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MEANS FOR CONTROLLING SENSITIVITY OF VOICE OPERATED DEVICES

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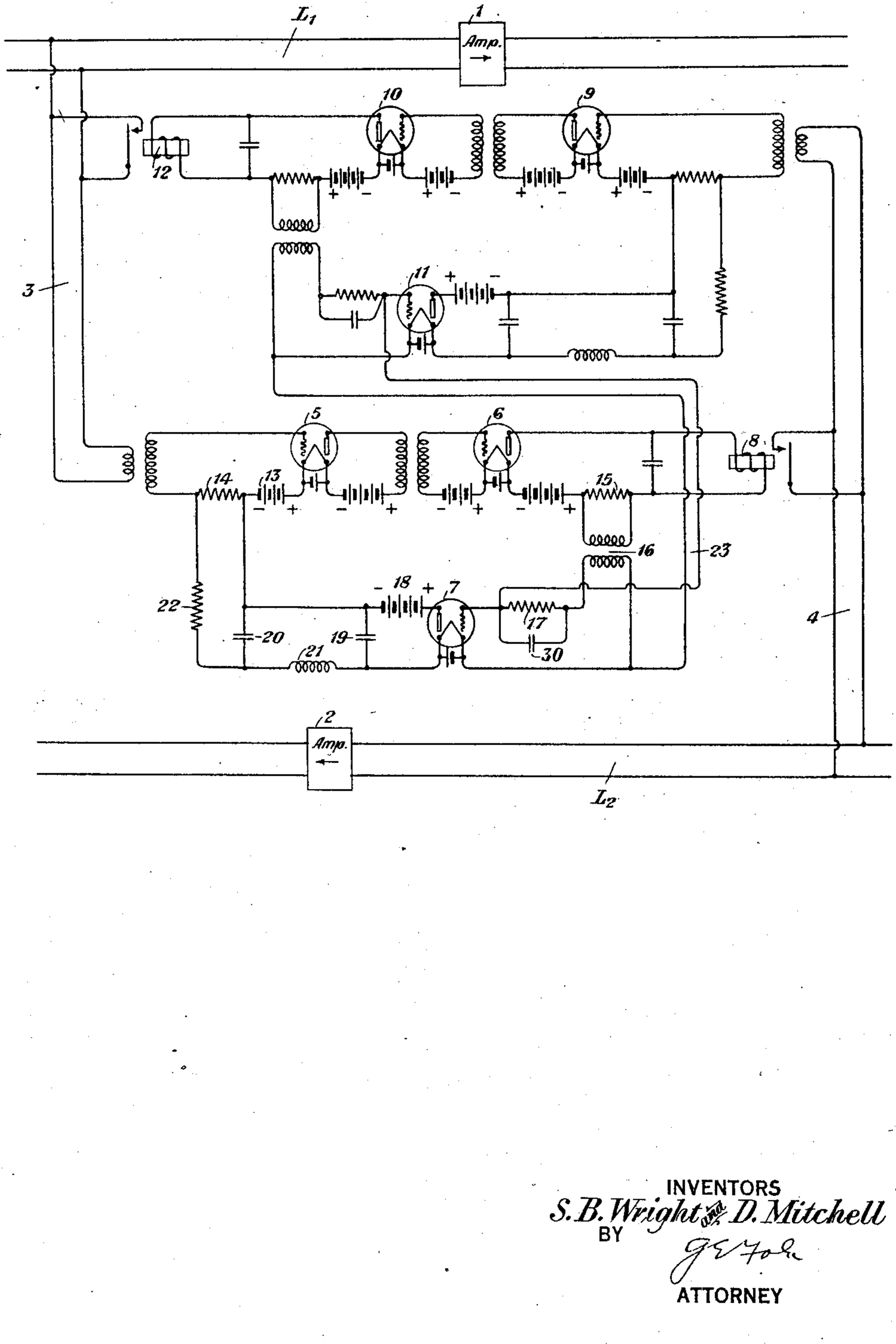

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MEANS FOR CONTROLLING SENSITIVITY OF VOICE OPERATED DEVICES

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This invention relates to improvements in voice operated devices, and more particularly to arrangements for automatically regulating the sensitivity of such devices.

An echo suppressor is such a voice operated device well known in the art and is utilized in connection with a two-way transmission system for disabling one of the one-way lines of such system, while transmission is taking place in the opposite direction over another of the one-way lines of the system, thereby preventing echo effects or reflected currents from being transmitted back to the transmitting end of the system and causing a disturbance or singing. The disabling apparatus usually comprises a short circuit which may be closed across the one-way line by the operation of a voice operated relay device connected to the one-way line for transmission in the opposite direction.

The voice operated echo suppressor must be so constructed that it will not be operated by noise currents existing on the system. Accordingly, it has been the practice to limit the sensitivity of the device by the greatest noise ever expected to be present on the line. As the line would not at all times include this maximum noise current, it is obvious that during quiet periods, the voice operated echo suppressor device would not be operating at maximum efficiency. It is the primary object of the invention to automatically vary the sensitivity of a voice operated device, such as the echo suppressor, in accordance with the volume of noise on the line so that on quiet connections its sensitivity will not be limited by the maximum noise to be expected. The arrangements of the invention for automatically regulating the sensitivity of a device are applicable to voice operated systems, four-wire echo suppressors, two-wire echo suppressors, and anti-singing devices, among others. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing, in the figure of which is shown a circuit diagram illustrating a preferred embodiment of the invention.

In the drawing, the invention is illustrated in connection with a voice operated echo suppressor device connected between the one-way lines of a circuit of the well-known four-wire type. The invention has been illustrated in connection with such an echo suppressor as this is believed to be a practical desirable use of the invention. Two one-way line sections for transmission in opposite directions are shown as L_1 and L_2. Bridged across line L_1 is a circuit 3 including a device comprising the vacuum tubes 5, 6 and 7 and the echo suppressor relay 8, which controls a short circuit across line L_2. Bridged across line L_2 is a circuit 4 including a device comprising the vacuum tubes 9, 10 and 11 and the echo suppressor relay 12 which controls a short circuit across line L_1. Amplifiers 1 and 2 are shown in the lines L_1 and L_2. The general operating features of an echo suppressor are well known in the art.

An echo suppressor without the automatic regulating features of this invention would normally have the sensitivity of its voice operated relays 8 and 12 limited by the maximum amount of noise current to be expected over lines L_1 and L_2. It is known that the amounts of noise on different circuits vary over a wide range, the difference between extreme conditions being at least 30 TU. Accordingly, it will be seen that it might be permissible to set echo suppressors 30 TU more sensitive than heretofore if the arrangements of this invention are provided to automatically reduce their sensitivity to take care of variations in noise. In accordance with this invention, the voice operated devices may be set at maximum sensitivity. Automatically operating control apparatus is provided to slowly reduce the sensitivity of both voice operated devices when either one is affected by steady noise but to quickly restore maximum sensitivity when this steady noise is not present. In other words, the arrangements of the invention will slowly reduce the sensitivity of the voice operated device and hold it to a

given value suitable for preventing operation by a continuous steady volume within the range of noise currents, and quickly increase sensitivity to a higher value when this steady volume has ceased. Arrangements are provided whereby both voice operated echo suppressor devices are acted upon in order to obviate the possibility of false operation. Thus, if the sensitivity of one suppressor only were reduced, transmission which was too weak to operate that suppressor might be strong enough as an echo to operate the other suppressor due to the difference in sensitivities.

The control apparatus illustrated is a vacuum tube device having a threshold action and comprising the tubes 5, 6 and 7. The circuit 3 bridged across the line L_1 is connected to the input of tube 5, which although an amplifier, is biased like a rectifier. It is normally biased by the drop in resistance 14 and the battery 13 to respond to the upper half of the impressed wave only. The output then passes through a transformer to the detector tube 6. The output of the detector tube 6 is connected to the echo suppressor relay 8 which controls a short circuit across circuit 4 and line L_2. The output current from tube 6 by passing through resistance 15 produces a voltage drop in said resistance and impresses, through transformer 16, an alternating voltage wave on the grid of tube 7 through the resistance 17 and the condenser 30 in parallel. A charge is stored up in the condenser in the well-known manner and produces a negative potential on the grid of the tube 7, thus causing its plate current to decrease. The action of the current from the output of tube 6 will thus tend to decrease the plate current of tube 7. In other words, when an alternating wave is impressed on the grid of tube 7, during the positive half of the wave current may flow from the grid to the filament and through resistance 17 and the condenser 30. This resistance is sufficiently large and the condenser sufficiently small so that the voltage of the grid will not be raised to any effective degree by this current. The resistance 17 and the condenser 30 are so proportioned that the condenser will not be wholly discharged during the negative half cycle. During the negative half of the impressed wave no current can flow from the filament to the grid, but the potential difference across the condenser is added to the applied voltage to give a large negative grid voltage. As is well known, the increase of the negative potential on the grid will tend to decrease the plate current. In other words, any increase in the output current of the rectifier tube 6 will tend to decrease the current flow in the plate circuit of tube 7. In the plate circuit of tube 7 are the battery 18, condensers 19 and 20 and resistance elements 22 and 14. Resistance 14 will be of a relatively high value. The effect of a reduction of the current in the plate circuit of tube 7 by alternating current impulses coming in from the output of tube 6 will be to cause condensers 19 and 20 to discharge. These condensers must discharge through the high resistances 14, 21 and 22 and hence will discharge slowly. If the plate current of tube 7 is increased, due to a lessening in the incoming impulses, the condensers will rapidly charge up. Accordingly, the combination of the output resistance of tube 7, the condensers 19 and 20, and resistances 14 and 22 will form a fast operate slow release circuit which is normally in the operated condition. Accordingly, a decrease in the plate current of tube 7 will slowly increase the negative bias on the grid of the amplifier tube 5 and render it less effective, but an increase in the plate current of tube 7 will rapidly restore the amplifier tube 5 to maximum effectiveness. In other words, the threshold of operation of the device may be slowly reduced from its maximum, but rapidly restored thereto. Due to the amplification in tubes 5, 6 and 7, the steady state output of tube 6 may be reduced to a very small fraction of its initial value before the slow release circuit has acted.

Connected to circuit 4 is a vacuum tube arrangement comprising the tubes 9, 10 and 11 controlling the echo suppressor relay 12. This arrangement is substantially similar to that already described. In order that noise currents coming in over one of the lines may affect both of the echo suppressor devices, the circuit 23 is provided connecting the input of tube 7 with the input of a similar tube 11 in the other device. The value of resistance 17 and the corresponding resistance in the other device would be large enough to prevent any slight action of one control circuit on the plate circuit of the detector tube in the other circuit.

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. A transmission line, an echo suppressor device associated therewith, and a device in said line for controlling the operation of said echo suppressor device, said control device comprising a vacuum tube arrangement having the threshold of operation affected solely in proportion to the amount of input current applied thereto in a comparatively steady state.

2. A transmission line, an echo suppres-

sor device associated therewith, and a device in said line for controlling the operation of said echo suppressor device, said control device comprising an amplifier tube, a detector tube associating said amplifier tube with said echo suppressor device, and a third tube connecting the output of said detector with the said amplifier whereby an increase in comparatively steady current in said detector output will decrease the effectiveness of said amplifier tube.

3. A transmission line, an echo suppressor device associated therewith, and a device in said line for controlling the sensitivity of said echo suppressor device, said control device comprising an amplifier tube associated with said line and arranged to operate at maximum sensitivity, a detector tube associating said amplifier tube with said echo suppressor device, a third tube connecting the output of said detector with said amplifier whereby the effectiveness of said amplifier may be controlled by the current in said detector output, and electrical delay means in the output of said third tube.

In testimony whereof, we have signed our names to this specification this 5th day of June, 1928.

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