

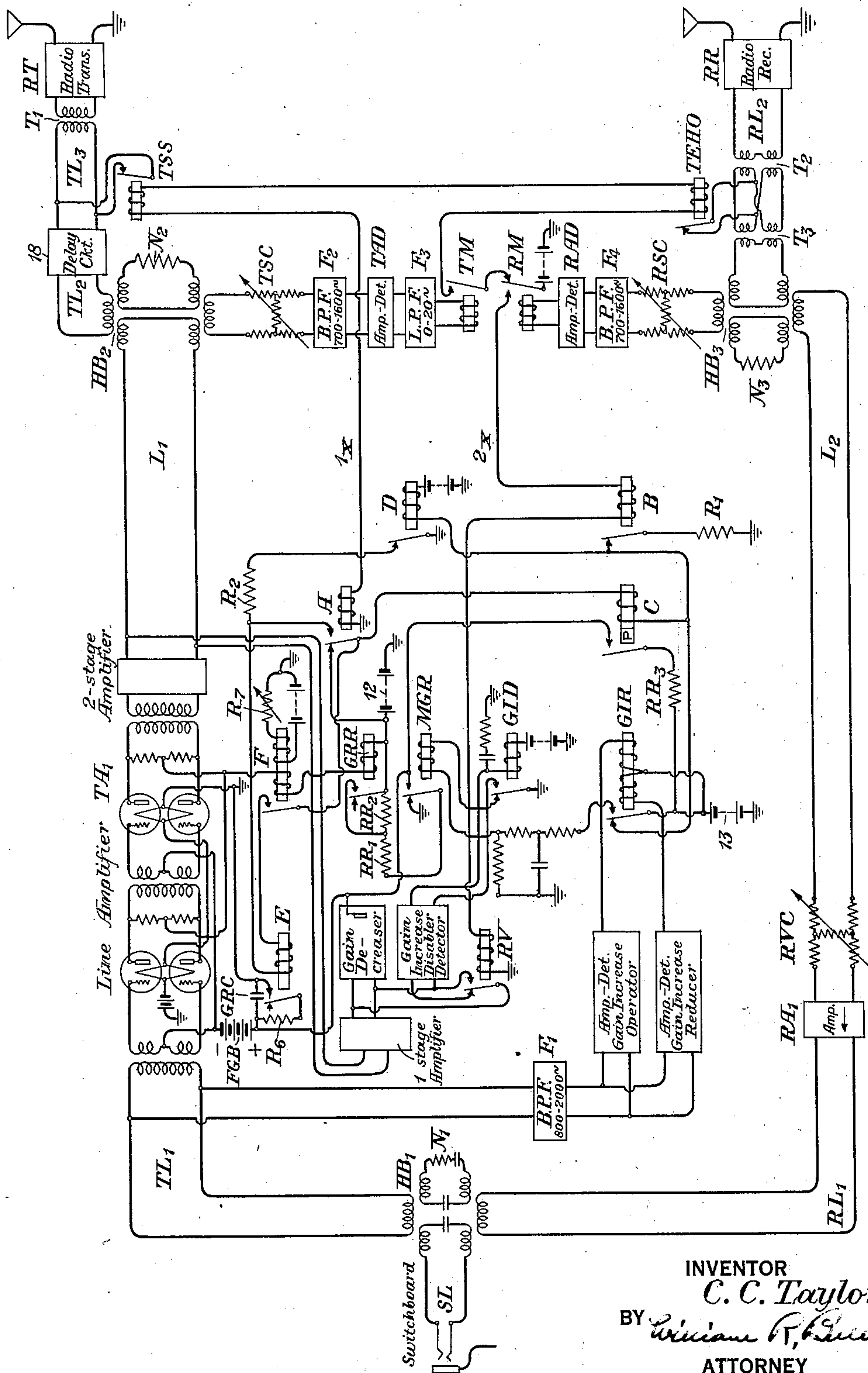
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SIGNAL TRANSMISSION SYSTEM

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SIGNAL TRANSMISSION SYSTEM

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This invention relates to voice operated devices, used with radio telephone systems or other channels for the transmission of intelligence, and more particularly, it relates to arrangements at a point where such a system may pass from a four-wire basis to a two-wire basis.

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 unbalance are effectively eliminated, and radiation by the radio transmitter of signals received by the radio receiver is prevented. Such a device may take on the specific form of a relay, voice operated from the transmitting side, which may remove a short circuit from the transmitting side and disable the receiving side and include also a relay, voice operated from the receiving side, which will render the first named relay ineffective. Such a device will be called a "vogdas" as abbreviation for voice-operated-device-anti-singing. Voice operated gain adjusting devices commonly called vogads have been developed to automatically regulate the transmitted speech volume, thereby relieving the technical operator of this duty. The vogad in the transmitting side must be so associated with the four-wire terminal and with the anti-singing devices as to prevent difficulty through false operation of various elements. On the other hand, some of such systems are quite complicated in nature and it is a purpose of this invention to bring about a simplified arrangement for maintaining suitable operation of the terminal set.

A system of this general nature is shown and described in my Patent No. 1,973,027 of September 11, 1934, and reference is made thereto for a more detailed statement than will be here included of parts of the circuit. One of the difficulties characteristic of vogads, and mentioned in that patent, is that since it is and should normally be very slow in operation it may be set to a low gain by the operator, and if the following speaker is a weak speaker, his speech may fail to operate the anti-singing devices. One of the objects set forth in that patent, then, was to provide means for rapid step-up of the vogad

gain in the event of weak transmitted speech. This is also one of the purposes of my present invention.

In such a system as shown in my patent and elsewhere there are times when the received speech may be too weak to operate the anti-singing devices. If at the same time the vogad has been left by a previous speaker at a high gain level, echoes from the received side may be able to give false operation of the anti-singing device from the transmitting side. One method of obviating this has been to introduce loss, either manually or automatically, into the receiving side of the circuit of sufficient magnitude so that the reduced echo currents will not give false operation of the anti-singing device. This has the marked disadvantage that the received volume is low and it places the full burden of maintaining a suitable echo margin on the receiving side of the circuit. One of the purposes of my invention is to prevent such false operation without introduction of excessive loss in the receiving side and I do so by providing means whereby there is rapid reduction of the vogad gain before received speech arrives, the reduction being to a value so low that any such echo effects as may be present will not be able to operate the anti-singing devices from the transmitting side.

Other objectives of this invention will appear in the light of the following specification and the accompanying drawing, in which the figure shows a circuit arrangement similar to that of my patent but embodying certain additional features for the attainment of the objects of the invention.

Throughout this specification when the term strong or weak transmitted speech is used it means that on arrival at the terminal the speech is relatively strong or weak, and when the term weak received speech is used it means the received speech is too weak to operate the vogdas from the receiving side at the sensitivity setting which has been determined by the amount of noise or other disturbances arriving on the receiving side.

The description of the figure, so far as its general behavior is concerned, will be understood fully by reference to my patent, referred to above. Here it is sufficient to point out the operation briefly. Thus the speech to be transmitted comes over the line SL, through the hybrid coil HB₁, to the input of line amplifier TA₁. A portion of the transmitted speech passes through the band pass filter F₁ to the amplifier detector gain increase operator and to the amplifier detector gain increase reducer.

These two control a relay GIR and the sensi-

tivity is high enough so the relay is operated by the stronger portions of all speech of sufficient volume to be of commercial importance.

Associated with the input circuit of the amplifier TA₁ is a biasing battery FGB and in series therewith a biasing condenser GRC. The output of the amplifier is used to control a gain decreaser and a gain increase disabler, all associated in such a manner as to control the gain of the amplifier TA₁, delivering an output to the transmission line L₁ sufficient to operate the relay TM, which, in turn, operates the relay TSS and TEHO to remove a short-circuit from the transmission line TL₂ and to render the receiving side of the circuit ineffective.

Consider the circuit as idle and the gain of the vogad as relatively low. Transmitted speech of any useful volume now arriving will operate the gain increase relay GIR, which then operates relay MGR to apply voltage from battery 12 to the condenser GRC, the polarity being such as to decrease the negative bias of the amplifier TA₁ and thus step up the gain. When the output of the amplifier has reached a sufficiently high voltage it will be effective on the gain decreaser which serves as a path for leakage of charge from the condenser GRC. At the same time the gain increase disabler detector is caused to function, operating the slow release relay GID and thus preventing further charging up of the condenser GRC, the adjustments all being such that the output volume of the amplifier TA₁ is substantially constant for all speakers.

In the circuit of this invention I have incorporated the relays A, B, C, D, E and F for certain useful purposes. Thus in series with the relays TSS and TEHO, which are controlled by TM, is the relay A, intended to perform functions somewhat similar to those of the relay A of my patent. Connected to the front contact of RM are the relays B and RV, adapted to perform functions somewhat similar to those of the corresponding relays of my patent. There is also a relay C adapted to perform functions similar to those of the relay C of my patent. In addition I introduce a relay D which operates with GIR in a manner to be hereinafter described. Finally I introduce relay E for placing a resistance in shunt to the biasing condenser GRC, and a relay F which carries the plate current of the amplifier TA₁ and which in part controls the operation of E.

The operation of the system as a whole will be apparent from the following description. For normal or strong transmitted speech the vogad operates in the usual manner and the relay TM is actuated. For weak transmitted speech the relay GIR will be operated, and removal of its back contact will immediately permit operation of relay D. This speech will not be strong enough to operate the relays TM and A, and current will therefore flow through relay C from the battery 12 through the back contacts of A and B, through the resistance R₁ and to ground. This connects battery 13 across condenser GRC, stepping up the gain of the vogad very quickly. With this step-up of gain the relay TM will operate, lifting the armature from the back contact of A, which breaks circuit for relay C. After this initial step-up of gain the vogad will then continue to operate in the normal manner.

It will be noted that there is an echo path for received speech to the transmitting side, the echo currents consisting primarily of reflections from the two-wire circuit SL and of such unbalance as may exist in the hybrid coil HB₁. In view of this

it is desirable to reduce the gain of the vogad rapidly when transmitted speech ceases or when there are appreciable pauses in the transmitted speech. This reduction should be sufficient so that for any echo currents which may come to the transmitting side the output of the amplifier TA₁ shall not be sufficient to operate TM. To this end I introduce in series with the plate circuit of TA₁ the relay F, and when this current is of sufficient magnitude, that is, when the gain of the vogad is high enough, it will close circuit through its front contact for the relay E, but relay E will operate only on the condition that relays A and D are both released, as will be the case for interruptions of transmitted speech. The relay E shunts the condenser GRC with the resistance R₆, permitting a rapid discharge of the condenser GRC, and thus a rapid decrease in the gain of TA₁. It should be emphasized, however, that this can occur only if relays A and D are released. From this it will be seen that whatever may be the volume of the speech to be transmitted the gain of the vogad will be adjusted (rapidly, if necessary) to permit operation of TM and of relay A, but as soon as transmitted speech ceases or is interrupted appreciably, the gain of the vogad is brought to a definite low value. Thus the circuit provides means for a rapid step-up and a rapid step-down of the vogad gain.

We will now consider the conditions for received speech. If this speech is of sufficient volume to operate RM, then the relays RV and B will be operated. Operation of RV short-circuits the input of the gain decreaser and readjusts the connections of the gain increase disabler detector, which contains a gas tube, in such way that this gas tube is tripped off and thus through the operation of relay GID prevents gain increase. Operation of relay B disables the relay C so that no quick increase in gain of the amplifier TA₁ through the front contact of C is permitted. Occasional false operation of TM, if it should occur under these conditions, will be of no harm for operation of RM would make it impossible for TM to operate relay TSS.

If the received volume is so low that it cannot operate RM, then the relays RV and B will not be operated. But again, false operation of TM is not possible, for the volume of the echo currents coming to the amplifier TA₁ will be low and at the same time the gain of the vogad will be low, having been brought into that condition immediately upon the cessation of transmitted speech by the operation of relay E.

The gain of the amplifier TA₁, at which relay F is operated, can be controlled by a supplemental winding on the relay F, the current through which is controlled by resistance R₇. Also a double assurance that the relay E will not be falsely operated is provided by a contact from the one side of relay E to a front contact on relay A, short-circuiting the relay E in the event that F and A are operated. R₂ is a current limiting resistance.

For satisfactory operation of the circuit, as described, certain adjustments are desirable. Thus, the sensitivity of the receiving amplifier detector RAD is set at a certain value by adjusting the receiving sensitivity control RSC. This sensitivity depends upon the amount of received noise coming in at the line RL₂, and the sensitivity is made as high as possible without causing excessive operation of the receiving master relay RM from noise. This setting having been determined, adjustment is then made of the loss device RVC to secure the necessary echo margin as explained.

below. The transmitting amplifier detector TAD has its sensitivity adjusted high enough to permit satisfactory relay operation by the transmitting voice volume it normally receives, but no higher, in order to avoid operation of the TM relay by line noise, room noise, or echoes of received speech.

The adjustment of the sensitivity of the GIR relay is set so as not to be as high as that of the TM relay, since a higher sensitivity is required for an anti-singing relay. The operation intended here requires that the GIR relay shall never be operated by echoes of received noise or speech. When the setting of the receiving amplifier detector RAD has been determined for the noise conditions prevailing, the received volume control RVC is adjusted to give a reasonable positive echo margin to GIR. This adjustment will be one satisfactory for the lowest return losses to be expected.

With these adjustment of RAD and RVC the bias of relay F is adjusted by the resistance R_7 so that F operates at a gain of TA_1 which is slightly under the gain at which echo operation of TM would occur for the lowest return losses to be expected. When the terminal is idle the gain of TA_1 is always below the point at which relay F releases.

One important requirement is that when the gain has been high on outgoing speech it shall be reduced, following cessation of speech, before relay TEHO in the receiving anti-singing device releases. Therefore, relays GIR, D and A shall release and E shall operate and reduce the gain before TEHO releases. Relay D operates as soon as GIR operates, preventing any possible operation of relay E. Under these circumstances, when speech ceases and GIR releases, D also releases, and when A releases E operates to reduce the gain if the gain has reached a value which causes F to operate.

It will be apparent with the frequent change from high gain to low gain of the vogad, occurring as this does with each interruption of transmitted speech, there will be a tendency, especially at the initiation of weak transmitted speech, to clip or lose one or two of the first syllables of such speech pending the rapid increase of gain in the vogad. This deterioration or degradation of transmitted speech is however, compensated for by improvement in the received speech in view of the fact that the losses which formerly were introduced in the receiving path in approximate proportion to the vogad gain to preserve echo margin need no longer be introduced, and the received volume is therefore not only on a higher level but is independent of the transmitted speech. Degradation of received speech, of course, is still present here as in former cases because of any noise present on the receiver side. Furthermore, the feature of clipping may be reduced by the introduction of a delay circuit such as shown at 18 in the transmission line TL_2 . Considering the overall circuit, it will be seen that such degradation which formerly was assigned entirely to the received speech is now divided between the received speech and the transmitted speech and, in any case, on the transmitting side is inversely proportional to the vogad gain.

From the description as given heretofore it will be seen that the following operations have become available:

(a) Normal operation of the vogad for strong transmitted speech.

(b) Rapid step-up of gain for weak transmitted speech.

(c) Rapid reduction of vogad gain for weak transmitted speech on interruption of the transmitted speech.

(d) Disablement of the rapid gain relay with strong transmitted speech.

(e) Protection against operation of the transmitting singing suppressor by echo of weak received speech through the establishment of low vogad gain under such conditions.

(f) Received volume of uniform value for all connections; this value being determined by the amount of received noise.

It will be observed also that through this circuit arrangement provision has been made for the following:

(a) Arranging for the voice waves to condition the circuit for improved operation of TM relay.

(b) Arranging to have the operation of the vodas control the time actions of the vogad, by means of a relay C.

(c) Making the amount of gain switched in by the voice in reversing direction of transmission depend on the volume of the speaker.

(d) In a vogad and vodas combination, arranging that where received volume adjustments are not made for each individual call the weakest talkers shall not determine the received volume for all calls. This results from the feature of reducing the gain of the vogad after each transmitted speech.

(e) In a vogad and vodas combination, arranging that where degradation of transmission occurs because of certain noise and talker conditions, this degradation is divided between the transmitted and received speech instead of being applied entirely to the received speech.

(f) In a vogad and vodas combination, arranging that where the concurrence of high radio noise and weak talker volume causes degradation of transmission, this degradation is divided between transmitted and received speech and the transmitted speech degradation is inversely proportional to the talker volume.

It is apparent that numerous variations may be made in this circuit without departing from the spirit of the invention. Some such changes, for example, are simplifications which may be provided by combining the actions of certain relays. Thus since relays A and TSS have substantially the same characteristics, these two relays may be combined into one by placing the contacts of A on the relay TSS. Also since the relays RV and B require substantially the same characteristics, these may be combined into a single relay.

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, an auxiliary means operated independently of the output volume of said voice operated gain adjusting device for causing said voice operated gain adjusting device to increase the gain at a rate faster than said predetermined normal rate, said auxiliary means being operative when the energy coming in to the gain adjusting device is of a level insufficient to operate the anti-singing device, and a second auxiliary means for causing said de-

vice to decrease the gain rapidly on cessation of transmitted speech.

2. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels so designed 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 the transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means for stepping up the gain quickly for weak transmitted speech and for lowering the gain on cessation of transmitted speech.

3. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels so designed 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 the transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means for reducing the gain on cessation of transmitted speech, the amount switched out on cessation being dependent on the speech volume of the speaker.

4. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels so designed 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 the transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means for reducing the gain on cessation of transmission, the reduction being of such magnitude as to leave the gain device at a gain independent of the speaker volume.

5. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels so designed 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 the transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means for stepping up the gain quickly for weak transmitted speech and for lowering the gain on cessation of transmitted speech, the amount of gain switched in on transmission of speech and the amount switched out on cessation, being dependent on the speech volume of the speaker and the volume of the received noise.

6. In a transmission system, a transmitting channel and a receiving channel, a voice operated anti-singing device connected to said channels so designed 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 the transmitting channel and designed to adjust the gain at a predetermined normal rate, and auxiliary means for stepping up the gain quickly for weak transmitted speech and for lowering the gain on cessation of transmitted speech, the amount of gain switched out on cessation of transmitted speech being equal to the amount switched in on initiation of transmitted speech.

7. In a transmission system, a transmitting

channel and a receiving channel, a vogad and a vodas combination associated therewith, one for giving the voice operated gain adjustment and the other for maintaining the voice operated anti-singing device, and auxiliary means associated with the system for adjusting the received volume to a maximum for the conditions of noise and echo present and for maintaining the received volume independent of the vogad gain.

8. In a four-wire circuit terminal, a vogad and a vodas combination subject to false operation by echo of received speech when the vogad is at high gain, means for preventing such false operation comprising relay circuits operative to rapidly reduce the gain of the vogad on cessation of transmitted speech.

9. The combination of claim 8 characterized by the fact that the reduction in gain occurs before the vodas operates to remove the disablement of the receiving path.

10. In a four-wire circuit terminal, a vogad and a vodas combination, means for adjusting the losses in the receiving side to a minimum consistent with maintaining a margin against excessive vodas operation from the transmitting side by noise or by echo when the vogad is set at a predetermined gain, means for rapidly stepping up the gain of the vogad for weak transmitted speech, and means for rapidly stepping down the gain on cessation of transmitted speech to a value to preserve the desired margin against noise and echo.

11. In a four-wire circuit terminal, a vogad and a vodas combination, a relay in the plate circuit of the vogad amplifier to be operated when the gain of the vogad exceeds a predetermined value and means responsive to the operation of said relay when no speech is being transmitted to reduce the gain rapidly.

12. In a four-wire circuit terminal, a vogad and a vodas combination, a condenser in the input circuit of the vogad adapted to be charged to control the grid bias of the vogad amplifier, a resistance adapted to be shunted around said condenser but normally on open circuit, a relay in the plate circuit of the vogad amplifier operable when the gain of the amplifier exceeds a predetermined value and a second relay responsive to the operation of said first stated relay, when no speech is being transmitted, to connect said resistance in shunt to the condenser.

13. A combination of claim 10, characterized by the fact that the reduction in gain occurs before the vodas operates to remove the disablement of the receiving path subsequent to an interruption of transmitted speech.

14. In a four-wire circuit terminal comprising a vogad and a vodas combination, the method of maintaining the gain on the receiving side at a relatively high value which consists in reducing the gain on the transmitting side to a definite value whenever speech is not being transmitted.

15. In a four-wire circuit terminal comprising a vogad and a vodas combination, the method of maintaining substantial margin against echo operation of the vodas which consists in holding the gain on the receiving side at a relatively high value and reducing the gain on the transmitting side whenever speech is not being transmitted.

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