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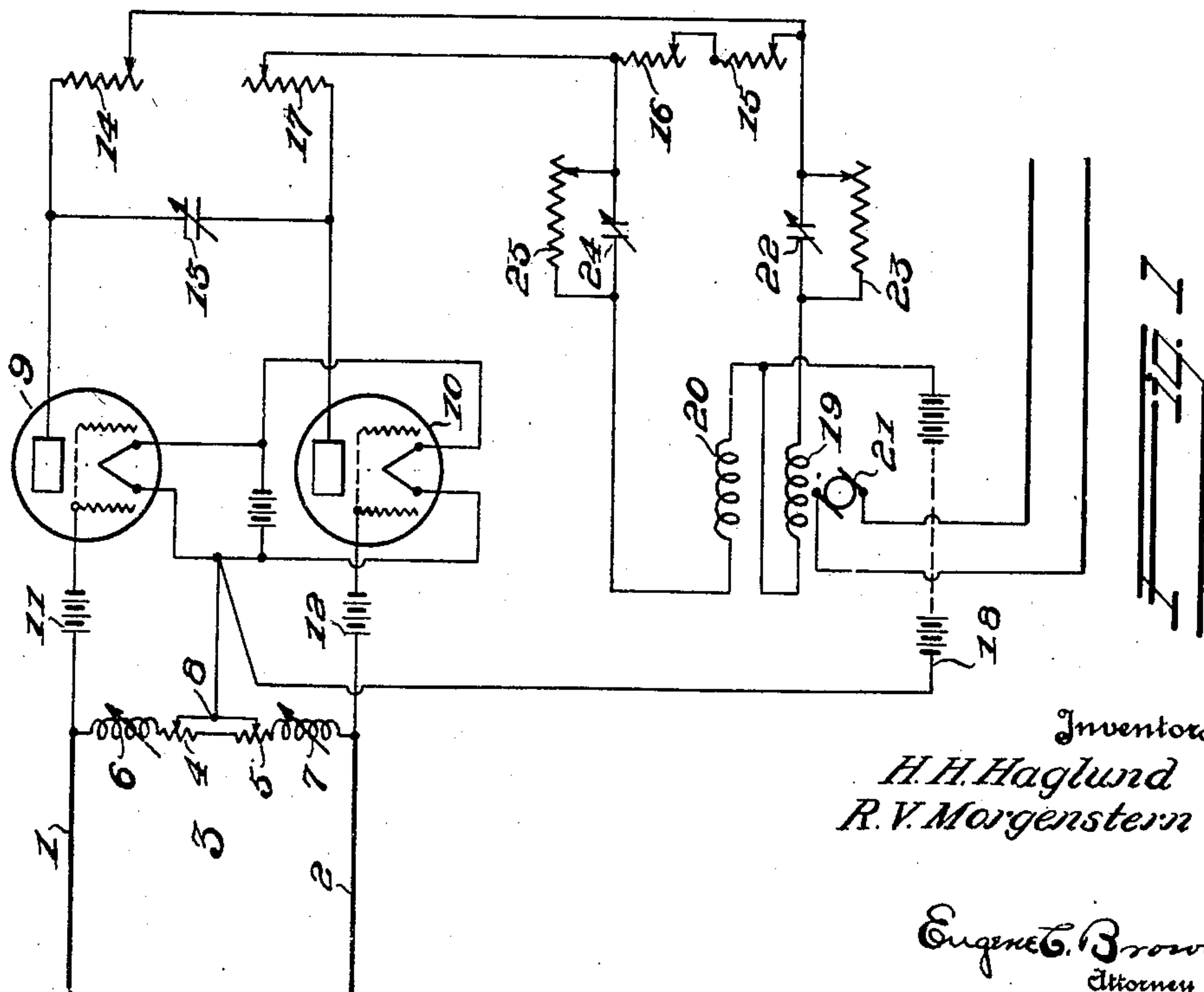
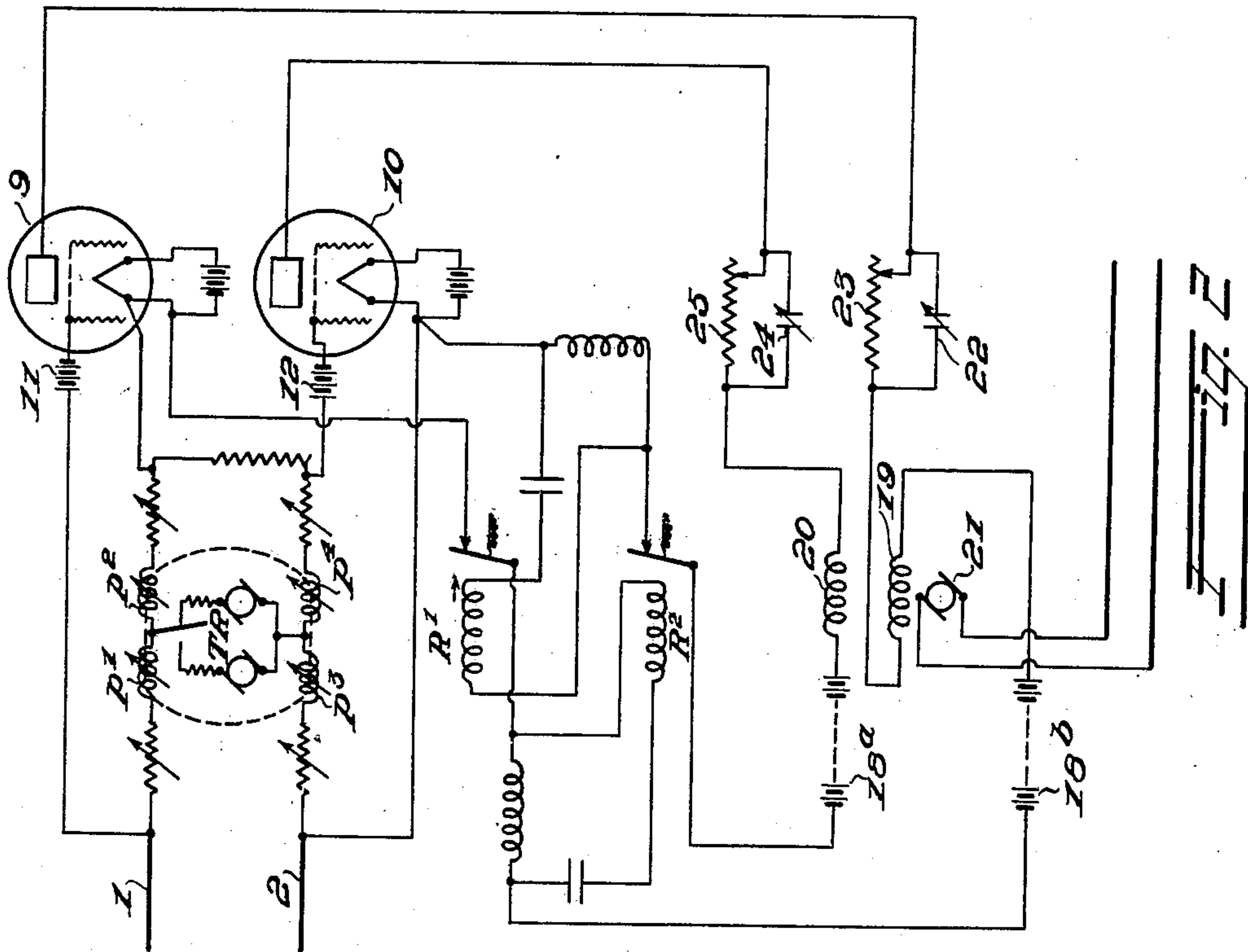
H. H. HAGLUND ET AL

1,946,907

SYSTEM FOR REPEATING OR RELAYING TELEGRAPH SIGNALS

Filed Feb. 28, 1931

2 Sheets-Sheet 1



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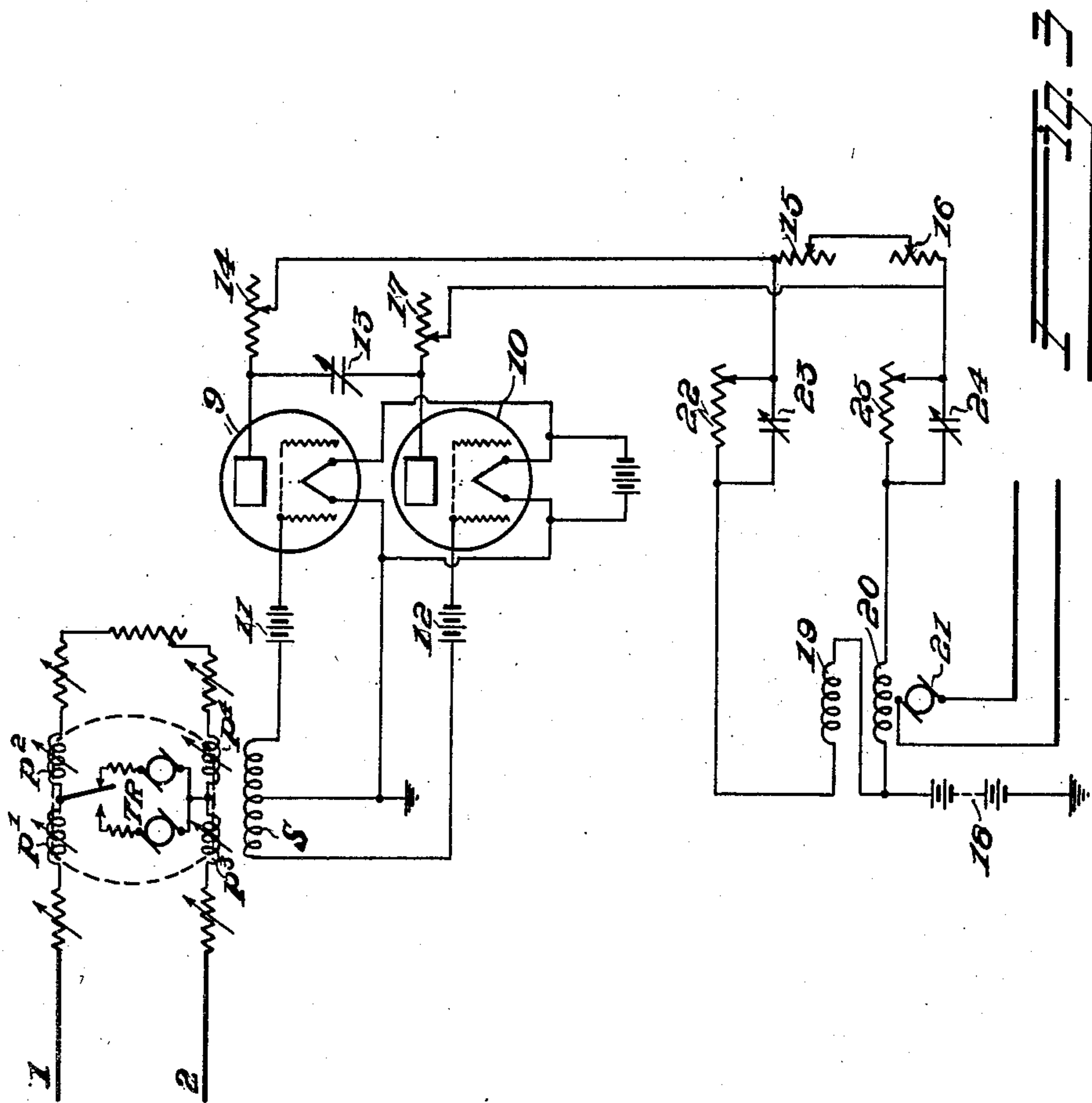
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UNITED STATES PATENT OFFICE

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SYSTEM FOR REPEATING OR RELAYING
TELEGRAPH SIGNALS

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Application February 28, 1931. Serial No. 519,206

5 Claims. (Cl. 178—70)

This invention relates to telegraph systems, and in particular to a repeater or relay system for repeating or relaying telegraph signals.

Our invention relates to a telegraph repeater of the type employing a dynamo-electric generator for repeating incoming signals, and an object of our invention is to devise circuits for controlling the energization of the field windings of said generator in accordance with the signals to be repeated.

More specifically, an object of our invention is to devise a system for controlling the energization of the actuating windings of an electromagnetic repeater, which may be of the dynamo-electric type, in which the circuit arrangements embody relays of the gaseous grid-controlled rectifier tube type. Such rectifier tubes are characterized by starting into operation upon the application of a certain critical potential applied to the grid, after which the current in the output plate filament circuit continues to flow substantially unaffected by variations in the grid potential. One form of such rectifiers has been referred to in various publications as a "grid glow tube". By reason of what may be termed the "trigger" action of the grid above referred to it was suggested in an article entitled "Gas-filled thermionic tubes" by A. W. Hull, published in the journal of the American Institute of electrical Engineers, November 1928, that tubes having this characteristic may appropriately be designated by the Greek derivative term "thyatron". In the following description and claims we shall for convenience employ this term without restricting it to any particular construction or structure.

Our invention is illustrated in the accompanying drawings in which:

Figure 1 shows the invention applied to a telegraph set, suitable for simplex working which may be either a one-way repeater or a terminal set.

Figures 2 and 3 show duplex terminal sets which may be made part of superposed telegraph systems.

In Figure 1 the two line wires 1, 2 are terminated in a shunting network 3 composed of adjustable resistances 4, 5 and adjustable inductances 6, 7. The net work or shunt is tapped at its electrical center 8.

Across each half of shunt 3 is connected the input circuit of a thyatron tube. The grid and filament of thyatron tube 9 are connected respectively to the line and center-tap terminals of that half of the shunt comprising resistance 4 and inductance 6. Similarly the grid and fila-

ment of tube 10 of the thyatron type are connected respectively to the line and center-tap terminals of that of the shunt 3 comprising resistance 5 and inductance 7.

The net work across the line wires and input circuit of the thyatron tubes is adjusted in impedance and phase relationship to fit the line circuit with which it is employed. By so adjusting this terminating network, the voltage applied to the input circuits of the thyatron tubes can be made substantially free from that signal distortion which is due to the unequal attenuation of signals of different frequencies by the line.

If necessary, stabilizing batteries 11 and 12 may be included in the respective input circuits of the tubes 9 and 10.

The output circuits of the thyatron tubes 9 and 10 are connected together by adjustable condenser 13 and by the resistances 14, 15, 16, 17 in series which shunt it. The purpose of this linking circuit is to stop the action of one thyatron tube when the other becomes energized, and the values of the condenser and resistances are properly adjusted for this purpose.

The output circuit of thyatron tube 9 extends from filament and battery 18 or other power source through one field winding 19 of a generator 21 and a network comprising condenser 22 shunted by suitable resistance 23, thence to the plate or anode of the thyatron tube by way of resistance 14. The output circuit of thyatron tube 10 extends from filament and power source 18 through a second field winding 20 of the same generator, and another similar network comprising condenser 24 shunted by resistance 25, thence to the anode of thyatron tube 10 by way of resistance 17.

The two field coils 19 and 20 of the generator 21 are connected in opposing relationship to one another so that with equal currents in these coils, there will be no field flux and hence no voltage across the armature of the generator, but when only one winding is energized, the armature will supply current of a certain polarity at its terminals, and of opposite polarity when the other winding alone is energized. The armature is connected either to terminal apparatus or to the next line section, depending upon whether the set illustrated in Figure 1 is to be used as a terminal set or as a repeater.

The operation of the circuit of Figure 1 is as follows:

When there are no signals on the line, so that neither of the thyatron tubes is started, the currents in the output circuits of the thyatron

tubes are very small, and, if the thyatron tubes and their associated circuits are matched, as they should be, the currents are equal. Since the two field coils 19 and 20 are connected in opposing relationship to one another, the resultant flux is zero and no voltage is produced in the armature of generator 21.

As signals are received, one or the other of the thyatron tubes, depending upon the polarity of the signals, breaks down and allows current to flow through the output circuit including the field coil of the generator. Let it be assumed that the incoming signal is of such polarity that the voltage drop across 4, 6 tends to make the grid of thyatron tube 9 more positive at the same time the voltage drop across 5, 7 tends to make the grid of thyatron tube 10 more negative. The thyatron tube 9 then breaks down and permits a current of substantial magnitude to flow in the output circuit including the field coil 19 of the generator. Condenser 13 becomes charged by the drop in voltage across resistance 14. The condenser 22 and its shunting resistance 23 in series with field coil 19 serve to give the desired shape to the outgoing current wave from the armature of the generator. The purpose of thus controlling the shape of the outgoing current wave is to compensate for line distortion.

As the polarity of the signal current received from line 1, 2 is reversed, positive potential is applied to the thyatron tube 10 and starts current flow in the output circuit of this tube. At the same time current flow in the output circuit of tube 9 is stopped by the action of the linking circuit when tube 10 becomes energized. The operation of the linking circuit involves a discharge of condenser 13 through resistances 14, 15, 16 and 17 and a charging of the condenser in the other direction by the drop in potential across resistance 17. This operation results in reducing the plate voltage of tube 9 below the value necessary to sustain its plate current, and the tube ceases to operate.

The flow of current through field coil 20 in the output circuit of thyatron tube 10, with cessation of current flow in field coil 19, causes a reversal in the direction of the field flux of output generator 21; hence, a reversal in the voltage across its armature. As before, the condenser 24 and its shunting resistance 25 in series with the field coil 20 serve to give the outgoing current wave from the armature the desired shape.

It is obvious that the arrangement shown could be employed on grounded as well as metallic circuits. By placing the shaping terminal shunt 3 across the arms of a suitable bridge, the arrangement shown could be employed for duplex working when superposed circuits are not utilized.

The circuit shown in Figure 2 is of the type utilizing a bridge composed of four inductances on a common core connected in series with four resistances. This type of bridge is shown in a copending application of R. V. Morgenstern, Serial No. 430,075 filed February 20, 1930, entitled Vacuum tube repeaters and terminal sets for superposed telegraph systems. Both the resistances and the inductances may be adjustable if desired but all four arms of the bridge must have the same characteristics or be balanced for duplex operation. The input circuit of tube 9 is connected across the arms of the bridge included in line 1, and the input circuit of tube 10 is connected in an opposite sense across the arms of the bridge included in line 2. The bridging

circuit shown in Figure 1 for automatically stopping one tube when the other becomes energized cannot be used in the circuit shown in Figure 2, but automatic interrupters R_1 and R_2 are provided in the respective plate circuits of tubes 9 and 10 for the automatic self-interruption of each plate circuit.

These interrupters function in the following manner: Suppose that a current is flowing in the output circuit of tube 10. If a line signal of the correct polarity to energize tube 9 is now received, current will flow in its output circuit which includes the inductance 28 and the armature or tongue and contact of the automatic interrupter R_1 . Inductance 28 is shunted by a circuit which includes condenser 29 and the coil of the automatic interrupter R_2 , the tongue and contacts of which are placed in the output circuit of tube 10. Current flowing through the inductance 28 in the output circuit of tube 9 will cause a momentary current to flow in the circuit containing the operating coil of interrupter R_2 , which in turn will cause the tongue of R_2 to leave its contact and momentarily interrupt the output circuit of tube 10, causing it to become energized until a line signal of the proper polarity to again energize it is received, which in a similar manner interrupts the output circuit of tube 9 through the medium of interrupter R_1 .

The rest of the operation of Figure 2 will be readily apparent from the foregoing description of the operation of Figure 1, it being understood that the two thyatron tubes are connected in opposite senses to the line so that one tube responds to signals of one polarity and the other tube responds to signals of the opposite polarity. The operation of Figure 2 is otherwise the same as Figure 1, except that the plate circuits of the thyatron tubes are interrupted by the self-operating interrupters R_1 and R_2 .

The arrangement shown in Figure 3 employs the thyatron tube circuits shown in Figure 1 for operation in connection with a duplex terminal set. In this arrangement the lines 1 and 2 are terminated in a balanced bridge arrangement involving four identical primary windings P_1 , P_2 , P_3 and P_4 , over a transformer having a single secondary winding S . It is understood that the primary windings and the secondary winding are wound upon a common core. The thyatron tubes 9 and 10 are connected in opposed relation between the center-tap of secondary winding S and the outer terminals of this winding, in such manner that the tubes are operated by signals of opposite polarities.

The operation of the circuit arrangement shown in Figure 3 will be apparent from the description of the operation of Figure 1.

We claim:

1. In a signaling system, an input circuit, an output circuit, a repeater element comprising a dynamo having an armature connected to the output circuit and a field winding associated with the input circuit, means including an electrostatically controlled gas discharge tube having an input circuit including a grid element connected to receive the signal impulses and an output circuit including anode and cathode elements connected and arranged to energize said field winding in accordance with incoming signals, said grid, anode and cathode elements being so constructed and arranged that the output circuit is unaffected by the grid potential after being started

2. In a signaling system, an input circuit, an output circuit, a repeater element comprising a

dynamo having an armature connected to the output circuit and a pair of field windings associated with the input circuit, means including an electrostatically controlled gas discharge tube having an input circuit including a grid element connected to receive the signal impulses and an output circuit including anode and cathode elements connected and arranged to energize each field winding from said input circuit in accordance with incoming signals, said grid, anode and cathode elements being so constructed and arranged that the output circuit is unaffected by the grid potential after being started said tubes being connected to said input circuit to respond to signals of opposite polarity.

3. In a signaling system, an input circuit, an output circuit, a repeater element comprising a dynamo having an armature connected to the output circuit, and a pair of field windings, means for energizing one of said field windings in accordance with signals of one polarity received over said input circuit, means for energizing said other winding in accordance with signals of opposite polarity received over said input circuit, said means being so arranged that said windings are energized in opposite directions and each said means including respectively a thermionic tube relay, said tube being characterized by a starting condition differing from its operating condition, means for applying a signal condition to start said device and means independent of energy

supplied by said signal condition for maintaining the discharge.

4. In a signaling system, as set forth in claim 3, means responsive to the energization of one discharge device for deenergizing the other electric discharge device.

5. In a duplex telegraph system, an incoming circuit, an outgoing circuit, a terminal network for balancing said incoming circuit, a repeater element comprising a dynamo having an armature connected to the outgoing circuit, and a pair of field windings, means including a relay for energizing one of said field windings in accordance with positive signals received over said input circuit, means including a second relay for energizing said second field winding in opposing relation to said first field windings in accordance with negative signals received over said input circuit, said relays being of the electrostatically controlled gas discharge tube type, responsive to short signal impulses, said tube, after a discharge has been started therethrough by a signal impulse, operating irrespective of signal impulses applied thereto, means responsive to the energization of one relay for deenergizing the other relay, and a signal transmitter connected to said terminal network in conjugate relation to the input circuits of said relays.

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