

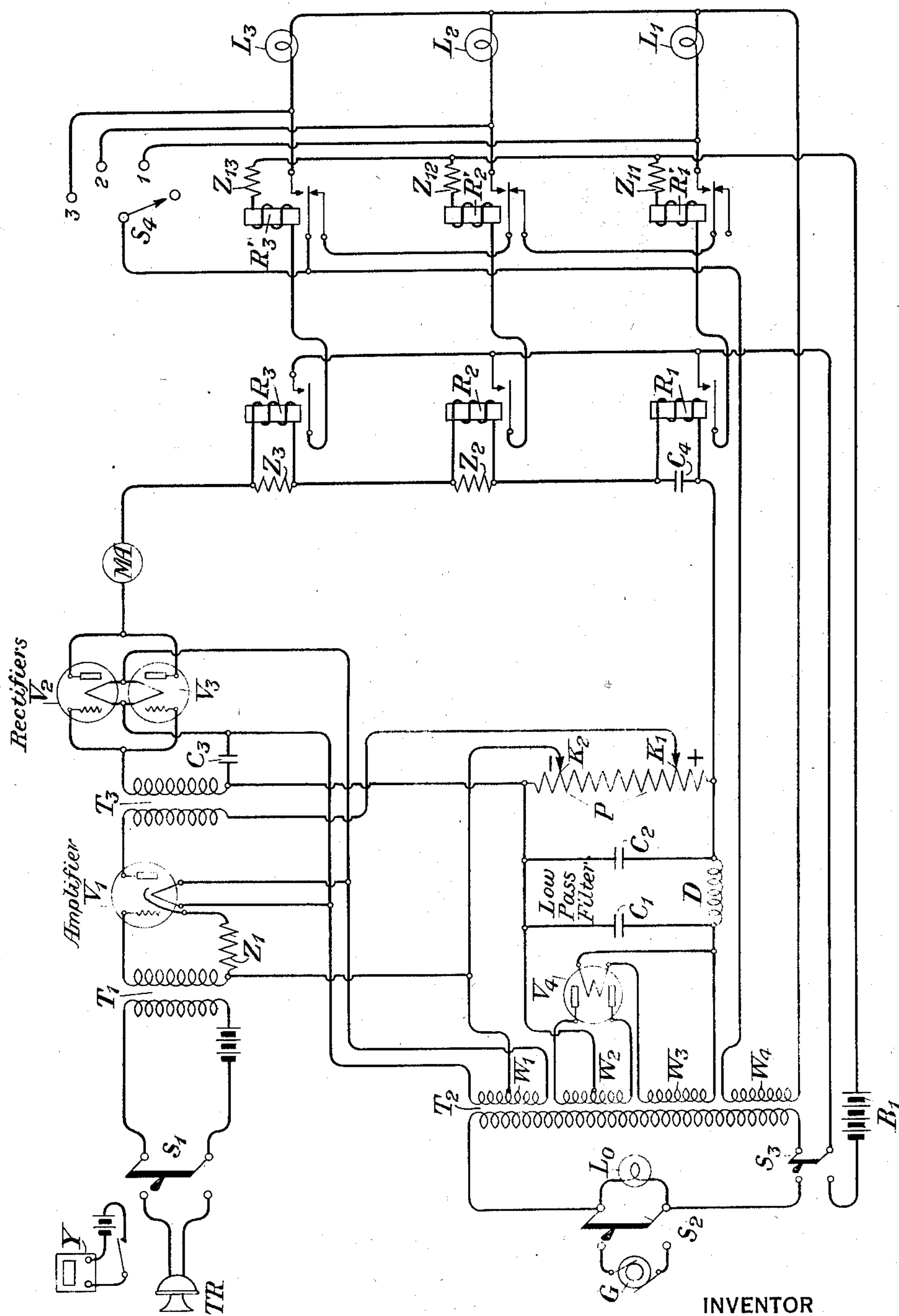
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SIGNAL MEASURING SYSTEM

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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 the level of speech or other currents.

5 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
10 good transmission. Two factors primarily 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
15 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
20 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
25 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 level and/or the proper distance between the speaker's lips
30 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
35 or operator the level of speech or other signal energy impressed upon a telephone transmitter which, for example, may be part of a telephone substation circuit.

It is a further object of this invention to indicate instantly to the speaker or operator whether
40 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
45 impressed upon the transmitter is 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
50 read in connection with the accompanying drawing illustrating one embodiment of the invention given merely for the purposes of illustration.

Referring to the drawing, the telephone transmitter TR, which may be a part of a telephone

subscriber's circuit, may be connected through a double-pole single-throw switch S₁ to the primary winding of the transformer T₁, the secondary winding of which is connected as part of the grid circuit of an amplifier tube V₁. 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 and impressed upon the transmitter TR may be transmitted to the grid circuit of tube V₁. The switch S₁ hence may be employed for connecting the telephone transmitter TR to the circuits of the amplifier tube V₁ so that either voice energy or the buzzer energy impressed upon the transmitter TR may be transmitted and amplified, the amplified energy being then utilized for obtaining an indication of the level of the impressed energy as will be described more fully hereinafter.

The measuring apparatus for determining the level of the energy impressed upon the grid circuit of the amplifier tube V₁ includes a generator of alternating current designated G which may be an ordinary 60 cycle alternating current generator of 110 or 115 volts which may be connected by a double-pole single-throw switch S₂ to the primary winding of a transformer T₂ through one side of another double-pole single-throw switch S₃. When both of the switches S₂ and S₃ are closed the lamp L₀ will be lighted and will therefore indicate that the current of the generator G is being transmitted to the measuring apparatus of the invention.

The transformer T₂ has four secondary windings, one of which, designated W₁, is connected to the filament of the amplifying tube V₁ as well as to the filaments of two rectifying tubes V₂ and V₃, the latter filaments being arranged in parallel relationship. The secondary winding W₂ of transformer T₂ is connected to the two plate electrodes of a full wave rectifying tube V₄ which has two filaments, these two filaments being arranged in series relationship and being supplied with energy by the secondary winding W₃ of the transformer T₂. The fourth secondary winding W₄ of transformer T₂ will be employed to heat the filaments of lamps L₁, L₂ and L₃ in a manner to be described more fully hereinafter.

A potentiometer P receives the current rectified by the tube V₄. The upper terminal of the potentiometer P is connected to the midpoint of the winding W₂ of transformer T₂. The lower terminal of the potentiometer P is connected to the filament circuit of the tube V₄ through a coil D, this coil being part of a low-pass filter

which also includes the shunt condensers C_1 and C_2 , the filter having a cut-off frequency of about 50 cycles, for example, the cut-off frequency being somewhat lower than the frequency of the current generated by the generator G . The voltage impressed across the outer terminals of the potentiometer P will be utilized to supply direct currents to various circuits of the apparatus of this invention, as will be described hereinafter.

The amplifier tube V_1 is of the heater type, the cathode of which is in circuit with a resistor Z_1 , the secondary winding of 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 circuit of the tube V_1 includes the primary winding of transformer T_3 , that portion of potentiometer P between adjustable contacts K_1 and K_2 , the winding W_1 of transformer T_2 , and the filament of the tube V_1 . The energy amplified by the tube V_1 is impressed upon the grids of both of the tubes V_2 and V_3 arranged in parallel relationship, the grid circuits of these tubes including the secondary winding of the transformer T_3 and a condenser C_3 . The contact K_2 of the potentiometer P may be adjusted for changing the bias of the grid electrodes of both tubes to any desired operating value. The plate electrodes of the tubes V_2 and V_3 are both connected in circuit with relay apparatus which will now be described.

The plate electrodes of tubes V_2 and V_3 are tied together and are connected in series circuit with a milliammeter MA , a resistor Z_3 , a resistor Z_2 , the winding of relay R_1 , that portion of the potentiometer P between the lower terminal of the potentiometer and the terminal K_2 , the secondary winding W_1 of transformer T_2 , and the filaments of tubes V_2 and V_3 . The winding of relay R_1 is shunted by condenser C_4 so that all of the direct current flowing in the series circuit just described will be by-passed through this relay winding.

If the impressed energy causes current to flow in this series circuit at a very low value it may be sufficient to operate the relay R_1 but the voltages impressed across resistors Z_2 and Z_3 will be insufficient to operate the relays R_2 and R_3 , the windings of which shunt these resistors respectively. If a greater current is rectified by tubes V_2 and V_3 , the voltage impressed across resistor Z_2 may be sufficient to operate the relay R_2 and this current will also flow through the winding of relay R_1 and maintain the latter relay operated. If a still greater current is rectified by tubes V_2 and V_3 , the voltage across resistor Z_3 may be sufficient to operate the relay R_3 and both relays R_1 and R_2 will be maintained in operated condition. Of course, the current flowing through this series circuit will be insufficient to operate any one of the relays R_1 , R_2 and R_3 when no speech or other energy is impressed upon the transmitter TR .

The operation of 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 lower blade of the switch S_3 , the armature and contact of relay R_1 , the winding of relay R'_1 , and resistor Z_{11} . The operation of relay R_2 will cause the operation of relay R'_2 , current flowing from battery B_1 over the circuit including the lower blade of switch S_3 , the armature and contact of relay R_2 , the winding of relay R'_2 and resistor Z_{12} . Similarly the operation of relay R_3 will cause the operation of relay R'_3 .

By opening switch S_1 and closing switches S_2

and S_3 the operator may light any one of the lamps L_1 , L_2 and L_3 which are associated respectively with relays R'_1 , R'_2 and R'_3 . By moving the rotary switch S_4 to its contact 1, the voltage across the secondary winding W_4 of transformer T_2 will be transmitted to the filament of lamp L_1 , the circuit including the winding W_4 , the movable arm of switch S_4 and the lamp L_1 . By moving the arm of switch S_4 to its contact 2 the lamp L_1 will be disconnected from the winding W_4 of transformer T_2 and extinguished and the lamp L_2 will then be connected to the winding W_4 and illuminated. By further moving the switch S_4 to its contact 3, the lamp L_2 will be disconnected from the circuit of winding W_4 and extinguished and the lamp L_3 will be lit. 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 the approximate level of the energy impressed upon the transmitter TR , 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.

Suppose, now, that switch S_1 is closed so as to connect the transmitter TR to the primary winding of the transformer T_1 and the circuit of the buzzer Y is then also completed. Assume also that the arm of switch S_4 is moved to its contact O . Now if the buzzer Y is held approximately three feet from the transmitter TR , the energy amplified by tube V_1 and rectified by tubes V_2 and V_3 will be so low as to operate the relay R_1 alone. The operation of relay R_1 will in turn operate the relay R'_1 , which in turn will cause the lamp L_1 to be lit. The circuit of lamp L_1 will include the winding W_4 of transformer T_2 , 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 remain unlit. If the lamp L_1 is painted red as suggested above, it will indicate that the level of energy impressed upon the transmitter TR is insufficient for good signal transmission.

If, now, the buzzer Y is moved closer to the transmitter TR , the amplitude of the current flowing through the anode circuits of the rectifier tubes V_2 and V_3 will 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 light the amber lamp L_2 . The circuit of lamp L_2 will include the winding W_4 of transformer T_2 , the armature and back contact of relay R'_3 , the armature and make contact of relay R'_2 and lamp L_2 . The lamp L_1 will, of course, become extinguished. The illumination of the lamp L_2 will indicate that the level of energy impressed upon the transmitter TR is better, 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 , 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 lamp L_3 includes the secondary winding W_4 of transformer T_2 and the armature and make contact of relay R'_3 . The lamp L_2 will at the same time be extinguished. The illumination of the green lamp L_3 will indicate 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 will now approximate that which a speaker's lips should occupy for good transmission.

If the buzzer be now moved away from the transmitter TR a sufficient distance, the lamp L₃ will become extinguished but the lamp L₂ will be illuminated. As the buzzer Y is moved still further away from the transmitter TR the lamp L₂ will become extinguished and the lamp L₁ illuminated. Thus each one of the lamps L₁, L₂ and L₃ will indicate, within certain limits, the level of the energy impressed upon the transmitter TR and if no energy is impressed upon transmitter TR, none of the lamps L₁, L₂ or L₃ will be illuminated.

If the circuit of buzzer Y is now opened and speech is impressed upon the transmitter TR, the level of the rectified speech currents produced will cause the lamps L₁, L₂ and L₃ to become illuminated according to the magnitude of currents. If, for example, a loud tone is produced close to the transmitter TR, the lamps L₁, L₂ and L₃, colored respectively red, amber and green, as already explained, will become illuminated successively. If the tone is produced somewhat more distantly from the transmitter then the lamps L₁ and L₂, the red and amber lamps, will be successively illuminated. If the tone is very soft or is very distant from the transmitter TR then only the red lamp L₁ will be lit. If the tone is not steady, the lamps will flash on and off according to the durations of the tone pulses and frequency of the flashes will depend, of course, upon the nature of the words or phrases used as will be understood by those skilled in the art. Yet the average light impression, that is, the average time during which the green lamp L₃ is on or the amber lamp L₂ is on, etc., will determine whether the speech is good, or only fair, or very poor. When no speech currents are impressed on the transmitter TR then none of the lamps L₁, L₂ or L₃ will be lighted, as will be apparent to those skilled in the art.

The tone impressed upon the transmitter TR causes a variable current to flow through the primary winding of the transformer T₁. This produces an alternating current voltage in the secondary winding of this transformer which is applied to the grid circuit of the amplifier tube V₁. The plate current of the tube V₁ is then caused to vary due to the alternating current voltage applied to the grid according to the customary action of the vacuum tube amplifier circuits. The amplified alternating current voltage transmitted to the secondary winding of the transformer T₃ is then applied to both of the grid electrodes of the tubes V₂ and V₃, respectively. The grids of the latter tubes are both biased negatively with respect to their respective cathodes and will hence pass plate current only during the positive grid swings and then only in accordance with the grid-voltage plate-current characteristic curve of these rectifying tubes. The combined plate currents of both tubes V₂ and V₃ will then flow through the circuit of the milliammeter MA, resistors Z₃ and Z₂ and the winding of relay R₁ and will operate relay R₁. Yet if greater currents traverse the latter circuit, then either relay R₂ will be operated or both relays R₂ and R₃ will be progressively operated, as already explained.

In one arrangement set up according to the circuit illustrated in the drawing, the adjustments of relays R₁, R₂ and R₃ were such that the relay R₁ operated when a current of about 2.5 milli-

amperes traversed the series circuit, relay R₂ operated when a current about 5 milliamperes traversed the circuit and relay R₃ at a current of about 16 milliamperes.

In the arrangement of the circuit tried out the generator G was the ordinary 110-115 volt, 60-cycle alternating current source. The transformer T₂ was of the Thordarson T-13-R-17 type. The winding W₁ of this transformer generated a voltage of about 2.5 volts across its terminals, the winding W₂ a terminal voltage of about 600 volts, the winding W₃ a terminal voltage of about 5 volts and the winding W₄ a terminal voltage of about 6.5 volts. The low-pass filter coil D was a Thordarson type T-13-C-29 coil and the condensers C₁ and C₂ were of about 8 microfarads capacity. The potentiometer P was a 20,000 ohm "Dividohm" device. The tube V₁ was of a No. 56 type, tubes V₂ and V₃ were of the No. 45 type and tube V₄ of the No. 80 type. The condenser C₄ had a capacity of about 8 microfarads and the resistors Z₂ and Z₃ were approximately of 250 ohms and 100 ohms respectively.

It is 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 distance required between the lips of the speaker and the telephone transmitter TR and/or the proper tone level for good transmission.

While this invention has been shown and described in certain particular arrangements 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. Apparatus for instantly indicating the magnitude of energy impressed upon a telephone transmitter, comprising means for amplifying and detecting substantially all components of the energy impressed upon the transmitter, a source of alternating current, a detector for detecting said alternating current, a potentiometer through which the detected alternating current flows, a plurality of impedances connected in series with each other and with said potentiometer, the amplified and detected energy flowing through said impedances, a plurality of relays the windings of which respectively shunt said impedances, said relays being adjusted to operate successively, the number of relays operated corresponding to the amount of energy amplified and detected, and indicating means controlled by said relays.

2. A system for 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 source of alternating current, means for rectifying said alternating current, a plurality of impedances connected in series both with said energy detecting means and said rectifying 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.
- 5 3. A system for indicating the amount of energy impressed upon a telephone transmitter, comprising means for detecting substantially all components of the transmitted current, a source of alternating current, means for rectifying said alternating current, and means responsive to
- 10 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 rectifying 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 successively operated corresponding to the magnitude of the detected current, and indicating means controlled by said relays, said indicating means being operated by
- 15 said alternating current.

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