

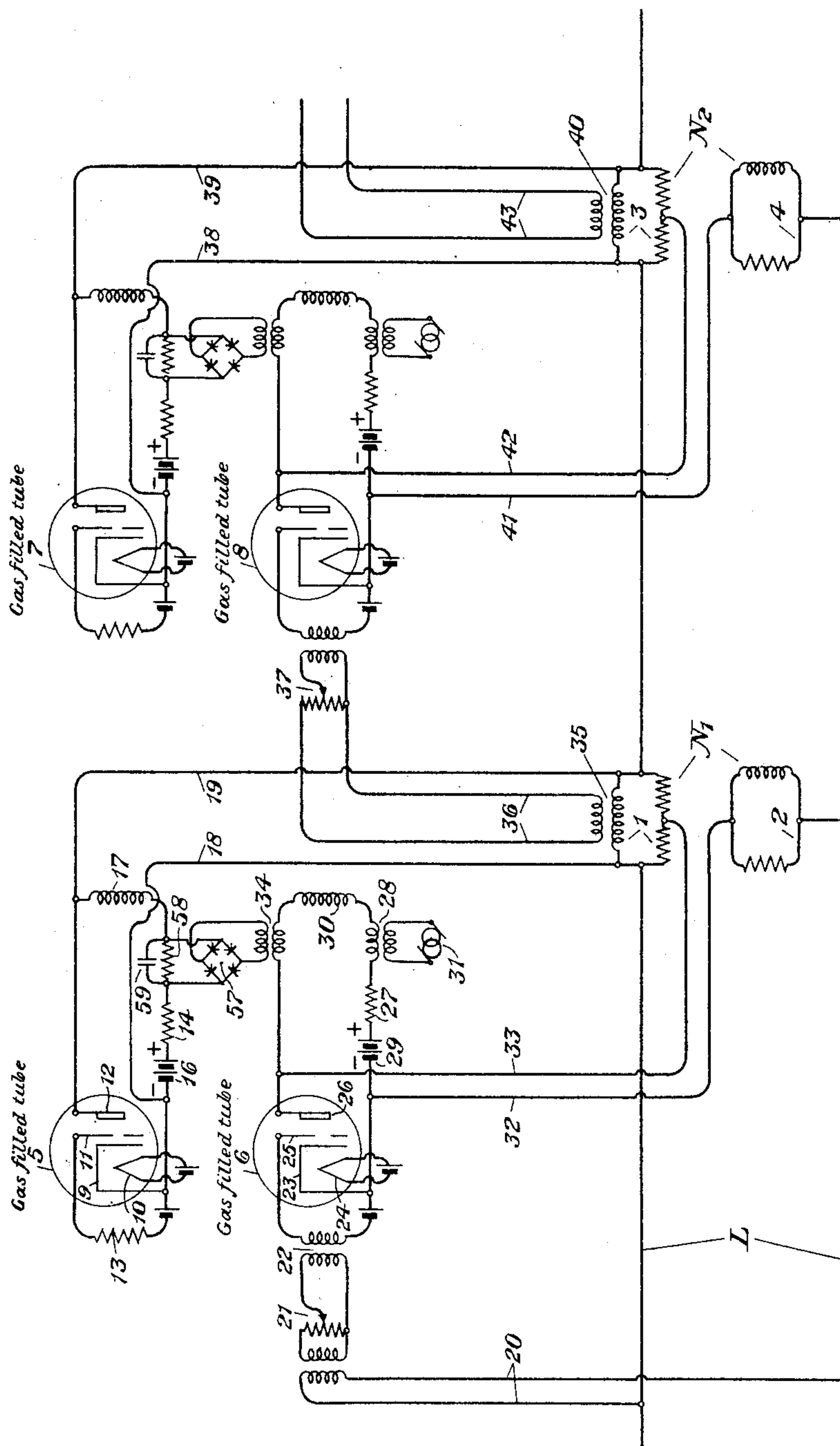
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TRANSMISSION REGULATING SYSTEM

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TRANSMISSION REGULATING SYSTEM

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This invention relates to transmission systems and more particularly to means for regulating transmission on the lines of such systems.

5 In telephone or telegraph transmission systems, particularly of the carrier type, it may be desirable to automatically regulate the transmission over lines of such systems so that the current at the end of the line will be
10 of constant output or of an output between desired levels. This has been accomplished by transmitting a pilot channel over a line and utilizing increases or decreases in said pilot channel to cut in or out of the line elements of networks or artificial lines to regulate transmission to keep the output between
15 desired levels. The means for switching in and out of the line the elements of these networks have heretofore been relays. In such systems, particularly those utilizing a number of carrier channels, it is necessary to effect very dependable operation of these relays as their contacts may be directly in the transmission circuit. Accordingly, careful
20 attention to their mechanical adjustment has been necessary. The arrangements of the invention provide a means for automatically controlling the transmission in a line by means of a pilot channel without the use of relays and hence afford the particular advantage of providing a device which eliminates mechanical moving parts in such a system.

25 In the arrangements of the invention the pilot channel is transmitted through the variable network or artificial line to the receiving circuit with the desired volume as determined by the number of pads or elements of the artificial line which may be connected
30 in the circuit. The connection of these pads or elements to the line is controlled by switching units employing gas-filled thermionic tubes to perform the functions heretofore performed by relays. The arrangement is
35 such that the number of elements of the

artificial line to be cut into the circuit will be dependent upon the voltage of the received current. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter
40 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
45 illustrating a preferred embodiment of the invention.

In the drawing is shown a transmission line L in which it may be automatically desired to regulate transmission by means, for example, of a pilot channel transmitted over the line. Accordingly, there would be included in the line L a plurality of artificial lines or networks, such as N_1 and N_2 . Each of these would comprise series and shunt elements. In the network N_1 would be the series resistance elements 1 and the shunt element comprising the circuit 2 including elements of resistance and inductance. In the network N_2 would be the series resistance elements 3 and the shunt element comprising circuit 4 including elements of resistance and inductance. Networks of this type are well known in the art. The connection in the line of the elements of network N_1 is controlled by a switching device comprising the gas-filled thermionic tubes 5 and 6. The connection in the line of the elements of network N_2 is controlled by a switching device comprising the gas-filled thermionic tubes 7 and 8.

The gas-filled thermionic tubes 5, 6, 7 and 8 are such that when the input voltage applied to the grid is of a certain value the tube will operate and an arc of relatively low resistance will be formed between the cathode and plate of the tube. Obviously when the tubes are in a non-operative condition and no low resistance arc exists, the resistance between cathode and plate is very high. The

tube 5 comprises a cathode 9, a heating element 10 for the cathode, a grid 11, and a plate 12. The grid circuit would include the resistance 13. The cathode-plate circuit would include the current limiting resistance 14, a battery 16, the inductance 17, and the resistance 58 to which is connected a circuit including the rectifier 57 and a winding of transformer 34. This circuit arrangement is provided for quenching the low resistance arc existing in tube 5 under conditions and in a manner to be pointed out hereinafter. The tube 5 would have its circuit elements so adjusted that normally it would in an operated condition and a low resistance arc would exist between the cathode and plate. The resistance of this arc would be so low that it would in effect close the following circuit about the series elements 1 of network N_1 ,—from the tip side of line L, conductor 19, cathode-plate of tube 5, and conductor 18, to the tip side of line L. Accordingly, series element 1 of network N_1 will not be connected in the line. The gas-filled tube 6 comprises a cathode 23, a heating element 24 for the cathode, a grid 25, and a plate 26. The plate circuit includes the current limiting resistance 27, the winding of transformer 28, the battery 29, inductance 30, and winding of transformer 34. The input circuit is connected through a transformer 22 to a potentiometer 21 and thence to a circuit 20 bridged across the line L. When no pilot channel current is flowing in line L and circuit 20, there will be no input voltage applied to the grid of tube 6 and it will not be operated. Hence a high resistance will exist between the cathode and plate of the tube. The shunt circuit element 2 across line L is completed by conductors 32 and 33 across the high resistance between the cathode and plate of tube 6 and hence the shunt element of network N_1 is not connected in the line L. Accordingly, when no pilot channel is transmitted over line L the network N_1 will not be connected in the line.

The gas-filled tubes 7 and 8 and their circuits are substantially similar to those of tubes 5 and 6, respectively. Normally tube 7 is operated and a low resistance arc exists between its cathode and plate. With this low resistance and conductors 38 and 39 the series element 3 of network N_2 may be disconnected from line L. Tube 8 has its input circuit connected through a potentiometer 37 to the circuit 36 which is connected by transformer 35 to the line L. When no input voltage is applied to tube 8 it will not be operated and a high resistance will exist between the cathode and plate. This high resistance will be included by conductors 41 and 42 in the path of shunt circuit element 4 across the line L. Accordingly, the shunt element 4 of network N_2 may be disconnected from line L.

If it is desired to regulate transmission in the line L, a pilot channel frequency will be transmitted thereover and the voltage therefrom will be applied over circuit 20 to the input of tube 6. If the voltage across the input of tube 6 should rise to a value sufficient to operate the tube, an arc will be established from the cathode to the plate in this tube. This arc will be an intermittent one as it will be intermittently quenched by the alternating current applied to the plate circuit from source 31. However, the formation of this intermittent arc between the cathode and plate of tube 6 will so reduce the resistance between these elements as to effectively close the shunt element of network N_1 . At the same time this intermittent reduction of the resistance in the plate circuit of tube 6 would furnish a low resistance path for the alternating current from source 31 through the primary winding of transformer 34. This current would be rectified by device 57 and be applied in sufficient strength to resistance 58 to reduce the voltage on the plate of tube 5 so that the arc therein will be quenched. The condenser 59 shunted across resistance 58 is so proportioned as to maintain a continuous flow of current of sufficient magnitude through resistance 58 to keep the arc in tube 5 extinguished. This would change the low resistance arc existing in tube 5 to a condition of no arc at all. This would effectively remove the low resistance between the cathode and plate of this tube and substitute therefor a high resistance. This would open the normal shunt path across the series element 1 of the network N_1 . As has been pointed out the alternating current from source 31 in the plate circuit of tube 6 will not permanently quench the arc in this circuit as long as it is continuously reestablished by the application of sufficient alternating voltage to the grid from the input circuit, and as a result the shunt element 2 is effectively shunted across line L. The alternating quenching frequency from source 31 should preferably be high as compared to the frequency or frequencies regulated by the network N_1 . Accordingly, it will be seen that the operation of tube 6 will cause the tube 5 to be deenergized, and when the tube 6 is deenergized tube 5 will again be operated. The removal of the short circuit on series element 1 permits voltage to be applied through transformer 35 and circuit 36 to the input of tube 8 and if sufficient pilot channel voltage is received with N_1 in circuit tubes 7 and 8 will function.

An illustration of the general operation of the arrangement shown is as follows: If the received current is above the desired amount, sufficient voltage will be received at the input of tube 6 to operate this tube and to deenergize tube 5. This will connect the network

N_1 into the line L and reduce the volume transmitted over the line. If the received current had been below the desired amount the switching device comprising tubes 5 and 6 would not have been operated and the network N_1 would not have been connected into the line. If, after the network N_1 has been connected into the line in the manner described, the pilot or control current flowing in the series element 1 of the network N_1 produces sufficient voltage on the grid of tube 8, the tube 8 will operate and the tube 7 will be released. The switching unit comprising tubes 7 and 8 will then function to cut the network N_2 into the transmission line L and further reduce the volume transmitted thereover. By means of a circuit such as 43, additional switching arrangements and additional networks might be connected into the line L. Accordingly, successive networks may be connected into the circuit in a manner similar to that heretofore described until the received current is reduced to the desired value. It might be desirable in utilizing the arrangements shown to have half of the networks connected on normal current and half disconnected so that the range of adjustment above and below the normal value would be equal. In the arrangement shown, it may be assumed that all of the networks are approximately of equal value so that their operation in sequence will increase the loss in the line in equal steps. Such an arrangement would be best suited to uses in cases where a large number of steps would not be required. If large attenuation, however, is required in the variable artificial line and at the same time it is necessary to have this change occur in small steps, a variety of sizes of networks might be utilized.

In the arrangements of the invention sufficient amplification will be obtained from the gas-filled tubes of the kind indicated to permit operating directly from the currents received from the transmission circuit without requiring a receiving amplifier particularly for the purposes of raising these currents to the necessary level for the control device. Gas-filled tubes of the type described also have the characteristic of being critically responsive to the specific value of the applied input voltage so that they can be adjusted to operate at the desired value of receiving current. These features constitute further advantages of the arrangements of the invention over relay devices for the particular apparatus proposed in transmission regulating systems.

While the arrangements described might be particularly adapted to a carrier current transmission regulating system, the principles employed would also apply to a control current system either for voice currents or radio circuits. Accordingly, while the invention has been described 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, a network comprising an element in series in said line and an element in shunt in said line, two gas filled thermionic tubes, means for completing the circuit for said shunt element over the cathode-plate circuit of a normally inoperative one of said gas filled thermionic tubes, a short circuit about said series element completed over the cathode-plate circuit of a normally operated one of said gas filled thermionic tubes, means controlled by the operation of said first tube for releasing said second tube, and means controlled by the voltage of currents transmitted over said line for operating said first tube.

2. A transmission line, a network comprising an element in series in said line and an element in shunt in said line, means for completing the circuit for said shunt element over the cathode-plate circuit of a normally inoperative gas filled thermionic tube, a short circuit about said series element completed over the cathode-plate circuit of a normally operated gas filled thermionic tube, means controlled by the operation of said first tube for releasing said second tube, means controlled by the voltage of currents transmitted over said line for operating said first tube, a second network similar to said first network, a combination of gas filled thermionic tubes similar to said first mentioned combination of tubes for effectively connecting the elements of said second network into said line, and means controlled by the voltage of currents transmitted through said first network for controlling the operation of said second combination of gas filled tubes.

3. A transmission line, a network comprising an element in series in said line and an element in shunt in said line, means for completing the circuit for said shunt element over the cathode-plate circuit of a normally inoperative gas filled thermionic tube, a short circuit across said series element completed over the cathode-plate circuit of a normally operated gas filled thermionic tube, means controlled by the operation of said first tube for releasing said second tube, means controlled by the voltage of currents transmitted over said line for operating said first tube, additional networks controlled by additional combinations of gas filled tubes similar to said first network and combination of tubes, and means for successively connecting said networks into said line by operating each combination of tubes by the voltage of currents transmitting through the preceding network.

4. A transmission line, a network comprising an element in series in said line and an element in shunt in said line, means for completing the circuit for said shunt element over the
5 cathode-plate circuit of a normally inoperative gas filled thermionic tube, a short circuit about said series element completed over the cathode-plate circuit of a normally operated gas filled thermionic tube, means controlled
10 by the operation of said first tube for releasing said second tube, means controlled by the voltage of currents transmitted over said line for operating said first tube, and means operative when the input voltage applied to said
15 first tube ceases for releasing said first tube and causing said second to become operative again.

5. A transmission line, a network comprising an element in series in said line and an
20 element in shunt in said line, two gas filled thermionic tubes, means for completing the circuit for said shunt element over the cathode-plate circuit of one of said tubes, a short circuit about said series element completed
25 over the cathode-plate circuit of the other of said tubes, and means controlled by the voltage of currents transmitted over said line for controlling the energization and deenergization of said gas filled tubes.

30 In testimony whereof, I have signed my name to this specification this 9th day of November 1931.

CHARLES S. DEMAREST.

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