality of specified frequencies within the range of voice current frequency precede and accompany interrupting speech.

The break-tone current passes through a radio link to the receiving branch of the western terminal 129. A portion of this current is diverted at point 130 through path 131. It passes through switching point 132 which has been closed by the effect of speech current in the western transmitting branch on the transmitting control relays 110. It is passed by break-tone filter 126 and rectified by the break-tone detector 127. The rectified break-tone current energizes the relays of the break-tone relay chain 128. The break-tone relay chain, in turn, operates the regular receiving relay control chain 109. The regular receiving relay control chain 109 opens switching point 119 to disconnect the receiving telegraph apparatus 118. It also operates receiving suppressor 133 to permit the interrupting speech currents to pass on their arrival at suppressor 133. The interrupting voice currents pass through low-pass filter 140 which is designed to prevent the passage of the control-tone currents. The break-tone relay chain opens switching point 134 so that the interrupting speech currents and the accompanying break-tone currents are diverted through a path including a filter 135 around switching point 134. The filter is a band elimination filter and is ar-

ranged to suppress the current of break-tone frequency. The interrupting speech currents pass through the volume control device 137 which is equipped with a control 138 for limiting the maximum volume and an alarm 139 for indicating when the maximum volume is attained. The interrupting voice currents then pass through the west receiving voice current amplifier 141 to hybrid coil 102. Thus, the original talker at the west terminal is able to hear the interruptions from the distant eastern talker, while the original talker is still talking. The mutilation occasioned by the break-tone band elimination filter during the break-in period will not make the effect of the interrupting speech currents unintelligible.

If it is assumed that the original talker pauses when interrupted, the relays in the receiving relay control chain 205 at the eastern terminal will be deenergized. This, in turn, will open path 231, which leads to the break detector 223, at switching point 222. Thereupon, the transmitting amplifier-detector 207, the transmitting control relays 208 and control-tone oscillator 235 will function in the manner described for corresponding elements at the eastern terminal for the transmission of normal speech. The conversation may then proceed in a normal manner. Switching point 134 will reclose, disconnecting the break-tone current band elimination filter from the western receiving branch.

If the western subscriber persists in talking, notwithstanding the interruption, and the eastern interrupting subscriber also continues to talk simultaneously, the speech from the eastern interrupting subscriber will continue to be received and the speech of both subscribers will be transmitted over the circuit so that each talker may be heard at the opposite terminal. When one or the other subscriber finally pauses, the normal transmitting amplifier-detector, transmitting control relays and control-tone oscillator of the opposite terminal will function in the manner described above for the normal transmission of speech from west to east.

It was pointed out above that the receiving relay control chain 205 functioned to control a switching point 209, between the transmitting amplifier-detector 207 and the transmitting control relays 208. For an interval after voice currents have passed through the receiving branch, the receiving control chain maintains switching point 209 open, so that the echo currents which get through the hybrid coil 220 into the transmitting branch due to the unbalance of the subscriber's two-way line 221 and the compensating network 236 cannot operate the transmitting control relays 208 so as to transit the echo currents. There is nothing in the circuit arrangement of the present invention to prevent these echo currents from passing through conductor 231 and switching point 222 to the break-in detector 223. It would be objectionable if this caused the operation of the transmitting break relays 224 as the echo currents would be transmitted through the radio link to the western station. The retransmission of echo currents can be prevented in this invention but the manner in which it is effected involves some sacrifice in the utility of the invention.

In order to prevent the retransmission of echo currents from the receiving branch which pass through the hybrid coil and get into the transmitting branch, the sensitivity of the break-in detector such as 223 is so adjusted with rela-

tion to the volume of the received speech that the transmitting break relays 224 are not operated as a result of echo currents. If the received currents are high and the unbalance is considerable, the sensitivity of the break-in detector may be required to be so low that it will discriminate also against the voice currents of speakers with weak voices. The result, of course, would be that such speakers could not interrupt. The percentage of speakers in this category is relatively small and it will become negligible as the balance between the two-way line and the compensating network is improved.

It will be observed that there are a number of controls in the present invention which operate to maintain the effect of unbalance at a minimum. The transmitting vogad regulates the input of the voice currents to the radio transmitter so that they are delivered to the radio transmitter at a uniform volume. The volume control in the receiving branch is regulated so that the input to the receiving voice current amplifier is not permitted to exceed a fixed maximum. The energy of the received voice currents which pass into the transmitting branch due to unbalance between the two-way line and the hybrid balancing network is maintained at a low level. Biasing the break detector against unbalanced received currents of such low level only, to prevent their operating the break-in circuit will discriminate against only speakers with the very weakest voices.

What is claimed is:

1. In a communication system, a transmission channel, means in said system for transmitting speech currents in a first direction through said channel, automatic means also in said system for transmitting telegraph signal impulses through said channel when speech is not being transmitted through said channel and means also in said system for simultaneously transmitting speech currents through said channel in a direction opposite from said first direction.

2. In a communication system, a first communication terminal, a second communication terminal, a two-way communication channel connecting said terminals, means for transmitting speech in a first direction over said channel, means for automatically transmitting telegraph signals in said first direction during lulls in the transmission of speech in said first direction, means in said system for suppressing singing at said first terminal and means also at said first terminal for receiving speech currents from said second terminal while speech is being transmitted from said first terminal.

3. In a communication system, a radio telephone control terminal, a two-way telephone branch therein, a transmitting branch and a receiving branch connected to said two-way branch, a telegraph transmitter, means connected to said transmitting branch for automatically connecting said transmitter to said transmitting branch so as to transmit telegraph signals when speech is not being transmitted over said transmitting branch, voice-operated means connected to said transmitting branch for operating a suppressor in said receiving branch to prevent singing while speech is being transmitted in said transmitting branch and means connected to said receiving branch for operating said suppressor so as to pass interrupting speech from a distant terminal.

4. In a communication system, a receiving-only communication branch connected to a two-

way communication branch, telephone receiving signal means connected to said branch, telegraph receiving signal means connected to said branch, a suppressor in said branch conditioned to regulate the passage of current from said receiving branch to said two-way circuit, a first control means connected to said suppressor responsive to current received in said branch for conditioning said suppressor to pass speech currents, a second control means connected to said suppressor for preventing the conditioning of said suppressor for the passage of speech while speech is being transmitted through an associated speech transmitting branch and an auxiliary control means connected to said suppressor for conditioning said suppressor to pass speech notwithstanding the transmission of speech through said associated transmitting branch.

5. In a communication system, a two-way communication branch connected to a transmitting communication branch and a receiving communication branch, means for transmitting speech through said transmitting branch, means for automatically transmitting telegraph signals through said transmitting branch when speech is not being transmitted through said transmitting branch, means for transmitting a first control current of a first frequency through said transmitting branch to condition a distant receiving terminal for the reception of speech signals and means for transmitting a second control current of a frequency different from said first frequency for interrupting a distant speaker.

6. In a communication system, in combination, a two-way telephone circuit connected to a one-way telephone transmitting circuit and a one-way telephone receiving circuit, automatic means for connecting telegraph transmitting means to said transmitting circuit while speech is not being transmitted over said transmitting circuit, automatic means for connecting telegraph receiving means to said receiving circuit while speech is not being received over said receiving circuit, a first voice-operated switching mechanism connected to said transmitting circuit for the conditioning of said transmitting circuit for the transmission of normal speech and a second voice-operated switching mechanism for conditioning said transmission circuit for the transmission of interrupting speech.

7. In a communication system, a two-way telephone circuit connected to a transmitting branch and a receiving branch, a first and a second voice-operated switching mechanism connected to said transmitting branch, means connected to said transmitting branch for operating said first mechanism in response to ordinary speech currents in said transmitting branch and means connected to said transmitting branch for operating said second mechanism in response to currents of interrupting speech in said transmitting branch.

8. In a communication system, a two-way telephone circuit, a one-way branch connected thereto, means connected to said branch for supplying current of a first frequency for controlling the transmission of ordinary speech currents and means connected to said branch for supplying current of a second frequency for controlling the transmission of interrupting speech currents.

9. In a communication circuit, means for conditioning the circuit for communication, comprising a first switching mechanism therein re-

sponsive to current of a frequency outside the voice range and a second switching mechanism therein responsive to current of a single particular frequency within the voice range.

10. In a communication circuit, the method of conditioning said circuit for communication which comprises: (1) performing a switching operation by voice currents; (2) performing a switching operation by a current of a frequency without the voice frequency range; (3) performing a switching operation by current of a particular frequency only within the voice frequency range.

11. A radio telephone communication system including interpolated telegraph and speech interrupting instrumentalities, telephone, telegraph and speech interrupting circuit conditioning means, a voice-current-operated switching mechanism therein, a second switching mechanism therein responsive only to current of a particular frequency within the voice range and a third switching mechanism also therein responsive only to current of a frequency without the voice range.

12. In a communication system, a single telephone communication channel conditioned to

conduct voice currents, instrumentalities connected to said channel for impressing also on said channel an alternating current of a single frequency within the frequency range of the voice currents transmitted over said channel, and selective means responsive to said alternating current for performing switching operations to condition said channel for communication.

13. A system in accordance with claim 12, wherein said instrumentalities and said means responsive thereto condition said system for the transmission and reception of interrupting speech.

14. In a communication system, the method of operation of a single communication channel, which comprises the transmission over said channel of current having frequencies in a particular band width as communication signals, and the transmission simultaneously over said channel of an alternating current of a single selected frequency, within the band of frequencies of said alternating current used for said communication signals, to condition said system for an alternative mode of communication.

ALFRED E. MELHOSE.