

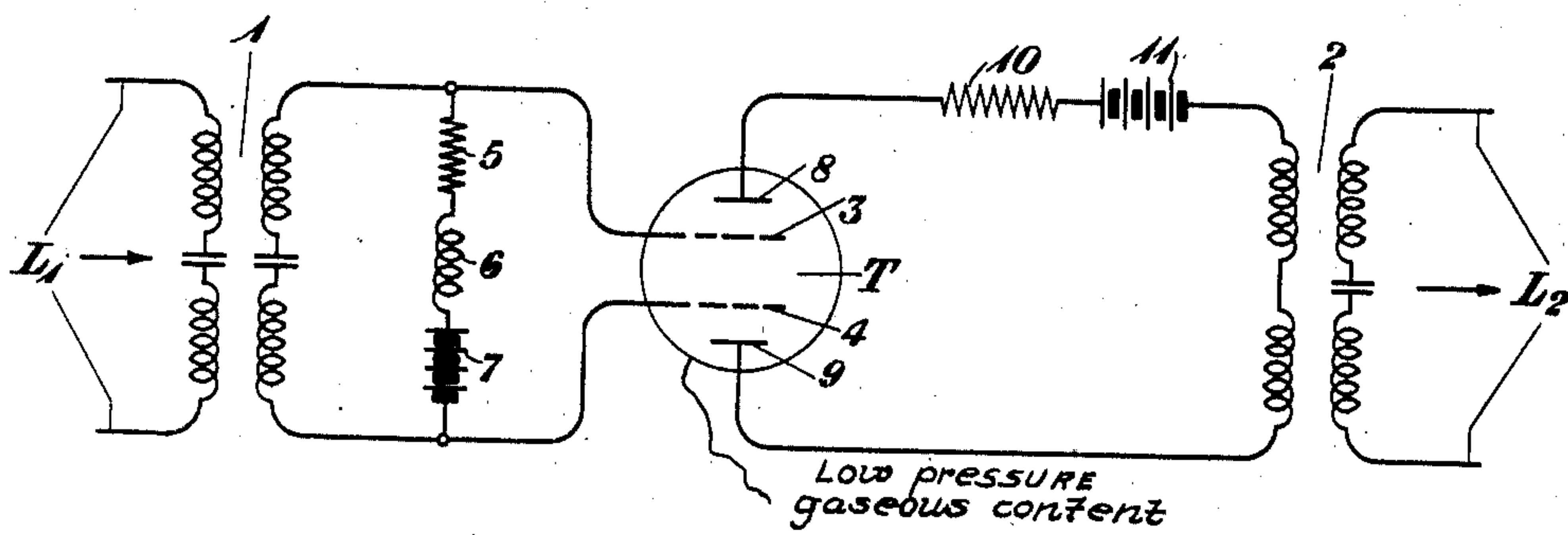
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REPEATER CIRCUITS

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REPEATER CIRCUITS.

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This invention relates to improvements in repeater circuits and more particularly to circuits employing as the repeater element an ionized gas tube. The invention is applicable, among other uses, to telephony for the purpose of obtaining in an outgoing circuit an amplification of voice currents originating in an incoming circuit. It is also applicable to telegraphy and signaling systems in general, where amplification is necessary in receiving, recording or reproducing impulses of electrical energy.

Certain types of telephone repeaters now in use employ as the repeater element a vacuum tube with a heated electrode as a source of free electrons. It has been found in practice that considerable energy is required to keep this electrode at the desired temperature, particularly in large telephone repeater installations. In such cases the vacuum tube filament current often amounts to several hundred amperes from a 24-volt battery. Furthermore, the life of this type of vacuum tube is largely determined by that of the heated filament. A practical method of eliminating the heated electrode in amplifiers utilized in telephone repeater circuits would, accordingly, be of considerable economic value and is one of the primary objects of the arrangements of this invention.

The repeater element of the invention comprises a tube which depends on the presence of ionized gas for its operation. In the tube is a gas, such for example as neon, at low pressure, which has the property of decreasing in electrical resistance as the potential across the terminals of the tube is increased. Any suitable gas, other than neon, which has such properties might be utilized in this connection. The tube will have four electrodes or terminals. The gas in the tube will be placed in a state of ionization and form a conducting path between the two electrodes connected to the outgoing circuit. The variation of potential across the two electrodes connected to the incoming circuit caused by the fluctuating voice, or signal waves, will vary the resistance of the gas and cause similar fluctuations of the current in the outgoing circuit. Other features and objects of the invention will appear more fully from the detailed description hereinafter given.

The invention may be more fully under-

stood from the following description together with the accompanying drawing in which is illustrated a circuit diagram embodying the invention.

The drawing shows two sections L_1 and L_2 of a transmission line interconnected by a repeater tube T . The incoming line section L_1 is connected through a transformer 1 to the terminals, or electrodes, 3 and 4 of the tube T . Transformer 1 may, if desired, operate to step up the line voltage. A local battery 7 is provided in the input circuit, as shown, to give a constant potential across electrodes 3 and 4. This places the gaseous content of the tube in the proper state of ionization to be uniform in its action and sensitive to the varying potential received from the line section L_1 . The varying potential due to the fluctuations of the voice waves thus applied causes a change in ionization in the gas. The resistance between electrodes 8 and 9 will vary inversely with the degree of ionization. The electrodes 8 and 9 are connected through a resistance 10, battery 11, and transformer 2, to the output section L_2 of the transmission line. The change in resistance in the path through the tube between electrodes 8 and 9 causes fluctuations in the current flow in the output circuit due to the local battery 11 and these fluctuations are proportional to the incoming line currents which are desired to be amplified. The amplitude of the current fluctuations may be greater in the output circuit than in the input circuit due to the energy supplied by the local battery 11. The resistances 5 and 10 are provided to limit the current in the tube and give stability of operation. The retard coil 6 is provided in order that the potential of the electrodes 3 and 4 will vary in accordance with the incoming line currents. It is desirable that the inner electrodes 3 and 4 be of some form, such as a grid, that will permit the passage of ions between the two outer electrodes 8 and 9. With this arrangement amplification of the incoming currents may be secured and the use of a heated electrode in the tube may be obviated.

While the arrangements of the invention have been shown as illustrated in certain specific arrangements which are deemed desirable, it is understood that they are capable of embodiment in many and widely

varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

- 5 1. A repeater system comprising a tube having a gaseous content the state of ionization of which will vary in direct proportion to the potential to which it is subjected, a pair of electrodes in said tube between
10 which is applied a potential varying in accordance with signal currents coming in over said system, and a second pair of electrodes connected to an output circuit of said system, the current in said output circuit
15 varying in accordance with the incoming signal currents, said first mentioned pair of electrodes being positioned between said second mentioned pair of electrodes and being independent of any connection therewith.
- 20 2. A repeater system comprising a tube having two sets of electrodes, an input circuit on which are impressed potential variations due to signal currents, said input circuit terminating at one of said sets of elec-
25 trodes, and an output circuit connected to said other set of electrodes, said tubes having a gaseous content through which a stable glow discharge is maintained between said output circuit electrodes substantially free
30 from any thermionic emission from any of said electrodes, the currents in said glow discharge being varied by the potentials impressed on said electrodes in said input circuit independently from the potentials ap-
35 plied to said other electrodes.

3. A repeater system comprising a tube having two sets of electrodes connected independently from each other, an input circuit on which are impressed potential variations due to signal currents, said input circuit terminating at one of said sets of electrodes, a resistance and an inductance and a constant source of potential bridged across said input circuit, an output circuit connected to said other set of electrodes, said tube having a gaseous content maintained in a state of ionization due to said stabilizing resistance and said last mentioned source of current resulting in a steady
40 45 50 luminous discharge between said last mentioned set of electrodes.

4. A tube having a low pressure content of gas of the helium group, a pair of electrodes, an output circuit connected to said electrodes and including a resistance and a source of current, said resistance and source of current being so adjusted that the potential gradient between said electrodes will be that characteristic of a glow discharge, a second pair of electrodes included in said tube positioned between said first mentioned pair of electrodes and independent of any connection therewith, and means to apply potentials thereto whereby said potential gradient
55 60 65 may be varied.

In testimony whereof, I have signed my name to this specification this 5th day of July, 1922.

CHARLES S. DEMAREST.