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TELEPHONE TRANSMISSION CIRCUIT

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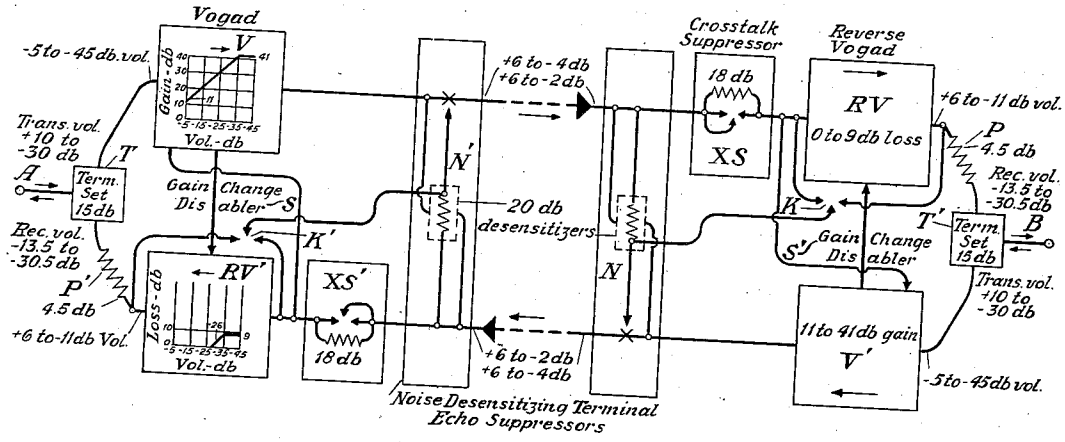


Fig. 1

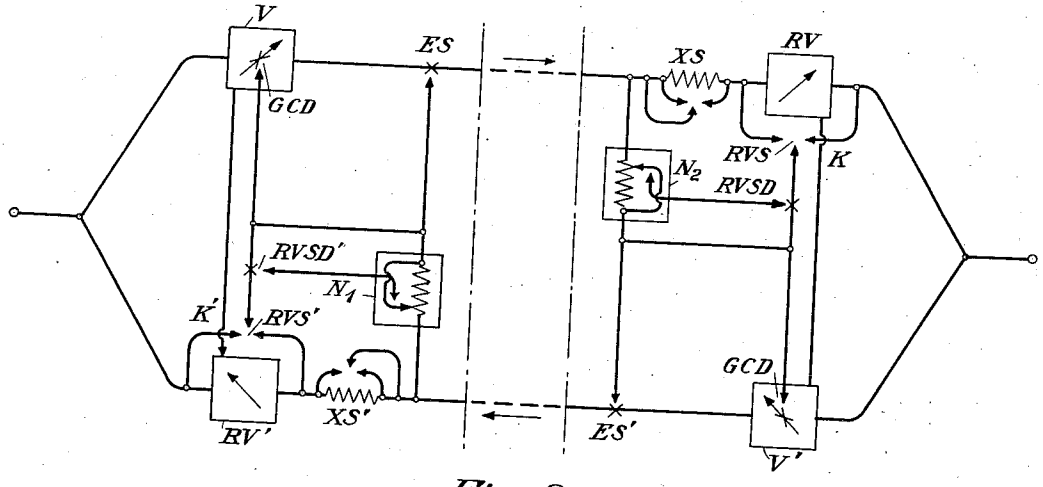


Fig. 2

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TELEPHONE TRANSMISSION CIRCUIT

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12 Claims. (Cl. 178—44)

This invention relates to telephone transmission on long line circuits, and, more particularly, to means for the improvement of transmission on circuits commonly spoken of as four-wire circuits. The invention relates to the type of circuits described in the application of Wright and Abraham Serial No. 752,150, filed November 8, 1934.

The object of the invention is to associate various known forms of transmission control devices in new and useful combinations to obtain maximum gain over such circuits consistent with maintenance of anti-singing conditions. A further object is to obtain maximum gain consistent with discrimination against echoes and against room and line noises.

The invention will be better understood by reference to the following specification and the accompanying drawing, in which Figure 1 is a circuit showing our invention, and Fig. 2 is a modified form of that circuit.

The invention is applicable to circuits such as described in an article by Osborne on "General switching plan for telephone toll service", published in the Bell System Technical Journal for July 1930, in which it is shown how, in such a country as the United States, it is advantageous to select certain strategically located cities as regional centers, these being interconnected directly with each other, such connections being spoken of as RC—RC links. From such regional centers there are additional circuits fanning out to important points spoken of as primary outlets or toll centers, the connections from regional centers to primary outlets being spoken of as RC—PO links.

In the application of Wright and Abraham, cited above, there are shown circuits which are designed to operate on the basis of volume controlled gain rather than on the basis of constant net loss. Fig. 1 of this application is the same as the circuit of Fig. 2 of that application, except for the addition of a feature which constitutes the subject matter of this invention. A full description of the circuit of Fig. 1 may be found in the copending application and it is sufficient to here state briefly that it consists of a four-wire RC—RC or an RC—PO or a PO—PO link which is brought to a two-wire basis at the terminals. On the transmitting side of one terminal there is a vogad, this term being an abbreviation for volume operated gain adjusting device. On the receiving side at the same terminal, there is a nodes, that is, a noise desensitized echo suppressor, followed by a cross-talk suppressor and by a reverse vogad. There is also a connection from the vogad on the one side to the reverse vogad on the other side at that terminal, by which the loss introduced in the reverse vogad is controlled by the gain in the vogad. In addition, there is a gain change disabler whereby speech coming in on the receiving side prevents further adjustment of the vogad so long as that received speech is present. The terminal at the other end of the line is a duplicate of that just described.

In the copending application it is pointed out that if the transmitted speech at A is of low volume the large gain then introduced by the vogad V may cause singing around the circuit and, for this reason, the reverse vogad RV' is introduced, this device putting in loss when the gain of the vogad is high. On the other hand, it will be evident that the introduction of this loss will cause a reduction in the received volume coming from the other terminal B and, for this reason, we find it desirable to remove this loss while the received speech is coming in. This is permissible, however, only if the echo suppressor has been operated to disable the other path, otherwise, singing around the link would occur. In order to accomplish our purpose then, we add the devices K and K' of such a nature that when the contacts at K' are closed the loss of the reverse vogad, if there is any, is removed. Such a device may be called a reverse vogad suppressor. The contacts K' might be operated in any manner desired by the incoming speech, but it is quite important that the loss of the reverse vogad should not be removed unless the echo suppressor has been operated. This echo suppressor N', however, is a noise desensitized echo suppressor, that is, a nodes, being a device which becomes less sensitive as the noise on the line increases. It is evident that there should be corresponding reduction in the sensitivity of operation of the contact K', and for this reson we find it convenient to have the contact K' controlled by the nodes.

It may be added that when the noise is high compared to the volume being transmitted over the circuit, the nodes will fail to operate, and the contacts K and K' will not be closed and in this case the received volumes will be identical with those given on the circuit of the Wright and Abraham application. If the difference between the speech volume and noise is sufficient to permit the echo suppressor to operate on all the speech but not the noise, and thus to close contact K', the loss of the reverse vogad will be removed from the direct transmission and, for the illustrations here given, volumes from zero to 9 db. louder will be obtained, depending on

the setting of the reverse vogad. In spite of the removal of this loss singing will not result since a large loss is introduced in the opposite direction of transmission by the echo suppressor N'.

There is one feature of this circuit to which attention is to be called, namely, that if the noise desensitizer operates, thus lowering the sensitivity of the receiving echo suppressor, and if at the same time the speech from the distant end of the circuit is weak, this speech may not completely operate the reverse vogad suppressor. The effect would be that the strong parts of speech would remove the reverse vogad but the weak parts would not, and, thus, an undesirable wavering effect on the speech quality might be present. This, of course, would not occur unless there were noise present which would desensitize the suppressor. However, it is possible to avoid any such contingency by modifying the circuit of Fig. 1 in accordance with that of Fig. 2. In this figure the arrangement is such that the reverse vogad remains in all the time when the desensitizer cuts down the sensitivity of the receiving echo suppressor by an appreciable amount.

Referring to Fig. 2, there are shown the same elements as in Fig. 1, but in a more conventionalized form. In particular there are shown the same contacts K and K' which are capable of removing the loss of the reverse vogads. But, under certain condition to be described in a moment, the circuit leading to contacts K or K' is disabled. Thus, part of the incoming speech from B will pass through N_1, that is, the noise operated gain adjusting portion of the nodes, and commonly called a "nogad", and will operate the echo suppressor ES. It will also operate the gain change disabler GCD, thereby disabling the vogad and preventing it from adjusting its gain and, finally, it will operate the reverse vogad suppressor RVS' at K' provided that RVSD' is not operated. The presence of noise causes the nogad to insert loss, and the device is so adjusted that when this loss reaches a prescribed value then RVSD' will operate, thus disabling RVS' completely.

Various schemes may be adopted for the RVSD control and it is not necessary to describe this, in view of the description in the copending application and the references to the prior art referred to therein, further than to state that the variable gain element in the nogad will usually be dependent upon the amount of charge on a condenser, and the RVSD control may well be operated by a single detector biased to operate when a certain voltage appears on the condenser. In this way then, when noise has effectively desensitized the receiving nogad so that there is some chance that the latter will not operate on all parts of the incoming speech, the reverse vogad disabling control is, itself, disabled so that a possible bad effect on quality, due to incomplete operation of this control by incoming speech, is removed.

There is an additional feature in Fig. 2 by which it differs from the circuit of Fig. 1. In Fig. 1 the gain change disabler, GCD, operates directly from the voice current in the receiving side, the connection being from the one side of the cross-talk suppressor. In Fig. 2 the GCD is operated from the nogad and thus, it will be noted, that as the sensitivity of the nogad falls, due to noise, the sensitivity of operation of the gain change disabler also falls. This has the advantage that there is no danger of the gain change disabler being operated by noise rather than speech.

What is claimed is:

1. In a four-wire telephone system, the combination at one terminal of a vogad in the transmitting side, and a reverse vogad in the receiving side controlled by the vogad on the transmitting side, and means for removing the loss due to the reverse vogad by incoming speech on the receiving side.

2. In a four-wire telephone system, the combination at one terminal of a vogad in the transmitting side, and a reverse vogad in the receiving side controlled by the vogad, a nodes, and means subject to the nodes for removing loss due to the reverse vogad the nodes being under control of the incoming speech on the receiving side.

3. In a four-wire telephone system, the combination at one terminal of a vogad in the transmitting side, and a reverse vogad in the receiving side, and means for removing loss due to the reverse vogad in the receiving side by incoming speech on the receiving side when the transmitting path has been disabled.

4. In a four-wire telephone system, the combination at one terminal of a vogad in the transmitting side, a nodes and a reverse vogad in the receiving side, and means for removing loss due to the reverse vogad in the receiving side when the nodes has been operated to disable the transmitting path.

5. The combination of claim 1 characterized by the fact that the means for removing the loss has a sensitivity dependent on the amount of noise on the line.

6. The combination of claim 1 characterized by the fact that the means for removing the loss becomes less sensitive for increase of noise on the line.

7. The combination of claim 2 characterized by the fact that the means for removing the loss is disabled if the nodes has been desensitized.

8. The combination of claim 2 characterized by the fact that the means for removing loss is disabled if the nodes has been desensitized by a predetermined amount.

9. In a four-wire telephone system, the combination at one terminal of a vogad in the transmitting side, a nodes and a reverse vogad in the receiving side, means for removing loss due to the reverse vogad by incoming speech on the receiving side, and further means by which the first-named means is disabled if the noise rises above a certain value with respect to the minimum expected speech volume.

10. The combination of claim 2 characterized by the fact that additional means subject to the nodes and under control of incoming speech on the receiving side prevent any gain change in the vogad in the opposite path.

11. The combination of claim 9 characterized by the fact that the first means mentioned is effective only if the transmitting path has been disabled.

12. The combination of claim 2 characterized by the fact that there is a gain change disabler controlled from the receiving side and blocking further change in gain of the vogad, and further characterized by the fact that this disabler is controlled through the nodes in such a manner that the disabler sensitivity is lowered when the nodes has been desensitized.

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