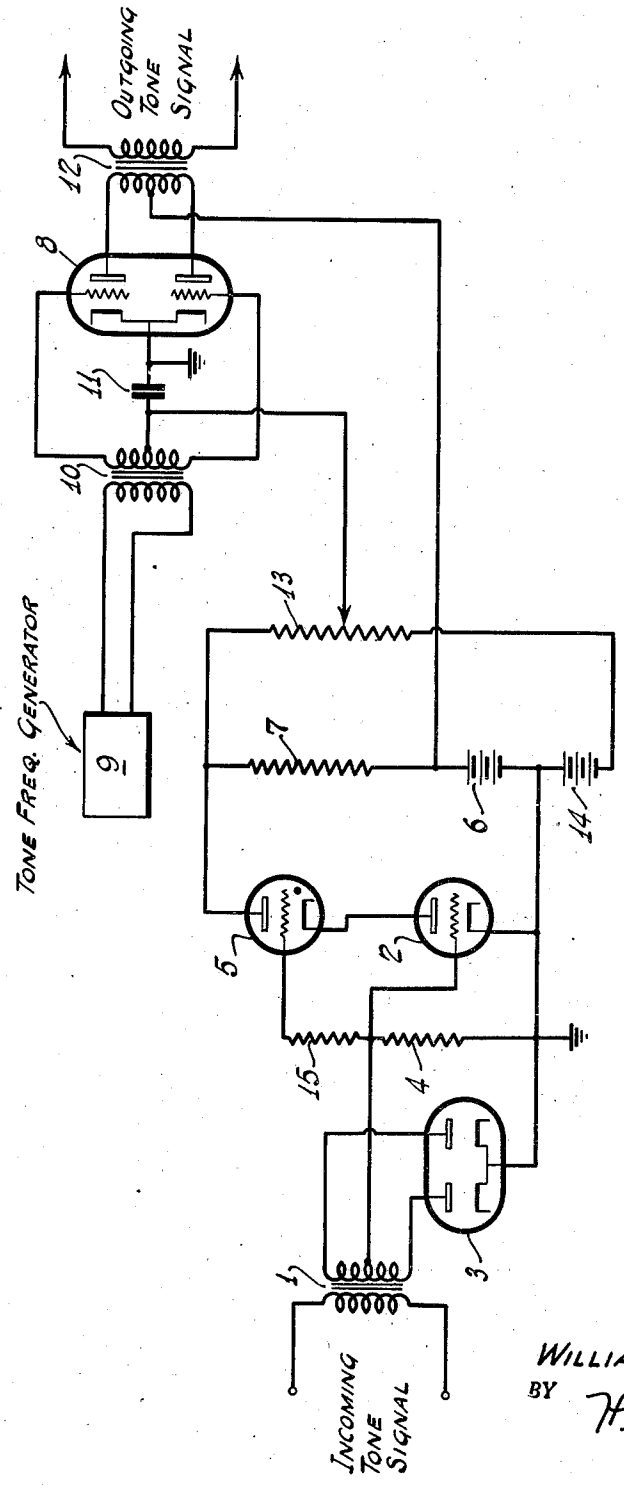
July 23, 1946. W. E. SIMPSON 2,404,754

TONE FREQUENCY SIGNAL REPEATER

Filed May 29, 1942



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Patented July 23, 1946

2,404,754

UNITED STATES PATENT OFFICE

2,404,754

TONE FREQUENCY SIGNAL REPEATER

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Application May 29, 1942, Serial No. 444,991

9 Claims. (Cl. 178—66)

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This invention relates to tone frequency signal repeaters and more particularly to an arrangement which has been found practical in systems of telegraphy. It is often times desired to receive telegraph signals on one channel and to repeat the same on a different outgoing channel. Where the marking and spacing elements of the signals are respectively characterized by on and off keying of a tone frequency, it has been found that the tone frequency generator used at a repeating station is apt to heterodyne with the ripple component of the rectified incoming signal. Such heterodyning is very objectionable in that it does not insure the maintenance of signals of uniform amplitude.

Accordingly, it is an object of my invention to provide a telegraph repeater circuit which is electronic in action and which permits of sending out a regenerated tone frequency signal completely free from the effects of a ripple component in the rectified incoming signal.

It is another object of my invention to provide a keying circuit which would be particularly useful as a repeater, and to provide therein a system of electronic devices such that no adverse effects will result from the use of a rectified incoming signal in keying an output circuit for the transmission of interrupted tone frequency signals.

Other objects and advantages of my invention will be made apparent in the description to follow. This description is accompanied by a drawing, the sole figure of which represents in diagrammatic form the essential elements of a preferred embodiment of my invention.

Referring to the drawing, I show an incoming tone signal circuit which includes the primary winding of a transformer 1. The secondary of this transformer has a mid-tap which is connected to the grid of a vacuum tube 2. The terminals of the secondary of the transformer 1 are connected respectively to the anodes of a double diode rectifier tube 3. The common cathode of this tube is grounded. A load resistor 4 completes the rectifier tube circuit.

The vacuum tube 2 has an output circuit which includes the space path of a gaseous discharge tube 5. This output circuit may be traced completely from the cathode of tube 2 through an operating potential source 6, a resistor 7, the anode of tube 5, and a connection between the cathode of tube 5 and the anode of tube 2.

An output tube 8 is shown having two triode sections arranged for push-pull operation under control of a tone frequency voltage which may be derived from a suitable generator 9. This generator is coupled to an input circuit of tube 8 by means of a transformer 10. The secondary of this transformer has terminals connected respectively to individual control grids in the tube 8. A mid-tap on the secondary of transformer 10 is coupled across capacitor 11 to the common cathode of tube 8. This cathode is grounded. The anodes of tube 8 are connected respectively to the two terminals of a primary winding on an output transformer 12. The secondary of this transformer is connected to any suitable outgoing circuit. In order to control the on and off keying of the output tube 8, I provide a biasing circuit for its grid which is connected to the mid-tap on the secondary of transformer 10 and leads therefrom to a tap on a potentiometer 13. This potentiometer is connected between the negative terminal of a direct current source 14 and the anode of tube 5. Sources 14 and 6 are series-connected.

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The operation of my repeater circuit will now be explained.

In the absence of an incoming tone signal, the grids of tubes 2 and 5 are rendered sufficiently positive so that both of these tubes are conductive. The gaseous discharge tube 5 having become ionized, its anode potential drops to a value such that a cut-off bias is applied through potentiometer 13 to the grids of tube 8. The tone frequency output from the generator 9, therefore, has no effect upon the tube 8 during a "space" element of the signal train.

Upon arrival of a marking element of the incoming tone signal, full wave rectification takes place in tube 3. The potential drop resulting in resistor 4 causes tube 2 to be completely cut off. The grid in tube 5 is also rendered negative by virtue of a connection thereto from the grid end of resistor 4 through an additional resistor 15. Since no current can further traverse the space path of tube 2, the gaseous tube 5 becomes deionized. The increase in the positive potential on the anode of tube 5, therefore, is reflected in an increased voltage drop through the potentiometer 13 which shifts the bias on the grids of tube 8 so as to render this tube conductive. The tube will then amplify the tone frequency generated by the unit 9 during a marking element of the signal train.

It will be apparent that the ripple component in the rectified signal as applied to the grid of tube 2 will have no appreciable effect upon the conductive state in the tube 5. In other words, the slight variation in the impedance of tube 5 is negligible in value compared with the changes in value between on and off keying which are

attributable to the conductive and non-conductive states in the gaseous tube 5.

While my preferred circuit arrangement has been described in its relation to a repeating system, it will be clear to those skilled in the art that the circuit itself is capable of a variety of different uses under different conditions. In other words, its use is not necessarily restricted to "on" and "off" keying of telegraph signals. Other uses may include those which pertain to facsimile systems as well as other systems of communication. The scope of the claims is, therefore, to be understood as though not restricted to the precise details of the exemplary embodiment which has been shown and described.

I claim:

1. A gaseous triode discharge tube in combination with a device for controlling its periods of ionization, said device comprising a vacuum discharge tube having at least three electrodes of which the anode is connected to the cathode of said gaseous tube, the vacuum tube cathode having a circuit connection to the gaseous tube anode, said circuit connection including a direct current source and a load impedance, an input circuit impedance interconnecting a control grid in said vacuum tube with its cathode, an impedance interconnecting the control grids in the two said tubes, and a source of intermittent control potential which, when applied across said input circuit impedance, causes the vacuum tube to be blocked, thereby interrupting a normal discharge in said gaseous tube.

2. The combination according to claim 1 and including rectifying means in circuit between said source of intermittent control potentials and said input circuit impedance.

3. In a signal-controlled circuit arrangement, a tube having a gaseous discharge path in series with the discharge path of a vacuum tube, each of said tubes having a cathode, an anode and a control grid, said tubes having a common input circuit impedance across which a rectification component of a tone-modulated signal is intermittently impressed, and an output circuit common to said tubes, said output circuit including a direct current source and a load impedance, said source constituting means for producing simultaneous discharges in the two said tubes during periods when no signal is applied to said input circuit, said vacuum tube being subject to a cut-off bias in the presence of signals, and constituting means for extinguishing the gaseous discharge in the other of said tubes.

4. The combination according to claim 3 and including means for delivering an outgoing tone signal which is keyed on and off by differences in the potential drop across said load impedance.

5. The combination according to claim 3 and including a repeating circuit having a tone frequency generator, an electronic amplifier subject to control by said generator and means effective to apply a blocking bias to the input circuit of said amplifier during periods of discharge in said tubes, said means comprising a negative biasing source connected in circuit with a potentiometer and connected also to points of different potential in the output circuit common to said tubes.

6. In a signal repeater, a gaseous triode discharge tube the space path of which is in series with that of a vacuum tube having at least a cathode, an anode and a control grid, a source of incoming tone frequency signals, rectifying means having input terminals coupled to said source and output terminals coupled to input circuits for both of said tubes, and arranged to bias the vacuum tube to cut-off in the presence of rectified potentials, a direct current operating potential source for said tubes, a keyed tone frequency signal repeater circuit including a push-pull amplifier, an outgoing tone frequency source, and biasing means connected to the input circuit of said amplifier and controlled by alternate conductive and non-conductive states in said gaseous tube for causing the output voltage from said outgoing tone frequency source to be keyed in accordance with said incoming signals.

7. The method of repeating keyed tone signals by means of two discharge tubes the output circuits of which are series-connected, one of said tubes being of the vacuum type and the other tube being gas-filled, which method comprises, rectifying a keyed incoming tone signal, simultaneously exciting said tubes when said signal is keyed "off," utilizing a rectified component of said signal when it is keyed "on" for biasing said vacuum tube to cut-off, and for thereby extinguishing said gas filled tube, generating a constant tone frequency, intermittently amplifying said tone frequency, and causing the periods of amplification of said tone frequency to be defined by corresponding periods of extinction of said gas filled tube.

8. In combination, a gaseous discharge tube, a vacuum discharge tube, each of said tubes having a cathode, an anode and a control grid, the cathode in one of said tubes being directly connected solely to the anode in the other of said tubes to form a series circuit which includes the discharge paths of the two said tubes, a direct current source for activating said tubes, said source being connected in series with a load in an output circuit extending between the anode and the cathode at the two ends of said series circuit, an input circuit including a resistor interconnecting the grids in the two tubes, and a second resistor interconnecting the grid and the cathode of the tube at the negative end of said series circuit, and common control means including a pulsating potential source connected across said second resistor, said means being effective in response to a positive control pulse to render both tubes conductive, and in response to a negative control pulse to block the vacuum tube, thus extinguishing the gaseous tube.

9. An electronic relay comprising a vacuum tube and a gas-filled tube, said tubes having their discharge paths series-connected in a circuit which is so constituted that the space current traversing one tube is always equal in amplitude to the space current traversing the other tube, a direct current source for activating said tubes, said source being connected in series with a load in an output circuit extending between the anode and the cathode at the two ends of said series-connected discharge paths, a resistive input circuit a portion of which is individual to one tube and another portion of which is common to the two tubes, control grids in each tube having connections to said input circuit, and means for applying control potentials to said input circuit in such manner that said tubes are rendered conductive simultaneously, and when the vacuum tube is biased to cut-off then the gas-filled tube becomes extinguished.

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