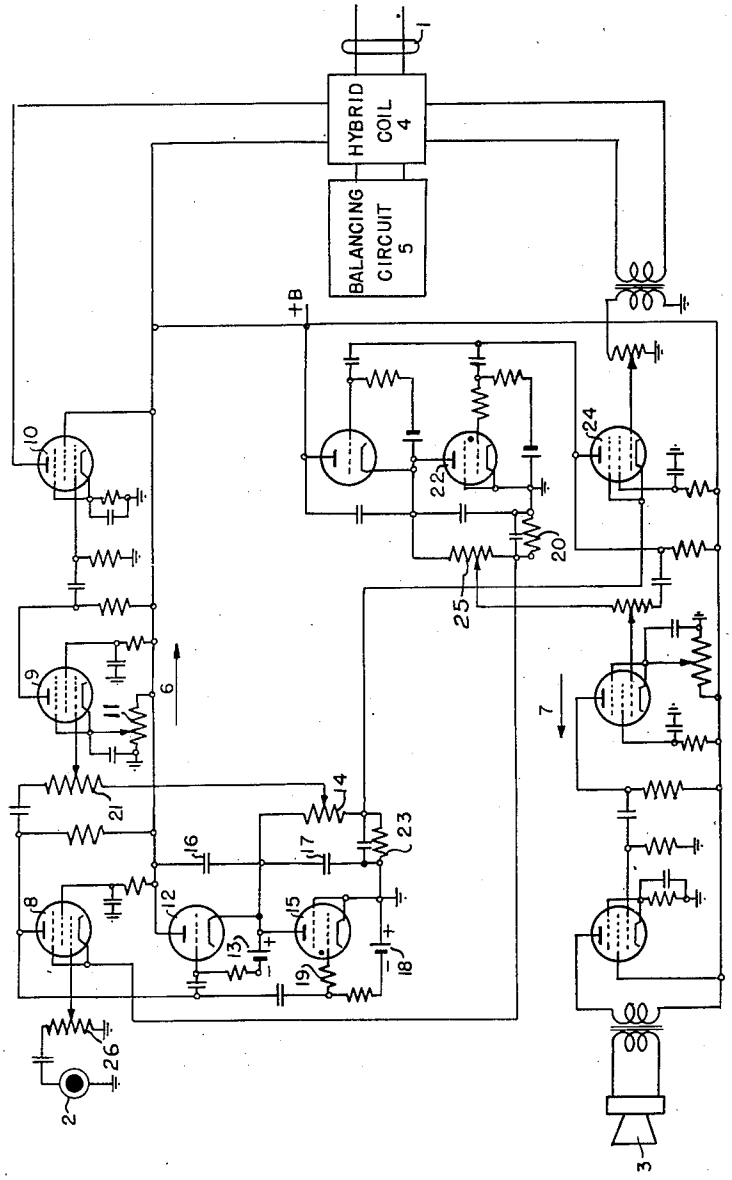
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VOICE OPERATED CONTROL CIRCUIT

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VOICE OPERATED CONTROL CIRCUIT

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The present invention relates generally to improvements in signal current transmission systems of the type in which signal controlled switching circuits are provided for enabling certain of the signal current channels included therein which are normally partially or completely blocked and, more particularly, to improvements in telephone substation circuits having incorporated therein coupled signal current channels for the transmission of incoming and outgoing signal currents.

In the usual telephone substation circuit a hybrid system or anti-sidetone impedance network is provided for independently coupling the transmitter and the receiver to the line extending from the substation. In this arrangement one of the factors which determines the efficiency of the sidetone suppression is the impedance of the talking circuit established by the connection of two subscribers' lines. This impedance is not the same for any two established connections and, accordingly, the hybrid system of each substation is usually balanced to provide maximum sidetone suppression for average line conditions. In installations wherein amplification of incoming and outgoing signal currents is required, as, for example, in executive loudspeaking sets, the conditions of unbalance introduced in the substation circuit by the impedances of the lines over which an established connection extends may become intolerable. This is particularly true in substation installations provided in an exchange area where the subscribers' lines are of widely different lengths. In order to completely obviate the singing which may result due to unbalance of the substation circuit occasioned by unfavorable line conditions, signal controlled switching means may be provided in the substation circuit for enabling the channels which are normally blocked. Such an arrangement is disclosed in my prior Patent No. 2,282,405, granted May 12, 1942, wherein gaseous discharge tubes are employed for controlling the gain of the signal current amplifiers. In this prior patent a gaseous discharge tube is associated with each channel so that the transmission efficiency of the channel may be controlled by the space current of the associated tube which has its input electrodes coupled to the channel so that a predetermined start potential is impressed on the start electrode of the tube when signal current traverses this channel. Since the start electrode loses control after the tube has fired, circuit means are provided in each channel for lowering the anode voltage of the associated gaseous discharge tube when the flow of signal

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current through the corresponding channel ceases, thereby to deionize the tube and restore control thereof to the start electrode. In one embodiment a relay and auxiliary vacuum tube are employed to effect the deionization of an associated one of the gaseous discharge tubes when the signal currents cease flowing, and in a second embodiment a source of alternating current is employed as the anode current supply for the gaseous discharge tubes. In the present invention an improved arrangement is employed wherein the voltage drop across a gaseous discharge tube is employed to enable an associated signal current amplifier, said gaseous discharge tube being fired in response to signal currents applied to the input of the amplifier, and wherein a vacuum tube, also controlled by the signal currents applied to the input of the amplifier, is connected in series with the gaseous discharge tube and a source of direct current in such a manner as to quench the arc discharge therein when the signal currents cease. Since the arc voltage is inherently constant and free from voice components the need for filters having large time constants, such as are usually employed in voice operated gain control systems, is eliminated. In arrangements of this nature it is common for the supply voltage source mentioned heretofor to vary as much as 20% and thereby cause severe variations in the amplifier gain control circuit. The gaseous discharge tube is therefore arranged to also maintain the potential supplied to the amplifier tube at a constant value independent of source variations or signal input potential variations.

It is an object of the present invention to provide an improved transmission system of the character described wherein the magnitude of the control voltage which is utilized to affect the amplifier gain is stabilized by means of a gaseous discharge tube independent of variations in the source potential and signal input potential.

It is a further object of the invention to provide an improved transmission system in accordance with the preceding object and wherein the gaseous discharge tube is provided with a control electrode upon which signaling currents are impressed in order to initiate a discharge in the tube at a lower anode potential than would be required in the absence of the control electrode.

Other objects of the invention will appear upon a further perusal of the specification taken in conjunction with the accompanying drawing which illustrates a substation circuit having in-

corporated therein the principles of the invention briefly referred to above.

Briefly described, the invention comprises a signal current amplifier which is adapted to have its gain controlled in accordance with the magnitude of a biasing potential impressed on a grid of one of the amplifier tubes, which biasing potential normally has a value such that the amplifier is partially or completely blocked, an auxiliary vacuum tube connected as a plate detector and having its input circuit coupled to the amplifier at a point ahead of the blocked tube and having its anode and cathode connected to a source of direct current in series with a load resistor, the voltage drop across the load resistor being employed to alter the biasing potential impressed on the normally blocked tube in the amplifier when signal currents are impressed on the amplifier input terminals, and a gaseous discharge tube connected across the load resistor to stabilize the voltage drop thereacross and to eliminate voice components therefrom while signal currents are being transmitted. In addition, the gaseous discharge tube is preferably provided with a control electrode which is also coupled to the amplifier at a point ahead of the normally blocked tube whereby a discharge will be initiated in the tube at a lower anode potential than would otherwise be possible.

Referring now to the drawing, the substation circuit there illustrated is shown connected to a telephone line 1 which may, for example, form a part of a conventional automatic or manual telephone system, in which case the distant end thereof will terminate in a line circuit the character of which is determined by the character of the exchange. The substation circuit comprises a transmitter or microphone 2 and receiving means in the form of a loudspeaker 3 which are coupled to line 1 through an anti-sidetone impedance network including a hybrid coil 4 and a balancing circuit 5 by means of signal transmission channels 6 and 7, respectively. The outgoing signal current channel 6 comprises a three stage amplifier including the amplifier tubes 8, 9, and 10, the first of which receives signal currents from the microphone 2 and the last of which delivers the amplified signal currents to line 1 through hybrid coil 4. The first and last stages of this amplifier are conventional, each employing cathode biasing. The cathode resistor 26 for tube 8 is connected in series with potentiometer 25 across gaseous discharge tube 22 for a purpose to be described later.

The second stage is the one wherein the gain of the amplifier is automatically controlled and this will be described in greater detail. The amplifier tube 9 employed in the second stage may have either a sharp or a remote cut-off characteristic. A sharp cut-off characteristic is preferable when the amplifier is to be normally completely blocked, while a remote cut-off characteristic is preferable when the amplifier is to be normally only partially blocked. In either case, the cathode of tube 9 is connected to the tap on a voltage divider 11 connected across the plate supply. The tap on divider 11 is adjusted so that the biasing voltage in the input circuit of tube 9 is such as to provide the desired minimum, or zero, normal gain. In order to change the value of the bias potential impressed on the control grid of tube 9, an auxiliary vacuum tube 12 is provided. Tube 12 is capacitatively coupled to the output of amplifier tube 8. The grid of tube 12 is biased to the cut-off point by means of battery 13 whereby this tube operates as a plate detector; that is, only the positive half cycles of a signal on the grid are amplified by the tube. When sound waves impinge on transmitter 2, the corresponding speech signals produced thereby are first amplified by amplifier tube 8 and then further amplified and rectified by control tube 12. The space current of tube 12 flows through resistors 14 and 23 in series, a portion of which is connected in series with the grid circuit of amplifier tube 9, thereby producing a voltage drop which acts to lower the bias potential impressed on the control grid of amplifier tube 9. The increased voltage drop across resistor 23, produced by the space current of tube 12, increases the cathode potential of tube 24 so as to block channel 7. The average value of the space current of control tube 12 varies in accordance with the magnitude of the speech signals impressed on the input of the amplifier. In order to prevent the voltage drop across resistor 14 from varying accordingly, and also to eliminate the voice components which would otherwise appear thereacross, a gaseous discharge tube 15 is connected across resistors 14 and 23. This gaseous discharge tube may have but two elements, in which case the voltage across resistors 14 and 23 would be permitted to rise until it reached the striking point of the gaseous discharge tube and would then drop to a constant value equal to that across the gaseous discharge tube when ionized. As is well known, the voltage drop across the gaseous discharge tube, when ionized, is inherently constant and is a function of the particular gas with which the tube is filled, the gas pressure, and the electrode shape and spacing. Thus a constant current will flow through resistors 14 and 23 and the excess space current of tube 12 will flow through tube 15. Condenser 16 is connected between the cathode and anode of tube 12 to prevent extinction of the gaseous discharge tube during the negative half cycles of signal current. Thus during the positive half cycles condenser 16 partially discharges through control tube 12, and during the negative half cycles condenser 16 partially charges in series with tube 15 in multiple with resistors 14 and 23 from the plate supply. Condenser 16 is made as large as possible consistent with the required speed of arc establishment. It should be noted that it is not necessary that condenser 16 be so large as to substantially eliminate voice components across resistor 14 by filter action for this function is performed by the gaseous discharge tube. The time delay in enabling usually produced as a consequence of the necessity of employing filters to eliminate voice components from the control voltage is thus substantially eliminated. The gaseous discharge tube will also prevent any ripple or hum present in the power supply system due to inadequate filtering from appearing across resistor 14. Condenser 17 is connected across resistors 14 and 23 to maintain the cathode of control tube 12 at ground potential for speech frequencies prior to the initiation of a discharge in tube 15.

Since the voltage required to initiate a discharge in a two electrode gaseous discharge tube is considerably greater than the voltage drop therein after the discharge has been initiated, tube 15 is preferably provided with a control electrode which is shown capacitatively coupled to the output circuit of amplifier tube 8. A battery 18 is connected so as to impress a biasing potential on the control electrode of tube 15. The signal voltage derived from the output of

amplifier tube 8 serves to initiate a discharge between the control electrode and cathode of tube 15. This discharge is transferred to the anode at a much lower anode voltage than would be required to initiate the discharge between cathode and anode without the control electrode. Once the discharge has transferred to the anode, the control electrode plays no further part in the operation until the signal currents cease, whereupon the discharge between the cathode and anode will be interrupted due to the decrease in space current of tube 12 and the control of tube 15 is then once more restored to the control electrode thereof. A high resistance 19 is connected in series with the control electrode of tube 15 to limit the current flowing thereto from the cathode and also to avoid undue loading of the output circuit of amplifier tube 8.

The tap on potentiometer 14 is adjusted so that the net biasing potential impressed on the control grid of amplifier tube 9 is the optimum value for full gain when the voltage drop across the potentiometer 14 and resistor 23 in series is equal to the arc voltage of gaseous discharge tube 15. The input signal level at which a discharge is initiated in tube 15 and amplifier tube 9 is enabled may be controlled by adjustment of potentiometer 20. The gain of the amplifier may be varied by adjustment of potentiometer 21 without affecting the input signal level at which enabling occurs.

Since the incoming signal channel 7 is identical to the outgoing signal channel 6, excepting that its input signal is obtained from the hybrid coil 4 over line 1 and its output is delivered to loudspeaker 3, it is believed that the operation thereof should be apparent from the preceding description of channel 6. When signals are being transmitted over channel 7, channel 6 is blocked by the increased potential developed across resistor 26 just as channel 7 was blocked by the increased potential across resistor 23 during the transmission of signal currents over channel 6.

While a particular embodiment of the invention has been described, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a transmission system, a signal current transmission channel including amplifying means, said amplifying means including a stage comprising an electron discharge tube having a grid electrode upon which a disabling potential is normally impressed, an impedance element, a source of direct current, a second electron discharge tube having its output circuit connected across said source in series with said impedance element and having its input circuit coupled to said channel at a point preceding said amplifier stage, said second electron discharge tube being biased to cut-off whereby signal currents traversing said channel are rectified in said output circuit to produce a unidirectional potential across said element, said impedance element being connected to said grid electrode of said first electron discharge tube so that the potential produced across said impedance element opposes said disabling potential to thereby enable said amplifier stage when signal currents traverse said channel, and a gaseous discharge tube connected across said impedance element to prevent voice components from appearing thereacross.

2. In a transmission system as claimed in claim 1, a control electrode in said gaseous discharge tube also coupled to said channel at a point preceding said amplifier stage to facilitate the initiation of a discharge therein when signal currents traverse said channel.

3. In a transmission system, a channel over which signal currents are at times transmitted, an amplifier in said channel adapted to have its gain controlled through variation of a biasing potential, an impedance element, a source of direct current, a vacuum tube having its output circuit connected across said source in series with said impedance element and having its input circuit coupled to said channel, said vacuum tube being biased to cut-off whereby signal currents traversing said channel are rectified in said output circuit to produce a unidirectional potential across said impedance element, said impedance element being connected to said amplifier so that the potential produced thereacross varies said biasing potential to thereby change the gain of said amplifier, and a gaseous discharge tube connected across said impedance element to maintain the magnitude of said unidirectional potential constant during variations of the potentials of said source and the signal input.

4. In a transmission system, a signal current transmission channel including an amplifier, a source of direct current, a space discharge device and a gaseous discharge device serially connected across said source, each of said devices having a control electrode coupled to said channel, said devices being normally nonconductive, an impedance element connected across said gaseous discharge device, said space discharge device being rendered conductive and thereby developing a potential across said impedance element in response to signal currents traversing said channel, said potential causing a discharge to be initiated in said gaseous discharge device, the initiation of said discharge in said gaseous discharge device being aided by the signal currents impressed on the control electrode thereof, said gaseous discharge device acting to maintain said potential constant during the signal transmission, the gain of said amplifier controlled by said potential.

5. In a voice operated control circuit, a source of direct current, a space discharge device and a gaseous discharge device serially connected across said source, a common circuit, each of said devices having a control electrode coupled to said common circuit, said devices being normally nonconductive, an impedance element connected across said gaseous discharge device, said space discharge device being rendered conductive and thereby developing a potential across said impedance element in response to signal currents traversing said common circuit, said potential causing a discharge to be initiated in said gaseous discharge device, the initiation of said discharge in said gaseous discharge device being aided by the signal currents impressed on the control electrode thereof, said gaseous discharge device acting to maintain said potential constant as long as the signal currents traverse said common circuit, said space discharge device being rendered nonconductive in response to the cessation of said signal currents thereby extinguishing the discharge in said gaseous discharge device.

6. In a telephone system utilizing a voice current repeater tube, voice controlled means for alternately rendering said tube effective and ineffective to repeat speech waves comprising a space discharge tube having an input circuit and

an output circuit and means for applying voice signals to said input circuit, biasing means normally rendering said second tube nonconductive, said space discharge tube energized in response to the application of said voice signals, an impedance element in said output circuit energized in response to the energizing of said space discharge tube, said impedance element being connected to said repeater tube so as to apply an enabling potential thereto when energized, and a gaseous discharge tube having its anode circuit shunted across said impedance element in respect to said source to prevent voice components from appearing thereacross.

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The following references are of record in the file of this patent:

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Number	Name	Date
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