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SIGNAL MEASURING SYSTEM

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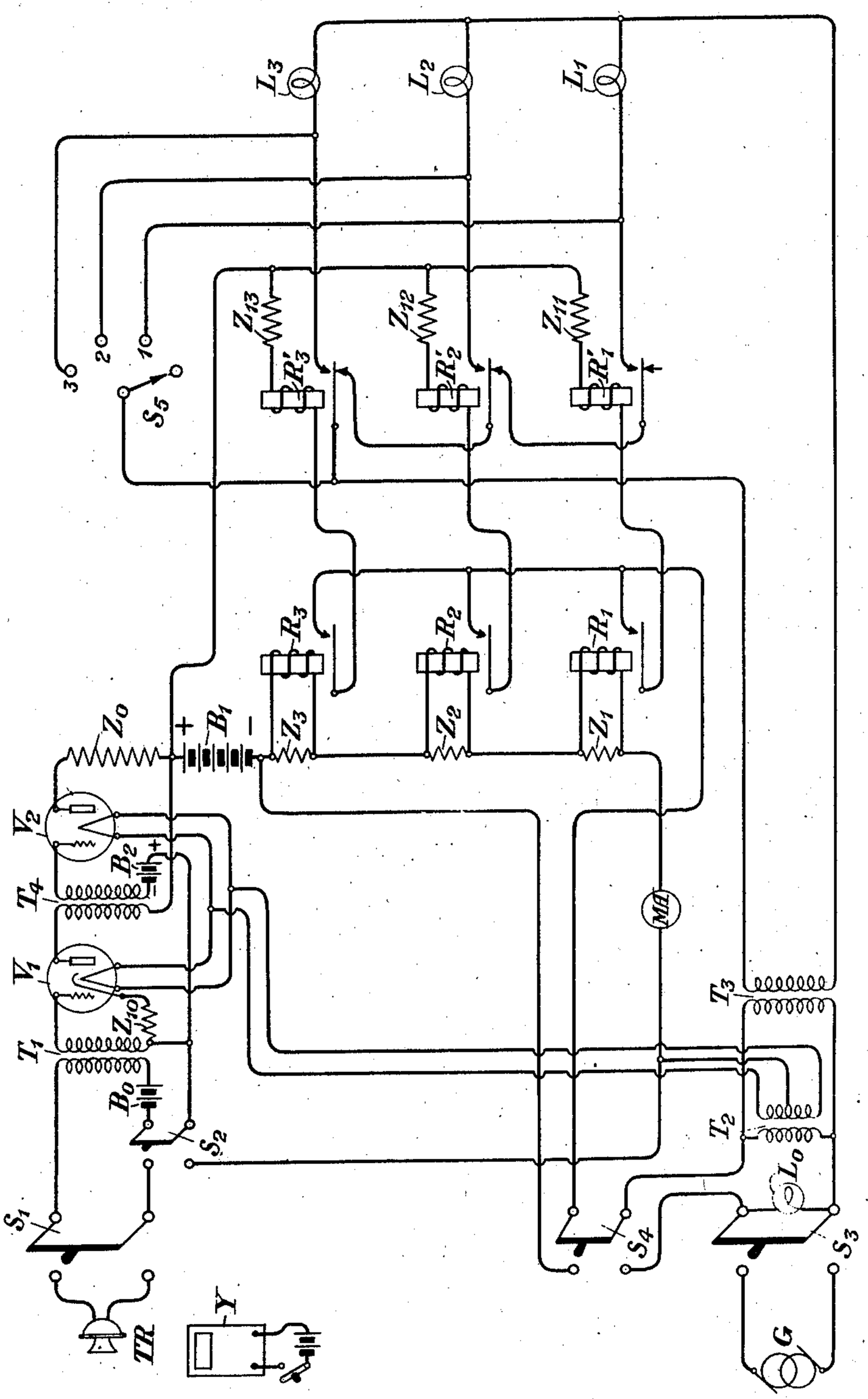


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## SIGNAL MEASURING SYSTEM

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This invention relates to electrical signaling systems. More particularly this invention relates to electrical systems for indicating to the speaker or operator the level of speech or other currents.

When speech or other energy is impressed upon the telephone transmitter of a telephone subscriber's set it is difficult and often impossible for the speaker or operator to determine whether the level of the impressed energy is sufficient for good transmission. Two factors largely determine whether or not the impressed energy is sufficient for good transmission to the distant end of the circuit. These two factors are (1) the distance between the speaker's lips and the telephone transmitter and (2) the tone or level of the voice used.

Speech or other energy of loud tone or high level need not be impressed as closely to the telephone transmitter as energy of lower tone or level to produce the same electrical effects. A very low tone or signal level will necessarily have to be impressed quite closely to the telephone transmitter to be effectively transmitted to the distant station. If a low tone is produced a substantial distance from the transmitter it may of course be so attenuated by the circuit as to be practically inaudible at the distant end. The determination of the proper tone or level and/or the proper distance between the speaker's lips and the telephone transmitter is of importance to the efficient use of signaling systems employed for telephone transmission.

It is therefore one of the objects of this invention to indicate instantly to the subscriber or operator the approximate level of speech or other signal energy impressed upon a telephone transmitter which, for example, may be part of a telephone subscriber's set.

It is a further object of this invention to indicate instantly to the speaker or operator whether the level of speech or other signal energy is sufficient for good transmission.

It is a still further object of this invention to indicate approximately what the level of the energy impressed upon the transmitter may be when the source of the energy is positioned at different distances from the transmitter.

These and other objects and features of the invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing illustrating one embodiment of the invention given merely for the purpose of illustration.

Referring to the drawing, the reference characters TR designate a telephone transmitter which may be a part of a telephone subscriber's set. This transmitter may be connected to the primary winding of a transformer $T_1$, the connection being established through a double-pole single-throw switch $S_1$ and through the upper blade of a double-pole single-throw switch $S_2$. The secondary winding of the transformer $T_1$ is connected as part of the grid circuit of an amplifier tube $V_1$ which will be referred to again hereinafter.

An electrical buzzer Y of any well-known type, having a source of current for its operation as shown, may be positioned directly in front of the transmitter TR so that sounds produced by the buzzer will become impressed upon the transmitter TR and then transmitted to the grid circuit of the amplifier tube $V_1$. It will hence be apparent that upon closure of the switches $S_1$ and $S_2$, voice energy or the buzzer energy may be impressed upon the transmitter TR and then amplified, the amplified energy being utilized for obtaining an indication of the level of the impressed energy as will be described more fully hereinafter.

The apparatus for determining the level of the energy impressed upon the grid circuit of the tube $V_1$ includes a generator of alternating current designated G which may be a 60-cycle alternating current generator of 100 or 115 volts which may be connected by a double-pole single-throw switch $S_3$ and through the lower blade of a similar double-pole single-throw switch $S_4$ to the primary windings of transformers $T_2$ and $T_3$, these primary windings being connected in parallel relationship. When both of the switches $S_3$ and $S_4$ are closed, the lamp $L_0$ will be lighted and will therefore indicate that the current of the generator C is being transmitted to the measuring appartus of this invention.

The secondary winding of the transformer $T_2$ is connected to the filament or heater of the tube $V_1$ as well as to the filament of the tube $V_2$, the two filaments being aranged in parallel relationship. The secondary winding of the transformer $T_3$ will be utilized to heat the filaments of lamps $L_1$, $L_2$ or $L_3$ in a manner to be described more fully hereinafter.

The amplifier tube $V_1$ is of the heater type, the cathode of which is in circuit with a resistor $Z_{10}$, the secondary winding of the transformer $T_1$ and the grid of the tube $V_1$, the latter circuit being commonly known as the grid circuit of the tube. The plate voltage of the tube $V_1$ is supplied by battery $B_1$ through the primary winding of the transformer $T_4$. The energy amplified by the

tube $V_1$ is impressed upon the grid of tube $V_2$ which is of the rectifying type, the grid circuit of the latter tube including a battery $B_2$ which produces the voltage for properly biasing the grid electrode of the tube with respect to its cathode. The plate circuit of the tube $V_2$ includes the cathode of the tube, both halves of the secondary winding of transformer $T_2$, the conductor common to these two halves of the secondary winding, the milliammeter MA, the resistors $Z_1$, $Z_2$, and $Z_3$, the battery $B_1$ and the resistor $Z_0$. The battery $B_1$ of this series circuit is employed to supply the anode voltage for the rectifying tube $V_2$. The flow of anode current through the series circuit just described will be utilized for the operation of various relays as will now be described.

The resistors $Z_1$, $Z_2$ and $Z_3$ are shunted by the windings of relays $R_1$, $R_2$ and $R_3$, respectively. These resistors may be of different magnitudes and the relays will be so adjusted that they will operate at different values of current flowing through the series anode circuit of tube $V_2$, above described. If the current flowing in this series circuit is of very low value it may be sufficient to produce a voltage across the resistor $Z_1$ which is ample to operate the relay $R_1$. But this small current will produce voltages across resistors $Z_2$ and $Z_3$ which will be insufficient to operate the relays $R_2$ and $R_3$. If a greater current is rectified by the tube $V_2$, the voltage impressed across the resistor $Z_2$ may be sufficient to operate the relay $R_2$ and therefore relay $R_2$ will be operated. Inasmuch as the same current traverses the resistor $Z_1$, the relay $R_1$ will be maintained in operation. If a still greater current flows through the anode circuit of tube $V_2$, the voltage established across resistors $Z_1$, $Z_2$, and $Z_3$ may be sufficiently large so as to cause the operation of all three relays $R_1$, $R_2$ and $R_3$ and of course relay $R_3$ will then operate while relays $R_1$ and $R_2$ will be maintained in their operated condition.

The operation of the relay $R_1$ will in turn operate the relay $R'_1$, the circuit of the winding of relay $R'_1$ including the battery $B_1$, the resistor $Z_{11}$, the winding of relay $R'_1$, the armature and contact of relay $R_1$ and the upper blade of switch $S_4$. Similarly the operation of relay $R_2$ will cause the operation of relay $R'_2$, current then flowing over the circuit including battery $B_1$, resistor $Z_{12}$, the winding of relay $R'_2$, the armature and contact of relay $R_2$, and the upper blade of switch $S_4$. Similarly the operation of relay $R_3$ will cause the operation of relay $R'_3$ as will be clearly understood.

By opening switches $S_1$ and $S_2$ and closing switches $S_3$ and $S_4$ the operator may light any one of the lamps $L_1$, $L_2$ or $L_3$ which are associated with the relays $R'_1$, $R'_2$ and $R'_3$, respectively. When the operator moves the rotary switch $S_5$ to its contact **1**, the lamp $L_1$ will be lighted, the circuit for lamp $L_1$ including the secondary winding of transformer $T_3$, the movable arm of switch $S_5$ and lamp $L_1$. By moving the arm of switch $S_5$ to its contact **2**, the lamp $L_1$ will be disconnected from the secondary winding of transformer $T_3$ and extinguished and lamp $L_2$ will be connected to that winding through the arm of switch $S_5$. Consequently the lamp $L_2$ will be illuminated. By further moving the arm of switch $S_5$ to its contact **3**, the lamp $L_2$ will be extinguished and the lamp $L_3$ will then be illuminated. The lamps $L_1$, $L_2$ and $L_3$ are preferably colored lamps, the lamp $L_1$ for example being colored red, the lamp $L_2$ amber and the lamp $L_3$ green. These three lamps will be used to indicate instantly to the speaker or operator what the approximate level of the energy impressed upon the transmitter TR may be, the lamp $L_1$ indicating a low level of impressed energy, the lamp $L_2$ a higher level and the lamp $L_3$ a still higher level. Of course more than three lamps may be employed in this circuit arrangement as will be obvious to those skilled in the art.

Suppose now that the switches $S_1$ and $S_2$ are both closed so as to connect the transmitter TR to the primary winding of the transformer $T_1$ and suppose also that the buzzer Y is unoperated and that no speech or other energy is impressed upon the transmitter TR. Under these circumstances the current flowing in the anode circuit of the rectifying tube $V_2$ and through the resistors $Z_1$, $Z_2$ and $Z_3$ will be so low as to be inadequate to operate relays $R_1$, $R_2$ and $R_3$. The relays $R'_1$, $R'_2$ and $R'_3$ will also be unoperated and if the movable arm of switch $S_5$ is on its contact O, none of the lamps $L_1$, $L_2$ or $L_3$ will be illuminated. If now the circuit of buzzer Y is completed and the buzzer is held approximately three feet from the transmitter TR, the energy impressed upon the transmitter and amplified by tube $V_1$ and rectified for tube $V_2$ will be of rather low value. This small amount of energy will, however produce a voltage across resistor $Z_1$ sufficient to cause the operation of relay $R_1$. The operation of relay $R_1$ will in turn operate the relay of $R'_1$ which in turn will cause the lamp $L_1$ to be lit. The circuit of lamp $L_1$ will include the secondary winding of transformer $T_3$, the armature and back contact of relay $R'_3$, the armature and back contact of relay $R'_2$, the armature and make contact of relay $R'_1$ and lamp $L_1$. The lamps $L_2$ and $L_3$ will of course remain unlit. The lamp $L_1$, which is painted red as suggested above, will indicate to the operator that the level of energy impressed upon the transmitter TR is insufficient for good signal transmission over the telephone circuit, for example, to which the transmitter TR may be connected.

If now the buzzer Y is moved closer to the transmitter TR the amplitude of the current flowing through the anode circuit of the tube $V_2$ wil be such as to produce a sufficient voltage across resistor $Z_2$ to operate the relay $R_2$. The operation of relay $R_2$ will then cause the operation of relay $R'_2$ and this in turn will cause the lamp $L_2$ to be lit. The circuit of lamp $L_2$ will include the secondary winding of transformer $T_3$, the armature and back contact of relay $R'_3$, the armature and make contact of relay $R'_2$ and the lamp $L_2$. By opening the circuit of the back contact of the armature of relay $R'_2$, the lamp $L_1$ will become extinguished. The illumination of the lamp $L_2$ will, however, indicate to the operator that the level of energy impressed upon the transmitter TR is better than before but this level of energy will still be insufficient for good signal transmission.

If now the buzzer Y is moved still closer to the transmitter TR, i. e., the buzzer is now positioned in approximately the normal position of a talker's lips close to the transmitter TR, the magnitude of the rectified current flowing through the resistor $Z_3$ will produce such a voltage across its terminals as will be sufficient to operate the relay $R_3$. The operation of the relay $R_3$ will in turn operate the relay $R'_3$ and this in turn will illuminate the green lamp, $L_3$. The circuit of the lamp $L_3$ will include the secondary winding of the transformer $T_3$ and the armature and make con-

tact of relay R'3. However, upon the opening of the back contact of relay R'3, it will be clear that the lamp $L_2$ will become extinguished. The illumination of the green lamp $L_3$ will indicate to the operator that the level of the energy impressed upon the transmitter TR is sufficient for good transmission. This position of the buzzer Y with respect to the transmitter TR may now approximate that which a speaker's lips should occupy for good transmission.

If the buzzer Y be now moved away from the transmitter TR a sufficient distance the relay $R_3$ will release and this in turn will cause the relay R'3 to release. The lamp $L_3$ will become extinguished. However, if the flow of current through resistors $Z_2$ is sufficient to maintain relay $R_2$ operated the relay R'2 will remain operated and the amber lamp $L_2$ will be reilluminated, the circuit for lamp $L_2$ including the secondary winding of the transformer $T_3$, the armature and back contact of relay R'3 and the armature and make contact of relay R'2.

If the buzzer be now moved still further away from the transmitter TR the relays $R_2$ and R'2 will become released and the lamp $L_2$ extinguished. But if the flow of current through the resistor $Z_1$ is sufficient to maintain relay $R_1$ operated relay R'1 will also remain operated and then the lamp $L_1$ will become reilluminated.

Thus it will be clear that as energy similar to that obtained from the buzzer Y is impressed upon the transmitter TR, one of lamps $L_1$, $L_2$ or $L_3$ will be illuminated and remain illuminated depending upon the level of energy so impressed upon the transmitter. As the level of energy rises from a very low value to a much higher value the lamps $L_1$, $L_2$ and $L_3$ will be progressively operated in sequence. As the level of energy becomes reduced from a very large value to a very small value the lamps $L_3$, $L_2$ and $L_1$ will become progressively illuminated in sequence. Each of the lamps will indicate within reasonable limits the approximate level of the energy conveyed to the transmitter TR.

If the circuit of the buzzer Y be now opened and speech be impressed upon the transmitter TR the level of the currents flowing through the anode circuit of tube $V_2$ and through resistors $R_1$ and $R_2$ and $R_3$ will cause the lamps $L_1$, $L_2$ and $L_3$ to become illuminated according to the magnitude of the speech currents so impressed, as will be clear from the description given hereinabove. A loud tone produced, for example, quite close to the transmitter TR will cause the lamp $L_3$ to become illuminated and then lamp $L_3$ will remain illuminated if this rather loud tone persists. If the tone be produced somewhat more distantly from the transmitter then the lamp $L_2$—the amber lamp—will be illuminated and the lamp $L_2$ will remain illuminated if this tone persists at approximately the same level. If the tone be very soft or very distant from the transmitter TR then of course the lamp $L_1$—the red lamp—will be lighted. If the tone be unsteady the lamps will flash on and off according to the durations of the tone pulses, the frequency of the flashes depending of course upon the nature of the words or phases used, as will be understood by those skilled in the art. Yet the average light impression obtained from the various lamps, that is, the average time during which the green lamp $L_3$ will be lit or the amber lamp $L_2$ will be lit, etc., will determine whether this speech is good or only fair or very poor.

The tone impressed upon the transmitter TR causes a variable current to flow through the primary winding of the transmitter $T_1$, the normal carrier current being supplied by battery $B_1$. This variable modulated current produces an alternating current voltage in the secondary winding of transformer $T_1$ which is applied to the grid circuit of the amplifier tube $V_1$. The plate current of the tube $V_1$ is then caused to vary due to the alternating current voltage applied to the grid according to the customary action of vacuum tube amplifier circuits. The amplified alternating current voltage transmitted to the secondary winding of transformer $T_4$ will then be applied to grid of the rectifying tube $V_2$. The grid of the latter tube is biased negatively with respect to its cathode and hence will pass plate current only during the positive grid swings, and then only in accordance with the grid-voltage plate-current characteristic curve of this tube. The rectified current of tube $V_2$ will then flow through the resistors $Z_1$, $Z_2$ and $Z_3$ as well as through the milliammeter MA and the voltages produced at the terminals of the latter resistors will be employed to operate one or more of the relays $R_1$, $R_2$ and $R_3$ as already explained.

It will be apparent that the arrangement illustrated in the drawing may be employed to visually indicate the proper and improper use of a telephone transmitter. The signals will especially indicate the proper distances required between the lips of the speaker and the telephone transmitter TR and/or the proper tone level for good transmission.

The apparatus described in this application may be readily employed for various purposes. The apparatus may be used for example, to train the announcers and artists in broadcasting studios to talk or sing into the microphone with the proper volume or voice level.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The combination of a telephone transmitter upon which speech currents may be impressed, an amplifier coupled to said transmitter, a detector coupled to said amplifier, a plurality of impedances connected in series with said detector, a plurality of relays the windings of which respectively shunt said impedances, a plurality of indicators each corresponding to one of said relays, each relay controlling the operation of the corresponding indicator, and means for successively operating a predetermined number of said relays, the number of relays operated corresponding to the amount of energy in the various frequency components impressed upon said transmitter.

2. Apparatus for indicating instantly the amount of energy impressed upon a telephone transmitter, comprising a detector for detecting substantially all of the components of the impressed energy, and means responsive to the detected energy for indicating the approximate magnitude of the detected energy, said indicating means comprising a plurality of relays, means for progressively operating a predetermined number of said relays, the number of relays progressively operated being controlled by the magni-

tude of the detected energy, and signal devices controlled by said relays.

3. A system for instantly indicating to a speaker the amount of energy impressed upon a telephone transmitter, comprising means for detecting the energy impressed on the telephone transmitter, a plurality of impedances connected in series with said detecting means, first and second groups of relays, the windings of the relays of the first group respectively shunting said impedances, the relays of the second group being operated in response to the corresponding relays of the first group, means for successively operating a predetermined number of the relays of the first group, the number of relays operated corresponding to the amount of energy impressed upon the telephone transmitter, and indicating means controlled by the relays of the second group.

4. A system for instantly indicating the amount of energy impressed upon a telephone transmitter, comprising means for detecting the energy in substantially all of the components impressed upon said telephone transmitter, and means responsive to the detected current for indicating the amount of detected current, said indicating means including a plurality of impedances connected in series with each other and with said detecting means, the detected current flowing through said series impedances, a plurality of relays, the windings of which respectively shunt said impedances, said relays operating successively, the number of relays operated corresponding to the magnitude of the detected current, and indicating means controlled by said relays.

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