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VOICE OPERATED CIRCUITS

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2 Sheets-Sheet 1

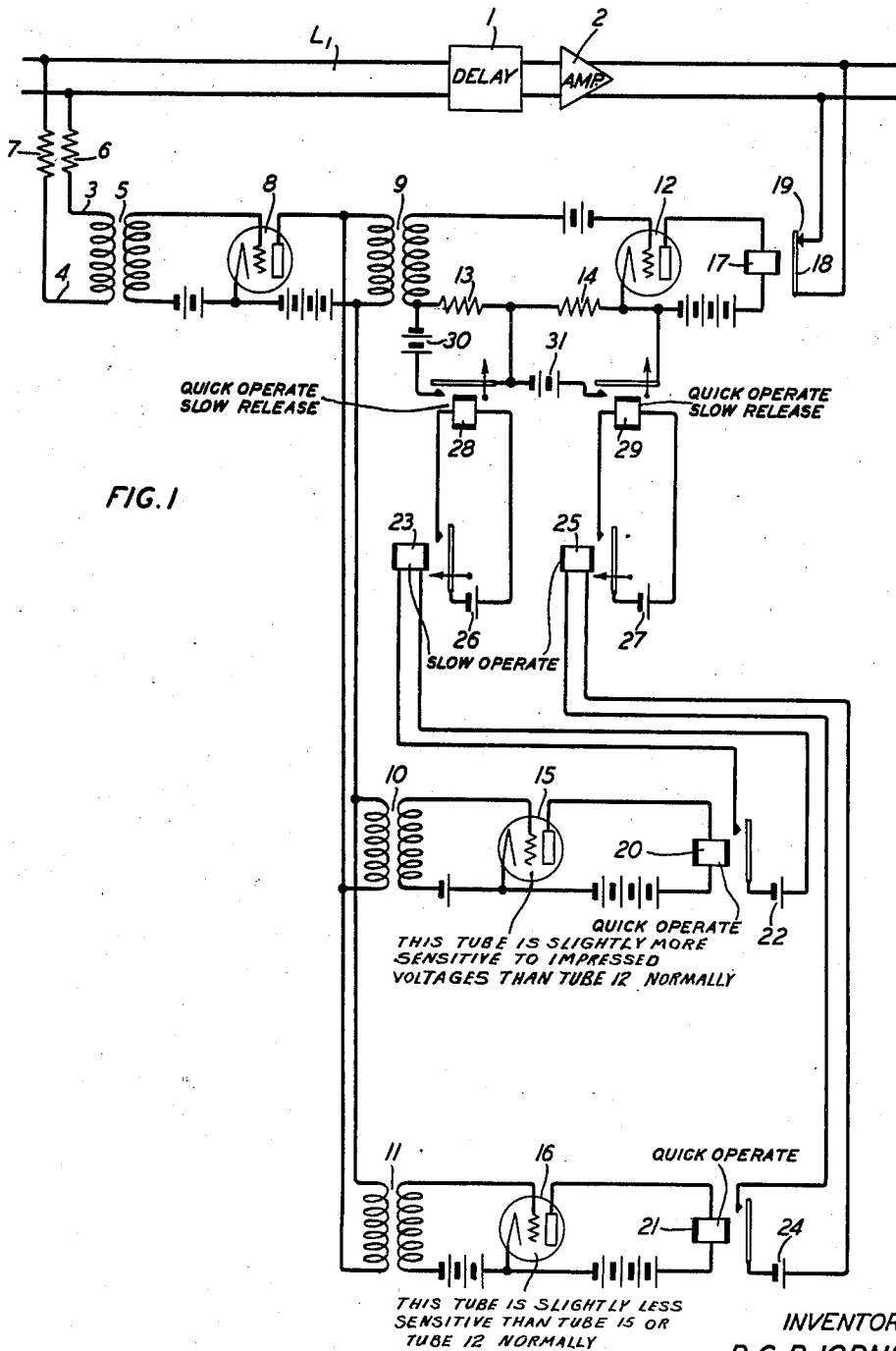


FIG. 1

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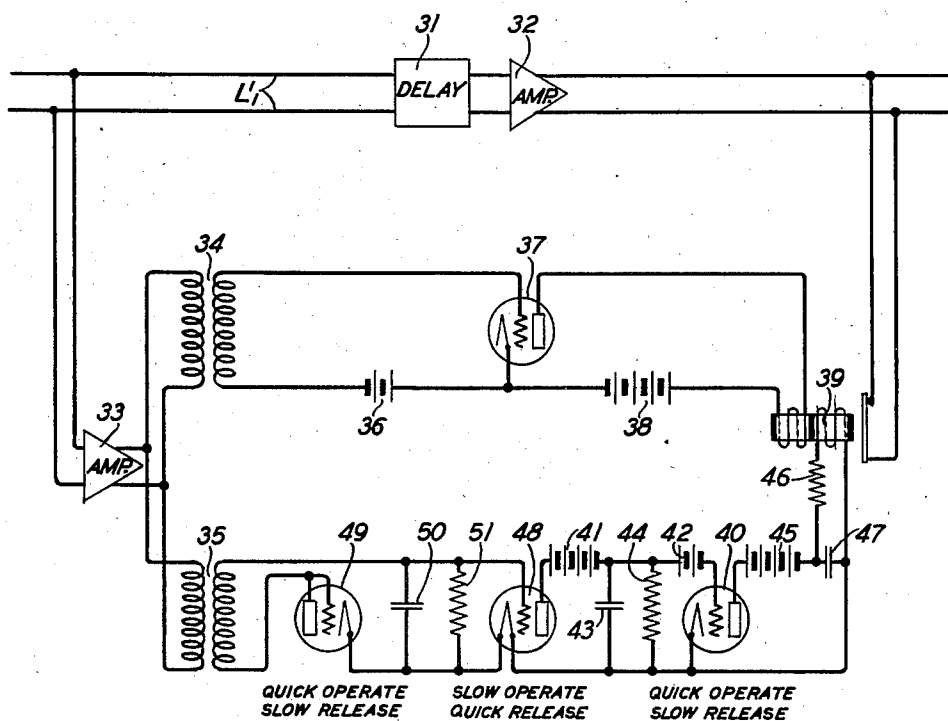
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FIG. 2



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VOICE OPERATED CIRCUITS

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3 Claims. (Cl. 178-44)

This invention relates to transmission controlling arrangements and more particularly to arrangements for controlling the sensitivity of voice operated devices used in connection with transmission circuits.

Tests have shown that steady currents such as those set up in telephone circuits by induction from power lines or other adjacent circuits are a serious limitation on the sensitivity at which a voice operated circuit can be worked. The seriousness of this difficulty becomes apparent when it is considered that the sensitivity of such a circuit is limited by the noisiest circuit which may be connected to the line at a given time, while for other circuits which may be connected, a greater sensitivity is possible. Also, if the voice operated device is adjusted to maximum sensitivity with the noisiest circuit, its sensitivity for less noisy circuits will be reduced.

It is an object of this invention to automatically adjust the sensitivity of signal-controlled apparatus with changing noise conditions on the line with which such signal-controlled apparatus is associated.

It is a further object of this invention to maintain signal-controlled apparatus operable by signals only even when noise currents are present in the signal lines in considerable volume.

In the manual operation of voice operated devices in telephone transmission systems, the operator is supplied with an indicator (such as a galvanometer) which shows when the voice operated device operates. With experience, the operator learns about how often and for what periods the voice operated devices should operate with normal speech. If the indicator shows that the devices are being maintained operated longer than normal speech should maintain them operated, it is known that noise is present in the line and is aiding in keeping the voice operated devices operated. A loss is then introduced into the circuit thereby decreasing the sensitivity of the voice operated devices to noise currents but maintaining the devices sensitive to voice currents.

The present invention consists of circuits and apparatus which simulate the operations of the manual operator and in addition, maintain the loss present in the circuit after the cessation of the noise currents for a time to avoid false operations which might occur due to variations in the amplitude of the noise currents.

As is well known in the art, voice currents have a syllabic frequency which may vary from 2 to 22 cycles per second, whereas the noise cur-

rents, against which the circuits to be described herein give protection, will usually consist of alternating or pulsating currents of a frequency higher than the syllabic frequency and persisting continuously for approximately 1 second or longer. The circuit may be designed or adjusted however, to accommodate quite different conditions.

The invention will be better understood from the following description and attached drawings forming a part thereof in which: Fig. 1 shows one form which the invention may take; and Fig. 2 shows another form utilizing but one relay. Each form is shown as applied to one side only of a four-wire transmission circuit, it being understood that suitable equipment will be associated with the other side of the line for a complete installation.

Referring to Fig. 1, line L_1 represents a one-way transmission line of a four-wire two-way system in which transmission occurs from left to right.

Currents existing in line L_1 are divided, a portion passing directly through delay circuit 1 and amplifier 2, while the remaining portion passes over conductors 3 and 4 and the primary winding of input transformer 5. Resistances 6 and 7 are inserted in lines 3 and 4 to keep the currents shunted into them at the smallest value consistent with the proper operation of the associated circuits.

The secondary winding of transformer 5 is connected to the input electrodes of a space discharge device 8 which is adapted to amplify the currents impressed thereon.

The amplified output currents of device 8 pass in parallel through the primary windings of transformers 9, 10 and 11. The secondary winding of transformer 9 is connected to the input electrodes of space discharge device 12 through resistances 13 and 14. The secondary winding of transformer 10 is connected to the input electrodes of space discharge device 15 and the secondary winding of transformer 11 is connected to the input electrodes of space discharge device 16.

The output circuit of space discharge device 12 includes the winding of relay 17 which is adapted to control a short circuit including armature 18 and contact 19 across line L_1 . Relay 17 is quick operating but has a release time sufficient to cover the weak endings of the speech syllables. On normal continuous speech it would regularly release between words. This release time can be obtained by any well known method. The out-

put circuit of space discharge device 15 includes the winding of relay 20 and the output circuit of device 16 includes the winding of relay 21.

Relay 20 by means of its associated armature and contact controls current from battery 22 to operate relay 23. Relay 21 in a similar manner controls current from battery 24 for the operation of relay 25.

Relays 23 and 25 by means of their associated armatures and contacts control current from batteries 26 and 27 respectively for the operation of relays 28 and 29, respectively. Relays 28 and 29 by means of their associated armatures and contacts control circuits which respectively insert biasing batteries 30 and 31 in the input circuit of device 12 in parallel with resistances 13 and 14 to thereby vary the grid bias of device 12 and hence its sensitivity.

Space discharge device 15 is so biased as to be slightly more sensitive to impressed voltages than device 12 in its normal operating condition, while device 16 is less sensitive than devices 15 or 12. Relays 20 and 21 are quick to operate but have substantially the same time of release as relay 17. Relays 23 and 25 are slow operating relays while relays 28 and 29 are quick to operate but slow to release. To operate relays 23 and 25 current must flow for approximately one second. The release time of relays 28 and 29 is approximately ten seconds.

This apparatus simulates the manual operator as to introducing loss as follows. If during a conversation relay 17 is maintained operated for approximately one second, the currents causing this will also cause the operation of the train of relays comprising relays 20, 23 and 28 to increase the bias of the grid of device 12 by the voltage of battery 30. If the amplitude of the incoming currents is sufficiently large and persist for the order of one second, battery 31 is also cut-in by relays 21, 25 and 29 to further increase the bias on the grid of device 12. The increased bias on device 12 will only reduce its sensitivity to speech currents lying below the noise margin. However, upon the cessation of speech, the anode current will cease to flow and relay 17 will be deenergized, the bias on tube 12 being now so large that the noise currents alone are insufficient to maintain relay 17 operated. The loss introduced (grid bias) compensates for the noise and device 12 and relay 17 are desensitized as to noise while their sensitivity to voice currents is affected only in the same energy range as the noise currents. Thus if the noise level is above a certain predetermined level for one second or more the sensitivity of the voice-operated device is lowered for a period of ten seconds since the release time of relays 28 and 29 is approximately 10 seconds. At the end of that period the sensitivity is raised again unless or until line current lasting for a sufficient time again causes or has caused operation of relay 23. The relays 20 and 23 operate as an exploring agency for noise conditions, and if conditions are such as to hold them operated a definite length of time, say one second, the sensitivity of the voice-operated circuit 12-17 is lowered for at least the predetermined period of say ten seconds, whereupon the continued lower sensitivity is dependent on the action of the exploring relays 20, 23.

Speech will operate relays 20 and 21 but since their release time is short they will release during the pauses between words. The operating time of relays 23 and 25 is made long enough to guarantee that relays 20 and 21 will release at

least once during that time interval if speech is on the circuit in the absence of noise. The rate of speaking is normally about 3 or 4 words per second. The relays 20 and 21 will release at least once every second so that speech alone is unable to affect the sensitivity of the voice operated devices.

Obviously other devices such as 15 and 16 with decreased sensitivity and similar trains of relays may be added if desired to provide for varying the sensitivity in more than the two steps illustrated.

Referring now to Fig. 2, line L_1' corresponds to line L_1 of Fig. 1 and includes delay circuit 31 and amplifier 32. An amplifier 33 connected to line L_1' in a manner similar to amplifier 8 of Fig. 1 has included in parallel in its output circuit the primary windings of transformers 34 and 35. The secondary winding of transformer 34 is connected through biasing battery 36 to the input electrodes of detector 37 corresponding to device 12 of Fig. 1. The output circuit of detector 37 includes the usual anode battery 38 and the "operate" winding of relay 39. Relay 39 is adjusted to perform the same function as relay 17 of Fig. 1, that is, the operation of relay 39 by means of its armature and associated contact removes a short circuit normally existing across line L_1' in the output of amplifier 32.

The secondary winding of transformer 35 is connected to the input electrodes of space discharge device 48. These connections include space discharge rectifier 49, condenser 50 and resistance 51. The anode of device 48 is connected to the grid of device 40 through anode battery 41 and grid bias battery 42. The cathodes of all these devices are connected in series as shown. A condenser 43 and resistance 44 are connected across the input electrodes of device 40.

The output circuit of device 40 includes anode battery 45, resistance 46 and "bias" winding of relay 39. A condenser 47 is connected in parallel to resistance 46 and bias winding of relay 39. The bias winding of relay 39 is wound as to oppose the effect of the "operate" winding.

In one embodiment of the invention, devices 49, 48 and 40 and associated circuits were arranged so that device 49 operated in about .001 sec. and continued upon cessation of input energy about .05 sec. Device 48 required about 1.0 sec. to operate and about .01 sec. to release, and device 40 operated in about .01 sec. and released in about 10 sec. Using the phraseology applied to the relays of Fig. 1, device 49 is quick operate, slow release; device 48 slow operate, quick release; and device 40 quick operate, slow release. The circuits by means of which these operate and release times are obtained are described in more detail hereinafter.

Some of the amplified output of amplifier 33 is impressed upon device 37 in the well known manner by the secondary winding of transformer 34. The output circuit of device 37 includes the operate winding of relay 39 and passage of current in this output circuit energizes relay 39 and the short circuit across line L_1' is opened, permitting speech to pass on. As is well known, the delay circuit 31 retards the passage of currents there-through long enough to permit the operation of relay 39.

The remainder of the output of amplifier 33 is impressed on device 48, the input circuit of which includes rectifier device 49 and resistance 51 and condenser 50. Current passing through rectifier 49 and resistance 51 causes a negative bias to be impressed upon the grid of device 48. As stated

above, the characteristics of condenser 50 and resistance 51 are such that device 49 acts quickly to change the bias on the grid of device 48.

The increased negative bias on the grid of device 48 causes a decrease in its anode current. However, as the anode current decreases with continued incoming line current through amplifier 33, condenser 43 discharges, maintaining a flow of current through resistance 44 for an appreciable time (one second) and the grid bias of device 40 remains substantially unchanged. If the line current persists for as long as one second the grid bias of device 40 is changed causing anode current to flow therethrough and the energization of "bias" winding of relay 39.

The constants of the circuit including devices 49, 48 and 40 are such that the magnitude of the current passing through the "bias" winding of relay 39 is proportional to the magnitude of the noise currents.

The similarity of operation of the circuit of Fig. 2 to that of Fig. 1 is obvious. The time constants which were characteristic of the relays in Fig. 1 are supplied by the space discharge devices and associated circuits.

The desensitizing action occurs in relay 39 due to its opposed windings, that is, if noise currents are present so that relay 39 would be maintained operated upon the cessation of speech, these currents are opposed in the bias winding so that relay 39 is desensitized as to noise.

As in Fig. 1, a circuit is provided for maintaining the desensitizing means operated for a considerable time (e. g., ten seconds) after the cessation of the actuating currents. In Fig. 2, this function is accomplished by the circuit comprising condenser 47, resistance 46, and the bias winding of relay 39. The characteristics of these elements are such that the current flow through the relay winding and resistance 46 when condenser 47 is discharging (upon cessation of current flow in the anode circuit of device 40) will maintain a bias on the relay for approximately ten seconds. Since relay 39 is maintained biased for this extended period, false operation due to varying noise currents is greatly minimized.

Having described the invention and the advantages thereof in one particular embodiment, it is to be understood that the invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. A transmission system comprising line wires upon which both noise and voice currents may be impressed, a circuit comprising parallel branches connected to said line wires, space discharge devices in said branches, the amplitude of the output of said branches being proportional to the amplitude of the actuating currents, and a two-winding relay having contacts which control the continuity of said line wires, said windings being arranged in opposed relation, one of said windings being included in the output circuit of said first branched circuit, said second winding being included in the output of said second branched circuit whereby the output currents of said second branched circuit cause said relay to be less sensitive to the output currents of said first branched circuit, a resistance in series with said second relay winding and a condenser in shunt to said resistance and said winding, said condenser and said resistance having such values that said winding is maintained energized for ten seconds after the cessation of the currents causing the operation of said second branched circuit.

2. A transmission system comprising a line for the transmission of speech waves, means controlling transmission along said line, means responsive to speech waves on the line for operating said controlling means, means opposing actuation of said controlling means, means relatively unresponsive to speech waves but responsive to energy on the line of more sustained characteristic than speech waves, for causing actuation of said opposing means, said last mentioned means when operated maintaining said opposing means operated for a period of the order of ten seconds after cessation of the currents causing its operation.

3. In a voice operated circuit subjected to voice waves and sustained noise energy, a voice operated device, a circuit responding to sustained noise energy for opposing the operation of said device, comprising in succession a fast operate slow release device responsive to said noise energy, a slow operate fast release device and a fast operate slow release device, said last mentioned device when operated opposing actuation of said voice operated device for a prolonged period after cessation of said noise energy.

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