

1,973,027

Filed Jan. 10, 1933

2 Sheets-Sheet 1

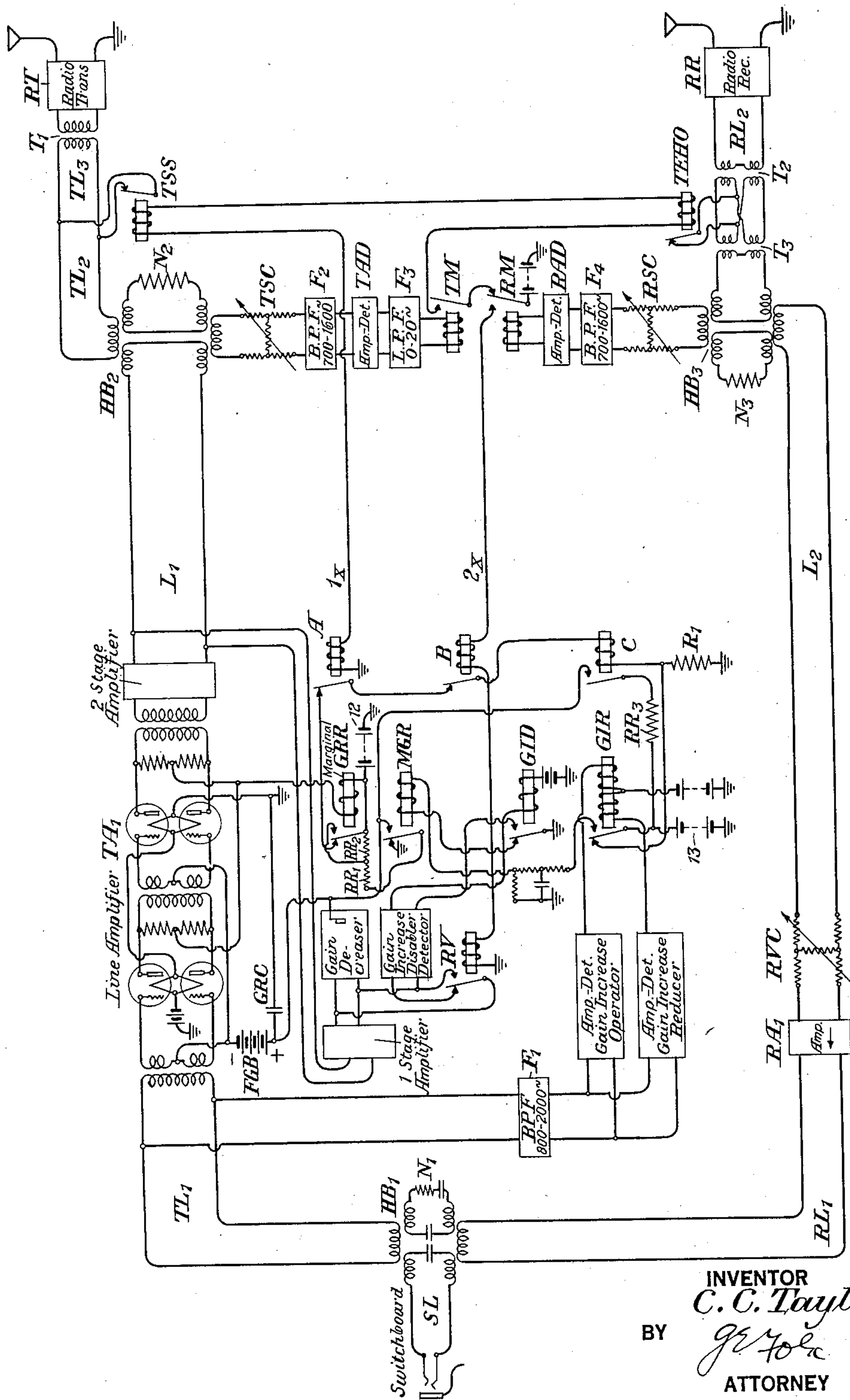


Fig. 1

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TRANSMISSION SYSTEM

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2 Sheets-Sheet 2

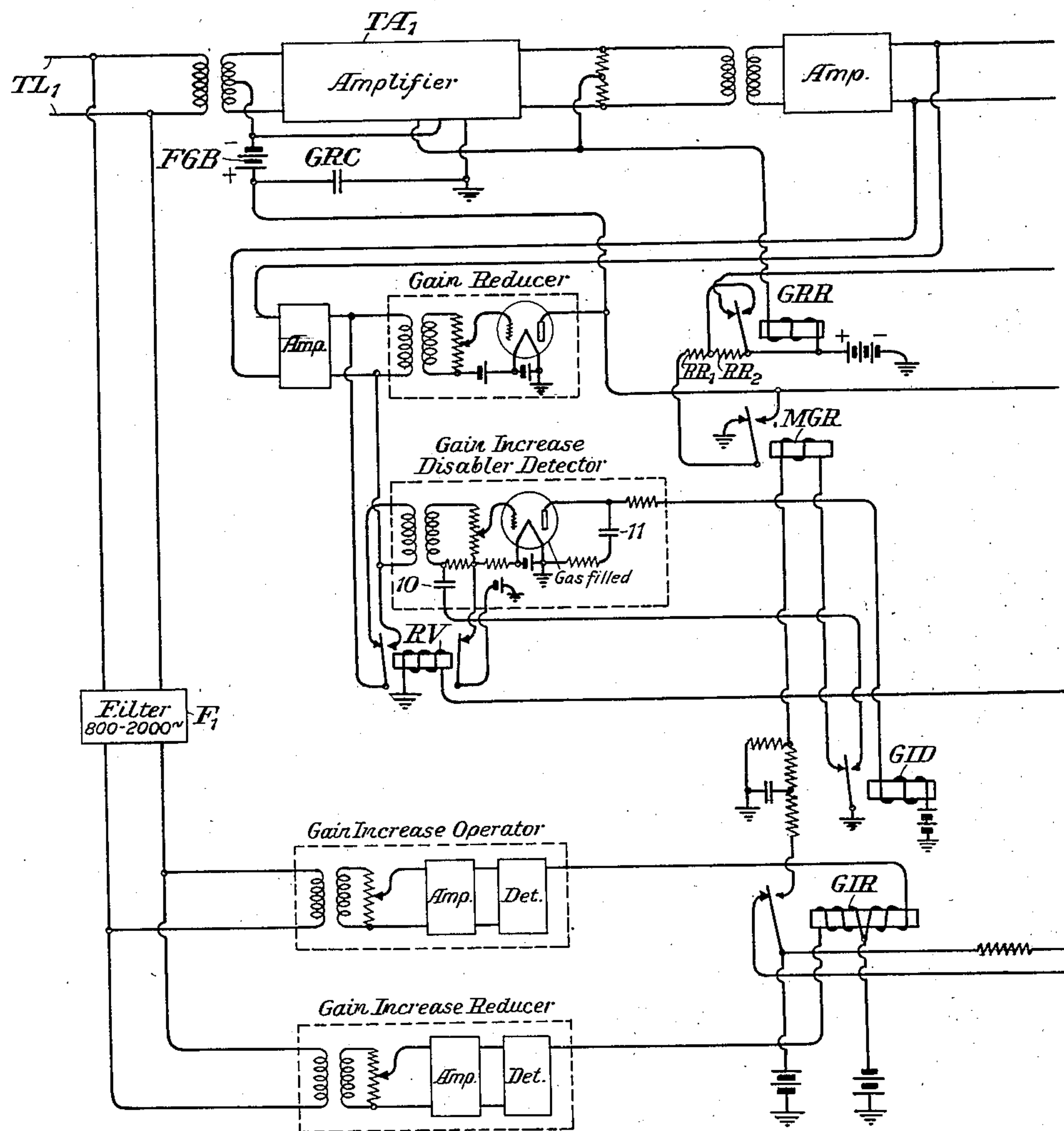


Fig. 2

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TRANSMISSION SYSTEM

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Application January 10, 1933, Serial No. 651,024

7 Claims. (Cl. 178—44)

This invention relates to voice-operated de-
vices used with radio telephone systems or other
channels for the transmission of intelligence and
more particularly to arrangements for intercon-
necting two of these devices in one terminal
thereby securing improved operation. This is
obtained by novel circuit arrangements whereby
the action of one voice-operated device is
changed by the faulty action of a second device
in such manner as to eliminate the said faulty
action thus making the operation more nearly
automatic and reducing the cost of operating
the system.

As is well known, a radio transmitter and
radio receiver may be connected by means of a
combination of four-wire and two-wire circuits
to a two-wire terminal at a switching point
where connections may be established by a
switching operator between the radio channel
and various telephone circuits. It is also well
known that terminal amplifiers, voice-operated
devices and other apparatus under the control
of the technical operator may be associated
with the four-wire circuit in such a manner that
echoes and singing, which might be caused by
radio or wire line unbalances, are effectively elim-
inated, and radiation by the radio transmitter
of signals received by the radio receiver is pre-
vented. This will be spoken of as the "anti-
singing device" hereafter. It is also well known
that one of the chief functions of the technical
operator is to constantly regulate the trans-
mitted speech volume thereby maintaining uni-
form percentage modulation of the radio trans-
mitter. A voice-operated gain-adjusting device
has been developed to automatically regulate
this transmitted speech volume thereby relieving
the technical operator of this duty. This will be
spoken of as the "gain-adjusting device" here-
after. In accordance with this invention circuit
arrangements are provided whereby the gain-
adjusting device and the anti-singing device are
so interconnected that improved operation of the
anti-singing device is obtained and an objection-
able feature of the operation of the gain-adjust-
ing device is eliminated.

In more detail, the operation of the gain-
adjusting device was such that when the switch-
board operator had been talking at high volume
preparing a call and then told the subscriber
to go ahead difficulty was experienced if this
subscriber came in at low volume. The gain of
the gain-adjusting device would have been ad-
justed to a low value by the operator and the
action of the device would not permit this gain

to be increased until the end of a two-second
period. The subscriber during this period
might not be able to operate the anti-singing
device and conversation could not get started.
This period of tie-up might be considerably ex-
tended by either the operator speaking again or
by the receiving side of the anti-singing device
operating under control of the subscriber at
the distant end of the circuit who was also at-
tempting to begin the conversation. It is well
known that faulty operation of the transmitting
side of the anti-singing device may occur if it
does not secure sufficient speech volume. When
this faulty operation occurs this invention causes
the gain of the gain-adjusting device to increase
very rapidly until sufficient speech volume
reaches the anti-singing device to assure its
operating satisfactorily. Then the operation of
the gain-adjusting device again becomes normal.
This action removes the difficulty experienced
in starting a conversation and also tends to
correct faulty operation of the anti-singing de-
vice from other causes. The action is limited to
the lower half of the gain range of the gain-
adjusting device thereby avoiding difficulties
which line noise operation might produce.

The invention may now be more fully under-
stood from the following description together
with the accompanying drawings in the Fig-
ures 1 and 2 of which the invention is illustrated.
Fig. 1 constitutes a circuit diagram of one ter-
minal of a radio telephone system such as might
be used in transatlantic systems. Fig. 2 is a
circuit diagram illustrating in greater detail the
voice-operated gain adjusting device shown sche-
matically in Fig. 1. Similar reference charac-
ters have been used to denote like parts in all
of the figures. It is expected that the other
terminal will have similar arrangements. These
terminals might likewise be used on submarine
cables or other communication channels and
it is understood that the invention is not to be
limited to radio telephone systems.

Referring to Fig. 1, SL designates the two-
wire line connecting the control terminal to the
switchboard. The two-wire line, SL, is connect-
ed through a hybrid coil HB₁ to a transmitting
path, TL₁, and a receiving path RL₁, being bal-
anced by a suitable network N₁. The path TL₁
and the following parts of the transmitting cir-
cuit include the line amplifier TA₁ which is part
of the gain-adjusting device, hybrid coil HB₂,
transmitting path TL₂, transmitting path TL₃,
transformer T₁ and radio transmitter RT.
The receiving path includes radio receiver RR,

receiver path RL₂, transformers T₂ and T₃, hybrid coil HB₃, receiving volume control attenuator RVC, amplifier RA₁ and receiving path RL₁.

Referring to Fig. 1 a gain-adjusting device is provided in the transmitting path in order that speech to be transmitted and coming from the switchboard on paths SL and TL₁ shall be applied at constant volume to hybrid coil HB₂, and radio transmitter RT. The gain-adjusting device comprises the variable-gain line amplifier TA₁ and its associated regulating devices, filter F₁, gain increase operator amplifier detector, gain increase reducer amplifier detector, gain increase disabler, gain decreaser and relays GIR, 15 GID, MGR, GRR, and RV. These devices will be described in more detail hereinafter.

In order that when transmission is taking place over either the transmitting or receiving path the other path will be disabled, echo or singing suppressor devices are associated with each path. We have called these arrangements the anti-singing device. The echo suppressor associated with the transmitting path TL₁ comprises an amplifier-detector unit TAD of well known type with its input connected through band pass filter F₂ and variable attenuator TSC to hybrid coil HB₂ in conjugate relationship with transmitting path TL₂, the output of amplifier TA₁ being balanced by a suitable network N₂. 20 The output of the amplifier-detector unit controls through master relay TM the relays TSS and TEHO for performing operations incident to the blocking of disabling operations whereby transmission is permitted in only one of the paths TL₂ and RL₁ at a time. Normally transmission path TL₂ is disabled by the back contacts of relay TSS which short-circuit the conductors, and transmission from transmission path TL₁ to the radio transmitter cannot take place. Blocking means comprising transformer arrangements T₂ and T₃ are associated between receiving lines RL₁ and RL₂. These disabling means comprise transformer arrangements which are so connected as to be balanced when 25 the contacts of relay TEHO are opened, thereby preventing transmission through the transformer arrangements. When the contacts of relay TEHO are closed, however, the transformer circuits instead of being balanced are in effect connected so as to be parallel-aiding, thereby permitting transmission to take place readily. Normally, relay TEHO, which is controlled by the amplifier-detector TAD, is deenergized so that the receiving path is unblocked to permit transmission to take place from receiving path RL₂ to the two-wire line SL. The input of an amplifier-detector arrangement RAD is connected through band-pass filter F₄ and receiving sensitivity control RSC to hybrid coil HB₃ in conjugate relationship with receiving path RL₁, and has in its output a relay RM which when operated opens the control circuit from the amplifier-detector TAD to switching relays TSS and TEHO, thereby maintaining the transmitting path TL₂ blocked, and receiving path RL₁ unblocked when signal currents are being received from the radio receiver.

The operation of the apparatus so far described for signal transmission is as follows: 30 Signal currents incoming over the two-wire circuit SL pass through the hybrid coil HB₁ and through the variable-gain amplifier TA₁. Some of the energy enters the amplifier-detector unit TAD and causes relays TM, TSS and TEHO to be energized. Relay TSS removes the short cir-

cuit from transmitting line TL₂, while relay TEHO by opening its contact causes the transformer arrangements T₂ and T₃ to block the receiving path. In the meantime a part of the energy passes from hybrid coil HB₂ through transmitting paths TL₂ and TL₃ to radio transmitter RT and is transmitted to the distant terminal. The receiving amplifier detector RAD associated with the receiving paths cannot now be actuated to disturb the circuit condition now existing because the receiving path is disabled in the manner already described. 80

If in the normal condition of the circuit a signal is received by radio receiver RR, the resulting signals pass through receiving path RL₂ and transformer arrangements T₂ and T₃. The energy divides in hybrid coil HB₃, part of the energy passing through receiving amplifier RA₁ and hybrid coil HB₁ to the two-wire line SL. The remaining received energy passes through receiving sensitivity control RSC to the amplifier-detector RAD, to cause the operation of relay RM which opens the circuit controlled by the amplifier-detector unit TAD, thereby preventing energization of relays TSS and TEHO, 90 so that the transmitting path is disabled and the receiving path remains unblocked so long as the signal currents are being received.

Referring to Fig. 1, the operation of the voice-operated gain-adjusting device is as follows: 105 Signal currents incoming over the two-wire circuit SL pass through the hybrid coil HB₁ and are impressed on the input of the variable-gain amplifier TA₁. The gain of the amplifier TA₁ is so controlled that regardless of the speech volume at its input, within limits, the speech volume at its output is maintained constant at a certain definite volume which we will call reference volume. The gain adjustment necessary to secure the reference volume output occurs as follows: The gain of the line amplifier varies with the "C" bias placed on the first two vacuum tube stages. When the grid voltage is low the gain is high. The grid voltage is under the control of the other parts of the circuit, namely, the gain increase operator, gain increase reducer, gain increase disabler and gain decreaser devices. These devices are well known in the art and are shown in more detail in Fig. 2. 120

Part of the voice currents at the input pass through a band pass filter F₁ into the gain increase operator, operating the gain increaser relay GIR. These same currents act on the gain increase reducer but have only a slight effect thereon because of their intermittent nature. However, on steady tones or noise the gain increase reducer will bias the gain increaser relay GIR in the direction to prevent operation on small noise currents. The gain increase operator may comprise a combination of potentiometers, amplifiers, and a detector. A low pass filter (not shown) may be provided in the detector output for the purpose of cutting off peaks of noise. The gain increase reducer may comprise a combination of potentiometers, amplifiers and detectors. The detector apparatus may be so biased that it will effect the relay GIR only on steady tones, such as noise, but not on speech currents which are intermittent in nature. The gain increaser relay GIR operates the master gain relay MGR provided the gain increase disabler relay GID is not operated. The master gain relay charges the gain regulating condenser GRC from battery through resistances RR₁ and RR₂, the charge 150

being in the direction to produce a voltage which opposes the fixed grid battery voltage from battery FGB. This effectively reduces the grid bias on the line amplifier and increases the gain. The voltage on the gain regulating condenser GRC also acts as a plate potential for the last tube of the gain decriaser.

The output of the line amplifier divides, part of it entering the gain decriaser and gain increase disabler circuits. The gain decriaser might include a potentiometer and a detector tube so adjusted as to operate on a volume from TA₁ above reference volume, but not below. The gain decriaser draws plate current from the gain regulating condenser GRC whenever the output of the line amplifier TA₁ goes above reference volume and thereby discharges this condenser through its plate-filament circuit, increasing the negative grid bias on the line amplifier and decreasing the gain. The gain increase disabler will include a discharge tube filled with a gas such as neon. This tube will have its constants so adjusted that it will break down when the output from TA₁ is at reference volume. When the gas filled tube of the gain increase disabler circuit breaks down the GID relay will operate. This will open the circuit for MGR relay and release it, thus serving to prevent any gain increase of TA₁. The operation of GID will connect a ground to the condenser 10 connected to the grid circuit of the gas filled tube in the gain increase disabler device. This will increase the sensitivity of the gain increase disabler by 1½ db. When the gas filled tube ceases to discharge, the condenser 11 in the plate circuit thereof will be charged through the winding of relay GID. This will prevent the relay GID from releasing for a period of two seconds after the discharge ceases in the gas filled tube. In this manner once the output reaches reference volume the gain of the line amplifier remains constant provided the volume does not go above reference volume or drop more than 1½ db. below reference volume for a period greater than two seconds. If the low volume condition occurs the GID relay releases permitting the master gain relay to operate, thereby increasing the gain until the output again reaches reference volume.

A relay RV operated by relay RM of the anti-singing device disables the gain decriaser and causes the operation of the gain increase disabler relay GID during the time received speech is operating the anti-singing device relay RM, thereby preventing gain adjustment by the echoes of the received speech. The operation of relay GID in this instance is caused by the removal of the grid bias by the opening of left hand contact of relay RV. After each operation of the RV relay the GID relay remains operated for the two-second period. The fact that the GID relay does not release until after a period of two seconds following a drop in output volume or an operation of the anti-singing device relay RM has caused difficulty in getting conversation started. This action is necessary to prohibit the line amplifier TA₁ gain from following too rapidly the variations in speech level, thereby removing some individuality from the voice and to assist in preventing echoes of received speech from adjusting the gain of the line amplifier TA₁.

The gain rate relay GRR operates from the plate current of the first stage of the line amplifier when the gain is about half of its maxi-

mum and with the gain regulating condenser, therefore, partially charged. The operation of this relay speeds up the condenser charge by reducing resistance in series with the plate battery through short circuiting resistance RR₂, thereby providing a more nearly constant rate of gain change over the entire range. The operation of relay GRR will open the circuit for relays A, B and C when the gain of TA₁ is one-half of its maximum. This will prevent the auxiliary charging circuit for condenser GRC from being completed under conditions pointed out hereinafter.

The invention may now be more fully understood by considering the action of relays A, B and C of Fig. 1 as they interconnect the anti-singing device with the gain-adjusting device. They form the subject of this invention and may be called the "quick gain-increaser circuit". This circuit increases the gain of the gain-adjusting device very quickly if that gain is in the lower half of its range. Under such conditions with relay RM non-operated, the gain increase relay GIR operates but the transmitting anti-singing device relay TM does not operate. The operation is then as follows: When relay GIR is not operated batteries 12 and 13 will have like poles connected to the circuit including the winding of relay C and relay C will remain inoperated. When the relay GIR operates battery 13 is removed from this circuit and relay C will be operated by battery 12, over contact of relay GRR, and contacts of relay A and B. Relay C when operated will rapidly increase the gain of the line amplifier TA₁ by charging the gain regulating condenser GRC through resistance RR₃. Relay C operates from battery through the left-hand contacts of relays GRR, A and B to ground through resistances R₁, when the left-hand contacts of relay GIR are open. Closing the left-hand contacts of relay GIR again short circuits relay C and it cannot operate. Relay A operates in series with relays TEHO and TSS when relay TM operates. Relay B operates in series with relay RV both being energized when relay RM operates. Relay GRR operates for the upper half of the gain range of line amplifier TA₁ and is non-operated for the lower half of the gain range. Relay C then operates when relay GIR operates but relays A, B and GRR are non-operated. This means that relay C will not operate when relay A operates simultaneously with relay GIR or as long as the transmitting anti-singing relay TM is operating normally. Relay B prevents operation of relay C when relay GIR is operated by echoes of the received voice currents which have operated relay RM thereby disabling relays TEHO, TSS, and A to prevent their operation by such echoes. This prevents quick gain adjustment by echoes of received speech. Relay GRR limits the quick-gain increase to the lower half of the gain range of line amplifier TA₁. This is very necessary in limiting any undesirable results of the rapid increase in gain caused by this circuit if false operation of the gain increase relay GIR should occur from noise currents.

This circuit tends to prevent initial clipping or mutilation of the voice currents caused by faulty operation of the transmitting anti-singing relays. It also prevents non-operation of these relays because of low speech volume from any cause and is particularly valuable when the gain of the gain-adjusting device has been regulated

to a low value by the switchboard operator talking at a high volume and a subscriber immediately tries to talk at a low volume. Without the quick gain increaser circuit the gain of the gain-adjusting device cannot be increased for two seconds after speech ceases or falls below a certain output volume because of the hangover of the gain increase disabler relay. This same hangover is involved after each operation of the receiving anti-singing relay RM. The quick gain increaser circuit eliminates this hangover and increases the gain of the gain-adjusting device very rapidly if signals are operating the GIR relay but faulty or non-operation of the transmitting anti-singing relay TM is occurring. When normal operation of relay TM is secured the quick gain increaser circuit no longer functions and the operation of the gain-increaser circuit is normal.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels designed so that energy transmitted to or over one of said channels will cause the device to disable the other of said channels, a voice operated gain adjusting device associated with said transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means operated independently of the output volume of said voice operated gain adjusting device for causing said voice operated gain adjusting device to vary the gain at a rate faster than said predetermined normal rate, said auxiliary means being operative when the energy coming in to said gain adjusting device falls suddenly to a level insufficient to operate said anti-singing device.

2. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels designed so that energy transmitted to or over one of said channels will cause the device to disable the other of said channels, a voice operated gain adjusting device associated with said transmitting channel, said voice operated gain adjusting device including a vacuum tube loss device having its cathode-anode circuit included in said transmitting channel and slow releasing means operated by the energy volume on the transmitting channel beyond said vacuum tube device when said energy volume is between predetermined limits for preventing changes in the loss caused by said vacuum tube device, and auxiliary means being operative independently of the output volume of said voice operated gain adjusting device for rapidly reducing the loss caused by said vacuum tube device during the predetermined period caused by the slow release of said slow releasing means after said energy volume on the transmitting channel falls below said predetermined limits and when said energy volume is insufficient to operate said anti-singing device.

3. In a transmitting system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels, said device including a relay asso-

ciated with said transmitting channel and responsive to energy volume transmitted thereover, a normally closed short circuit across said transmitting channel, and a control circuit completed by said relay for opening said short circuit, a voice operated gain adjusting device associated with said transmitting channel, auxiliary means for rapidly increasing the gain of said voice operated gain adjusting device, and means controlled by the completion of said control circuit in said anti-singing device for preventing the functioning of said auxiliary means.

4. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels, said device including a relay associated with said transmitting channel and responsive to energy volume transmitted thereover and a control circuit completed by said relay for rendering said transmitting channel operative, a voice operated gain adjusting device associated with said transmitting channel, said gain adjusting device including a vacuum tube loss device having its cathode-anode circuit included in said transmitting channel, a condenser for varying the potential on the grid of said tube device to control the loss caused by said device, a gain increase relay operated by energy coming in over said transmitting channel to said tube device, a charging circuit closed by said relay for increasing the potential on said condenser to decrease the loss of said tube device, a gain increase disabler relay operated by the energy volume on said transmitting channel beyond said vacuum tube device when said energy volume is within certain limits, means controlled by said gain increase disabler relay when operated for holding open said charging circuit for said condenser, an auxiliary charging circuit for increasing the potential on said condenser to reduce the loss of said tube device, said auxiliary charging circuit being completed by the operation of said gain increase relay, and means controlled by the completion of said control circuit in said anti-singing device for holding open said auxiliary charging circuit.

5. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels, said device including a relay associated with said receiving channel and responsive to energy volume transmitted thereover and a control circuit completed by the operation of said relay, a voice operated gain adjusting device associated with said transmitting channel, said gain adjusting device including a vacuum tube loss device having its cathode-anode circuit included in said transmitting channel, a condenser for varying the potential on the grid of said tube device to control the loss caused by said device, a gain increase relay operated by energy coming in over said transmitting channel to said tube device, a charging circuit closed by said relay for increasing the potential on said condenser to decrease the loss of said tube device, a gain increase disabler relay adapted to be operated by the energy volume on said transmitting channel beyond said vacuum tube device when said energy volume is within certain limits, means controlled by said gain increase disabler relay when operated for holding open said charging circuit for said condenser, an auxiliary charging circuit for increasing the potential on said condenser to reduce the loss of said tube device, said auxiliary charging circuit be-

ing completed by the operation of said gain increase relay, and means controlled by the completion of said control circuit in said anti-singing device for holding open said auxiliary charging circuit and for operating said gain increase disabler relay.

6. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels, said device including a relay associated with said transmitting channel and responsive to energy volume transmitted thereover and a control circuit completed by said relay for rendering said transmitting channel operative, a voice operated gain adjusting device associated with said transmitting channel, said gain adjusting device including a vacuum tube loss device having its cathode-anode circuit included in said transmitting channel, a condenser for varying the potential on the grid of said tube device to control the loss caused by said device, a gain increase relay operated by energy coming in over said transmitting channel to said tube device, a charging circuit closed by said relay for increasing the potential on said condenser to decrease the loss of said tube device, a gain increase disabler relay operated by the energy volume on said transmitting channel beyond said vacuum tube device when said energy volume is within certain limits, means controlled by said gain increase disabler relay when operated for holding open said charging circuit for said condenser, an auxiliary charging circuit

for increasing the potential on said condenser to reduce the loss of said tube device, said auxiliary charging circuit being completed by the operation of said gain increase relay, means controlled by the completion of said control circuit in said anti-singing device for holding open said auxiliary charging circuit, a gain rate relay included in the plate circuit of said vacuum tube loss device, said gain rate relay being adjusted to operate when the loss of said tube device is approximately one-half of its maximum, and means controlled by the operation of said gain rate relay for preventing the completion of said auxiliary charging circuit for said condenser.

7. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels designed so that energy transmitted to or over one of said channels will cause the device to disable the other of said channels, a voice operated gain adjusting device associated with said transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means operated independently of the output volume of said voice operated gain adjusting device for causing said voice operated gain adjusting device to vary the gain at a rate faster than said predetermined normal rate, said auxiliary means being operative only when said voice operated anti-singing device and said voice operated gain adjusting device are not operated substantially at the same time.

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