

Jan. 30, 1934.

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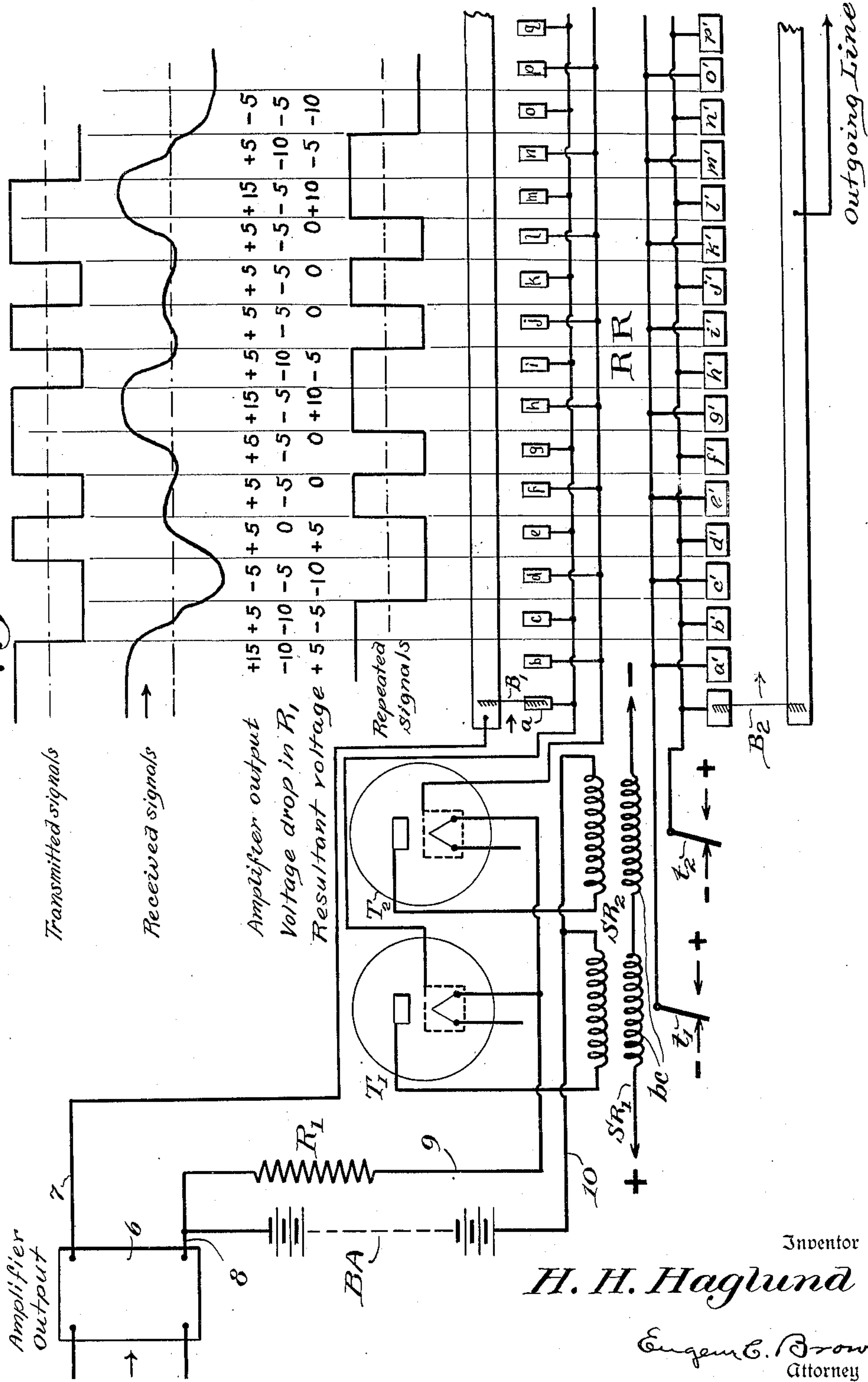
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TELEGRAPH SYSTEM

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3 Sheets-Sheet 1

Fig. 1.



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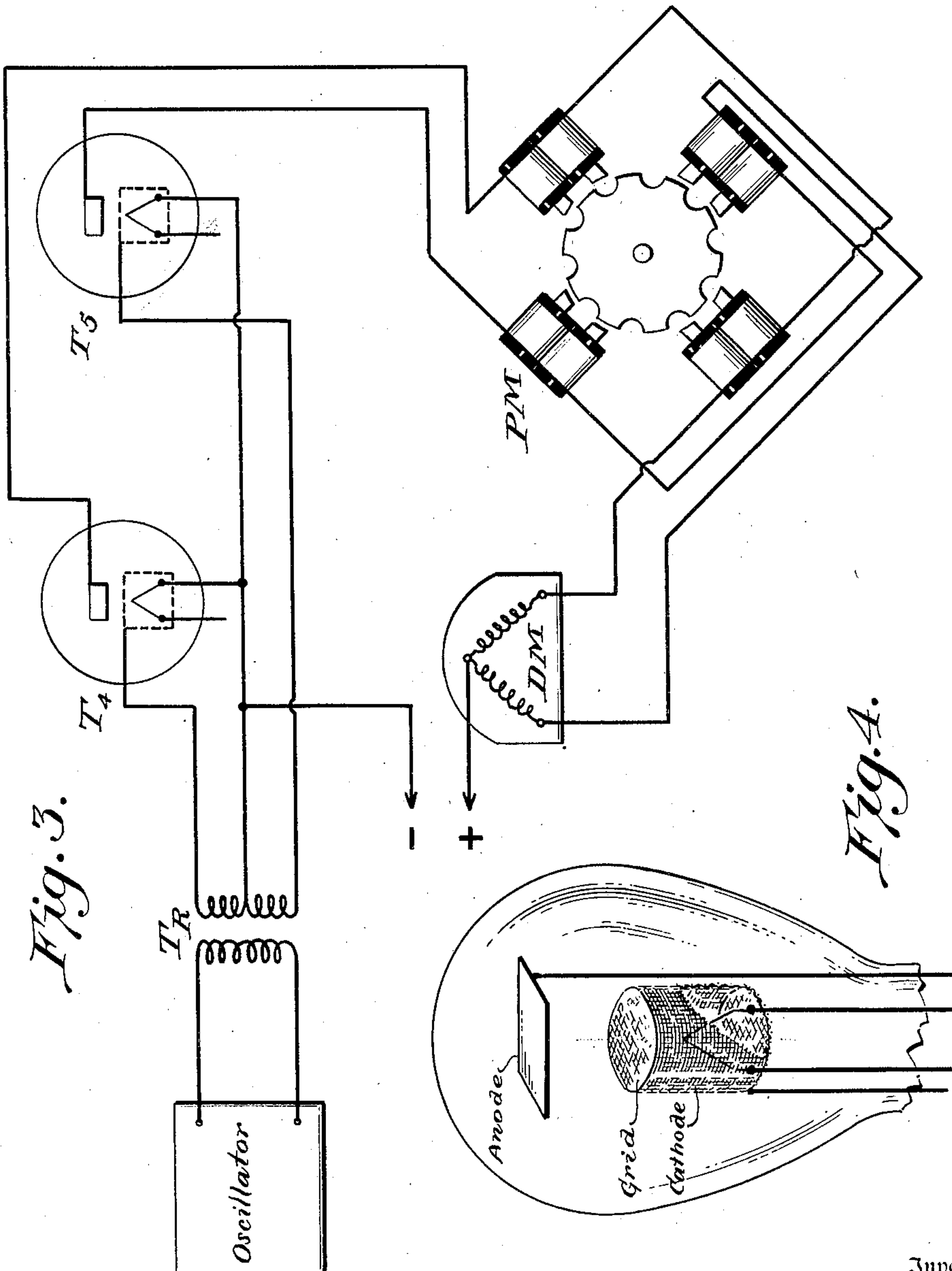
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3 Sheets-Sheet 3



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TELEGRAPH SYSTEM

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9 Claims. (Cl. 178—70)

This invention relates to electric signaling systems but more particularly to telegraph systems and to arrangements for operating telegraph receiving or repeating apparatus direct from the output of an amplifier or magnifier.

In my prior applications Ser. Nos. 335,963 and 343,109, I have disclosed signaling systems wherein the usual electro-mechanical relay devices may be eliminated by employing thermionic tubes of the so-called thyatron type which have the characteristic of starting into operation when a certain positive potential is applied to the grid and continuing to operate thereafter unaffected by the grid potential.

In tubes of the thyatron type the grid merely surrounds the cathode to form a shield between the anode and the cathode. I have discovered that if the grid of a mercury vapor or other gas-filled valve is constructed to completely enclose or envelop the cathode and is formed of reticulated material or wire having a very fine mesh, the tube will possess characteristics quite distinct from the thyatron. The current will start between the anode and the cathode the instant a predetermined positive voltage is applied to the grid and will continue to flow at substantially maximum value unaffected by variations in the grid potential so long as it remains positive but will stop suddenly the instant a certain critical negative potential is applied to the grid.

The operation of the tube in this manner is probably as follows:—When the grid is made positive, there is a flow of electrons from the cathode through the small apertures in the grid to the anode. These electrons collide with the atoms of the gas, causing ionization and thereby starting the arc. If the grid is now made negative by a certain critical value, positive ions collect and form a sheath about the wires or structure of the grid in the manner described by Dr. Irving Langmuir, but since the apertures are very small this sheath is made sufficiently thick to overlap and effectively block the ionic path through grid and as the cathode is completely enclosed or enveloped by the grid structure, the arc is completely choked off or extinguished and de-ionization takes place. This tube may therefore be characterized as a gaseous controlled rectifier wherein the grid so completely encloses or envelopes the cathode and has a mesh of such dimensions that the arc can be started by applying positive potential to the grid and can be extinguished by applying a negative potential thereto.

The object of my invention is to provide an electrical system wherein thermionic tubes control

the reception or repeating of recurring impulses and are themselves started and stopped by the application of the corresponding positive and negative potentials to the grids of the tubes.

For the purpose of disclosing this invention and discovery I shall refer in the following description to the accompanying drawings in which:—

Figure 1 is a diagram illustrating an arrangement embodying my invention for repeating signaling impulses;

Figure 2 is a diagram illustrating a circuit arrangement for phase correction in a telegraph receiving or repeating apparatus;

Figure 3 shows a circuit arrangement for operating a phonic motor; and

Figure 4 is a fragmentary illustration of a gaseous filled thermionic tube in which the cathode is completely enclosed or enveloped by a fine mesh wire grid having the characteristics which I have described.

In Fig. 1 I have indicated at 6, the output of an amplifier or magnifier of a signal receiving apparatus connected by conductor 7 with the continuous ring of a rotary repeater RR of the usual well-known construction. The segments *a*, *b*, *c*, etc. are connected alternately to the grids of two thermionic tubes *T*₁, *T*₂ of the construction described in which the cathodes are completely enclosed or enveloped by the fine mesh grids. The cathodes are connected in parallel to the other conductor 8 of the amplifier output through a conductor 9 and resistance *R*₁. The plates or anodes of the tubes are connected respectively through the actuating coils of the sending-on relays *SR*₁ and *SR*₂, through the conductor 10 and battery *BA* to the amplifier output conductor 8. The relay armatures *t*₁ and *t*₂ are normally biased to their left hand or negative polarity contacts by the biasing coils *bc*.

Let us assume that the received signaling impulses have a maximum of ten volts positive and a minimum of ten volts negative and that the amplifier output is normally biased to five volts positive so that there will be an available positive voltage of fifteen volts and an available minimum voltage of ten volts at the terminals of the amplifier. Also assume that there is a voltage drop of five volts across the resistance *R* when current flows through one tube and a drop of ten volts when current flows through both tubes.

The illustration of the transmitted signal with square topped waves is of course, not attained in actual practice. The diagram of received signals shows that there is a lag between the trans-

mission and the reception and also that the dots or impulses of unit length are too weak to be recorded. The diagram of repeated signals indicates that the regenerated signals repeated into the outgoing line or cable include the missing dot impulses and constitute a faithful reproduction of the original transmitted signals.

Let us examine the operation more in detail. When the brush B_1 is on the segment b , the received signal is at a maximum and hence there is a voltage of 15 positive at the terminals of the amplifier. At this instant current has been flowing through both tubes thereby causing a drop of 10 volts across resistance R_1 , thus leaving 5 volts positive to be applied to the grid of tube T_2 . This tube, therefore, continues to operate and holds its tongue or armature t_2 against its right hand contact. Consequently the tube T_2 will continue to operate and as the sending brush B_2 engages the segment b' , the repeated signal will continue as a maximum positive impulse from the tongue t_2 .

When the brush B_1 engages the segment c , the received signal is at zero and the voltage at the amplifier output is 5 volts positive bias. Both tubes are still in operation and hence there is a drop of 10 volts across resistance R_1 to be subtracted, leaving a resultant of 5 volts negative which is applied to the grid of tube T_1 . This stops the tube and the tongue t_1 of relay SR_1 is moved by its biasing coil to the left hand contact. As the sending brush now engages the segment c' , the repeated signal impulse transmitted to the outgoing line changes from maximum positive to minimum negative, as indicated by the diagram.

When the brush B_1 moves onto the segment d , the received signal is at a minimum 10 volts negative which is reduced by the 5 volts positive bias to 5 volts negative at the terminals of the amplifier. Since the tube T_2 is still operating, there is a drop of 5 volts across the resistance R_1 giving a resultant of 10 volts negative to be applied to the grid of tube T_2 . This stops tube T_2 and causes the tongue t_2 of sending-on relay SR_2 to move over to its left hand contact under the control of its biasing coil. Accordingly as the sending-on brush B_2 engages segment d' the negative impulse being transmitted to line is continued from tongue t_2 .

When the brush B_1 has reached the pick-up segment e , the amplifier output has dropped to its "no signal" value, due to the fact that a series of single impulses are coming in and the attenuation of the cable is assumed to be so great that these signals are almost completely lost in transmission. The voltage at the amplifier output is 5 volts positive due to the positive bias. Since neither tube is operating, there is no drop at the resistance R_1 and hence the 5 volts positive is applied to the grid of tube T_1 which starts it into operation, thereby energizing the relay SR_1 and moving its tongue t_1 over to its right hand contact. As the sending-on brush B_2 engages the contact e' , the repeated signal impulse shifts from negative to positive as indicated.

This will suffice to explain the operation. It will be observed that the tubes are started and are also stopped by the received signal impulses, whereas when the thyatron tubes are employed, as in my prior applications, it is necessary to provide a special rotary transmitter to stop the operation of the tubes. My present invention, therefore, greatly simplifies the apparatus required and consequently enhances the efficiency and permits of greater speed.

I have shown in Fig. 2 a correcting arrangement which may be employed in conjunction with the system shown in Fig. 1. The amplifier output may be an additional or parallel stage of the one shown in Fig. 1, or it may be the same one, the corrector circuit being paralleled with the signaling circuit. In this arrangement I also employ the voltage drop across a resistance R_2 . If the distributor is in synchronism with the received signals, reversals from negative to positive should occur when the brush B_3 is on a B segment. In that case the tube T_4 will operate. The load resistance is of such value that the current drawn through it produces a drop across resistance R_2 which is sufficient to prevent tube T_3 from starting even though the amplifier output voltage is a maximum when the next A segment is reached by the brush B_3 . Under these conditions no correction will be made, and when the amplifier output is again negative, the tube T_4 will stop, thus restoring the condition necessary to allow a correction when it is needed.

If the distributor brushes need a correction when the amplifier changes to positive, the brush B_3 will be in contact with an A segment. This causes positive potential to be applied to the grid of tube T_3 , starting the tube and thus operating the magnet M of the brush corrector. The drop in resistance R_2 is not sufficient to prevent the starting of tube T_4 when the brush engages a B segment. Both tubes will continue to operate and the corrector magnet will remain energized until the amplifier output shifts to negative potential thus stopping both tubes and restoring the condition necessary for another possible correction when the amplifier again becomes positive.

Since the correction can only take place when the amplifier output is positive, no corrections can take place when no signal is being received and hence the corrector cannot respond to single or "dot" impulses.

For the purpose of illustrating another application of my invention I have shown in Fig. 3, a circuit arrangement for driving a phonic motor under the control of the gaseous grid controlled tubes described herein. It will be evident that the tubes T_4 and T_5 will be alternately started and stopped by the alternating potentials impressed upon their grids from the oscillator through the transformer Tr . The diametrically opposite pairs of poles of the phonic motor PM will be energized alternately from D. C. source through the differential meter. A circuit arrangement embodying control tubes of the type described greatly simplifies the operation of synchronous motors of this and similar types which require considerable current and hence do not operate well under the control of electromagnetic relays.

It will be obvious to engineers that my invention is equally applicable to wireless systems and that various arrangements of circuits and apparatus can be made within the scope of my claims, those disclosed in the accompanying drawings being merely illustrative for the purpose of making a clear and complete disclosure of the invention.

I claim:—

1. In a signaling system, apparatus for receiving from a line or cable impulses of short duration recurring in rapid succession, electromagnetic translating devices, thermionic gas-filled tubes having an input circuit including a grid element connected to receive said impulses and an output circuit including anode and cathode elements connected to said translating devices, said grid

being of a fine mesh construction and completely enveloping said cathode whereby the output circuit is substantially unaffected by variations of positive grid potential after being started thereby but is immediately stopped by a critical negative grid potential.

2. In a signaling system in which periodic signal impulses of short duration are transmitted, a signal responsive means comprising a thermionic gaseous tube wherein the grid, anode and cathode elements are so constructed and arranged that when started by a critical positive grid potential the current flows between the anode and the cathode substantially unaffected by variations in positive grid potential but is stopped by a critical negative grid potential, a source of current connected to the anode and cathode and means for subjecting the grid to signal impulses in synchronism therewith.

3. In a signaling system as set forth in claim 2, an electromagnetic relay in circuit with said anode and cathode, a source of potentials, a transmission circuit, and means operating in synchronism with the signal impulses for connecting said transmission circuit to said source of potentials under the control of said relay.

4. In an electrical system in which periodic currents of short duration are transmitted, apparatus for increasing the effective length of the received impulses, comprising a thermionic gaseous tube characterized by anode, cathode and grid elements so constructed and arranged that current continues to flow in the anode-cathode circuit irrespective of variations in the positive grid potential after being started by a predetermined potential applied to the grid but said current being stopped by a critical negative grid potential, a source of current, an electro-magnetic translating device, said tube having an input circuit including the grid element connected to receive said impulses of short duration and an output circuit including the anode and cathode elements and said source of current connected to said translating devices.

5. In a communication system wherein single unit impulses are either missing or are too weak to affect receiving instruments, apparatus for repeating the received intelligence signals and supplying the missing impulses, comprising a pair of thermionic gaseous tubes characterized by anode, cathode and grid elements so constructed and arranged that current continues to flow in the anode-cathode circuit irrespective of variations in the positive grid potential after being started by a predetermined potential applied to the grid but said current being stopped by a critical negative grid potential, means for alternately connecting the grids to the signal receiving apparatus in synchronism with the signal impulses, a source of current connected to the anode-cathode circuits in parallel relation, and electro-magnetic relays connected in said respective anode-cathode circuits.

6. In a communication system, apparatus for repeating and regenerating the received intelligence signals, comprising a pair of thermionic

gaseous tubes characterized by anode, cathode and grid elements so constructed and arranged that current continues to flow in the anode-cathode circuit irrespective of variations in positive grid potential after being started by a predetermined potential applied to the grid but said current being stopped by a critical negative grid potential, means for impressing the receiving signal impulses upon the grids alternately, a source of current connected to the anodes and cathodes in parallel relation, transmitting relays in circuit with the anode-cathode circuits respectively, a source of current and a distributor operating to complete the connection of said source to a transmitting circuit synchronously with the received intelligence signals for predetermined intervals under the control of said relays.

7. In a system of communication in which signal impulses are transmitted and received, apparatus for increasing the effective length of the received impulses, comprising a vapor electric arc device in circuit therewith, arc-sustaining electrodes, means for continuously ionizing gas within the device, an electrostatic member within the device completely enclosing one electrode for timing the starting of successive arcs therein by said signal impulses, and electrical connections for charging said member with a critical negative potential to stop the successive arcs at predetermined intervals, and means for utilizing the energy of the successive arcs.

8. In a system of communication in which signal impulses are received, apparatus for increasing the effective length of the received impulses, comprising a vapor electric arc device having arc-sustaining electrodes, means for continuously ionizing gas within the device, and an electrostatic member completely enclosing one electrode and operating as a timing element to start and to stop the successive arcs therein determined by the signal impulses, said arc being started by the application of a predetermined positive charge upon said member, the arc continuing unaffected by variations in positive potential of said impulse but instantly ceasing upon the application of a critical negative potential to said member.

9. In a system of communication in which signal impulses are received, apparatus for increasing the effective length of the received impulses, comprising a pair of vapor electric devices, each provided with arc-sustaining electrodes, means for continuously ionizing gas within the device and an electrostatic member completely enclosing one electrode and operating as a timing element to start and stop the successive arcs therein, means for subjecting said members alternately to the received signal impulses to thereby start an arc upon the application of a positive potential, the arc continuing unaffected by variations in positive potential of the signal impulses, and means controlled by the signal impulses for instantly stopping the arc when the impulse is at zero or negative potential.

HAKON H. HAGLUND. 140