

June 16, 1931.

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1,810,004

VOICE OPERATED RELAY CIRCUITS

Filed June 6, 1929

2 Sheets-Sheet 1.

FIG. 1

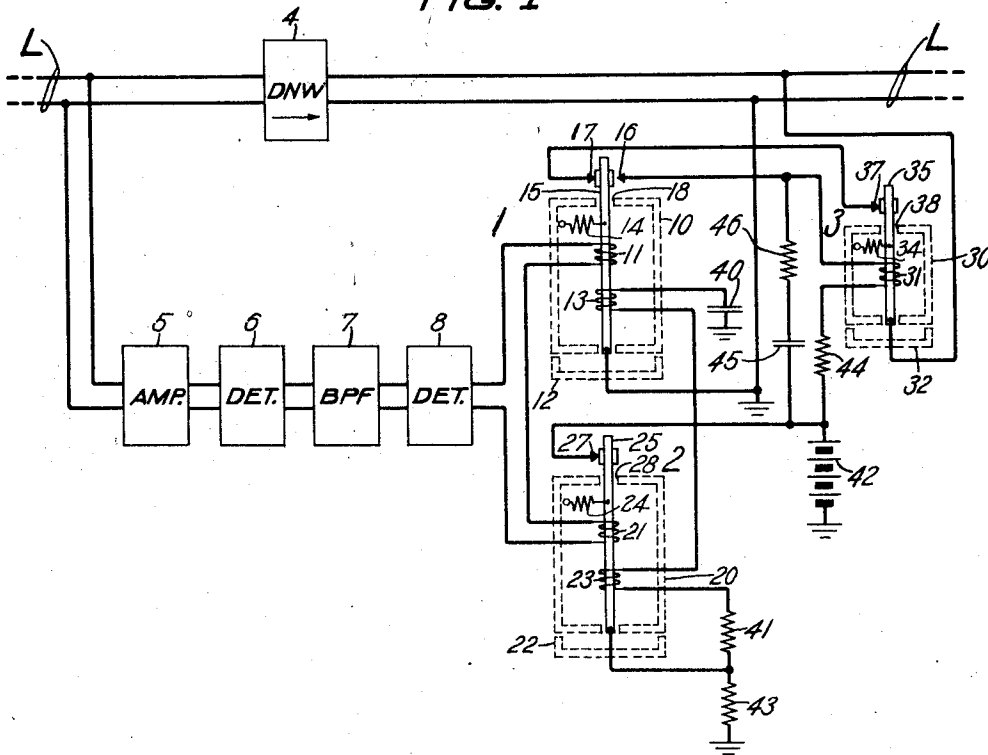
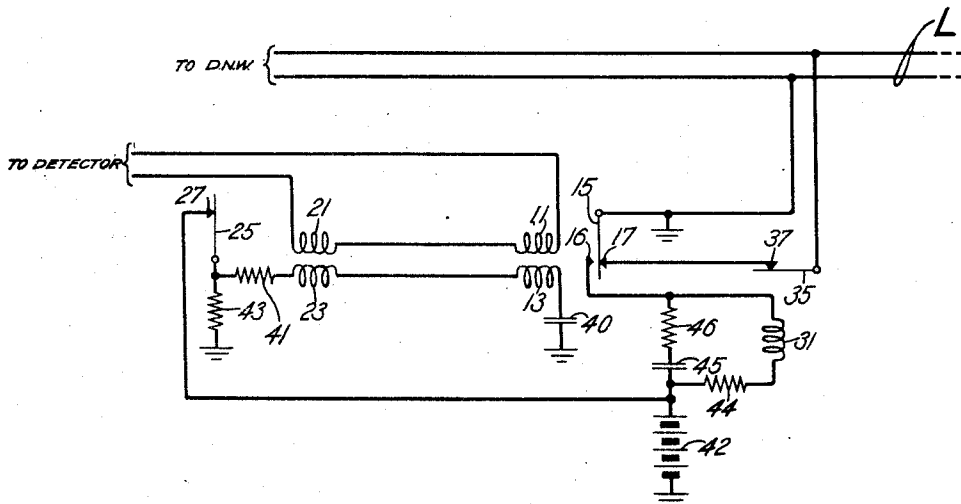


FIG. 1-A



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FIG. 2

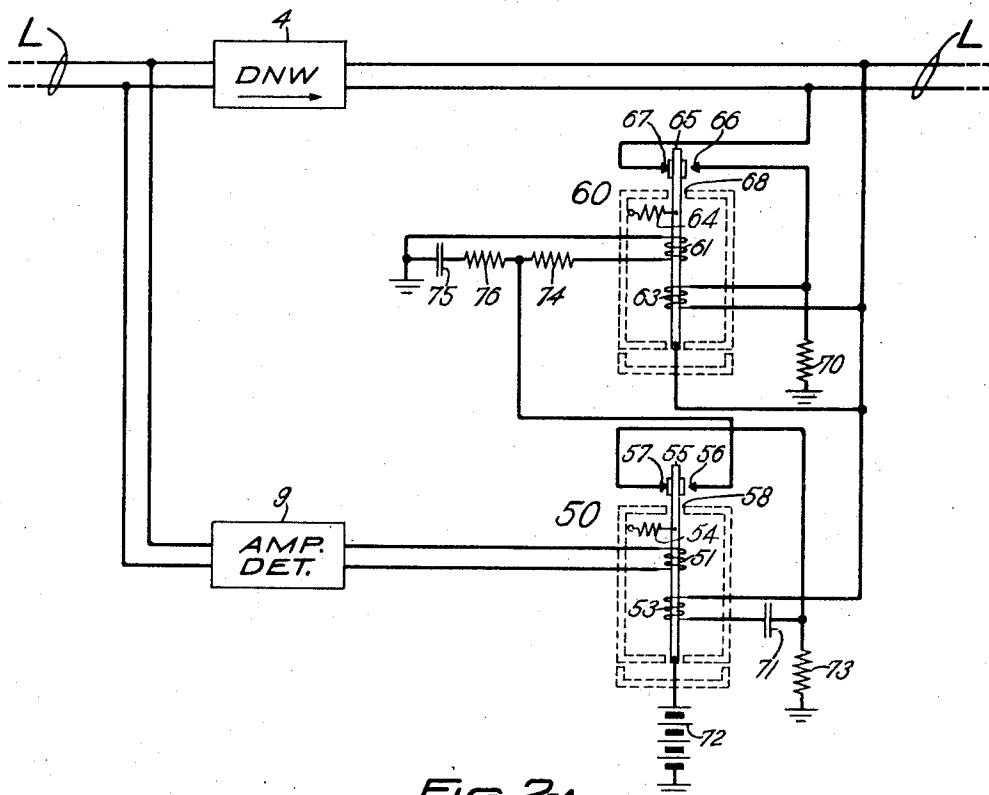
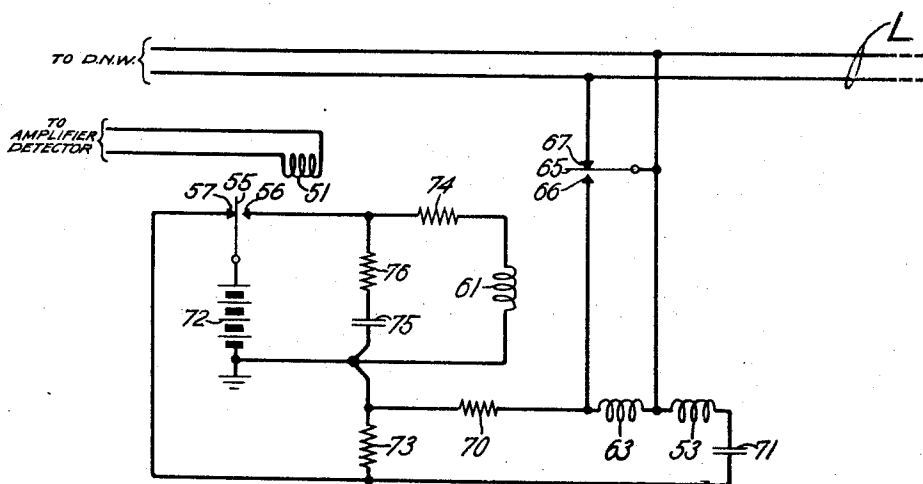


FIG. 2-A



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VOICE OPERATED RELAY CIRCUITS

Application filed June 6, 1929. Serial No. 368,985.

This invention relates to accelerating and delay action devices, and more particularly to relay arrangements suitable for controlling signal operated devices in signaling systems such, for example, as echo suppressors or voice operated repeaters.

The main object of the invention is to provide a circuit arrangement which will operate on intermittent pulses without contact chattering.

Related objects are to provide a new and improved relay system adapted to be selectively responsive to alternating currents approximating a particular frequency; and the use of such an arrangement in connection with local or other circuits to provide for rendering them operative and inoperative.

The invention is applicable to any type of communication system in which accelerating and delay action devices are employed but has especial application to systems in which it is desirable to operate the relay device on intermittent pulses and the detailed description will refer specifically to such a system.

One of the features of this invention consists in the method employed to secure a so-called "hangover" time in the case of echo suppressors or the switching time in the case of voice operated repeaters when voice currents cease without affecting adversely the time of operation of this relay when voice currents begin.

In the prior art where a relay circuit has been operated from the output of a detector or rectifier, it has been customary to employ a condenser or filter arrangement to smooth out the impulses. This will retard the time of operation of the circuit especially when the impulse frequency is low and a large capacity is required to obtain a smooth current wave. Another feature of this invention consists in the method employed to obtain a very fast operation of the circuit on impulses of low frequency without contact chattering.

This is accomplished in the preferred embodiment of the invention herein shown and described by providing a circuit employing three relays, wherein the first impulse will

break the normally closed contacts of the main relay and the auxiliary relay. When the normally closed contact of the auxiliary relay is broken a condenser discharges causing the main and auxiliary relays to fully operate. Full operation of the main relay causes the hangover relay to operate. At the cessation of the impulse from the rectifier the auxiliary relay releases again charging the condenser. The main and auxiliary relays are held in the non-operated position until another impulse from the rectifier repeats the cycle of operation just described. The hangover relay remains operated for a definite time interval after each impulse.

In the other embodiment of the invention herein shown and described only two relays are employed. The first impulse from the rectifier causes the normally closed contact of the main relay to open. When this contact is opened a condenser discharges through another winding on the main relay and also through a winding on the second or operating relay. This causes the main relay to completely operate thereby closing the normally open contact on the main relay and breaking the normally closed contact on the operating relay. When the normally open contact on the main relay is closed current flows from a source of potential through another winding from the operating relay which fully operates the operating relay and charges a second condenser. When the impulse from the rectifier has been reduced sufficiently, the second condenser discharges through a winding on the operating relay holding it operated for a definite period of time. When the armature of the main relay returns to its normal position, the first mentioned condenser charges and tends to hold the armature of the main relay firmly on the normally closed contact for a short time and also tends to make the armature of the operating relay return to its normal position. The charging period of the first mentioned condenser must be made short compared to the hangover time of the operating relay. Also, the charging current of the first mentioned condenser must at no time exceed the discharge current of the other condenser

since the operating relay is to be held operated by the discharge current from the last mentioned condenser.

The invention will be better understood by referring to the following detailed description and accompanying drawings wherein Figs. 1 and 2 are circuit diagrams of diverse embodiments of the invention, and Figs. 1—A and 2—A illustrate the same embodiments shown in Figs. 1 and 2 respectively, showing the relays in schematic form to facilitate following the description of the invention.

Referring to Figs. 1 and 1—A, L represents a normally disabled transmission path such as a one-way path of a repeater, or the one-way line of a 4-wire circuit. In the operation of such circuits, it is desirable, in order to prevent singing that apparatus shall be operated to put the path in condition for transmission only during the time when voice currents are being transmitted in the direction indicated. In the case of echo suppressors control relays would be bridged across the opposite half of the 4-wire circuit and would short-circuit it whenever speech passed on the first side for a period long enough to avoid echoes, as shown for example, in U. S. Patent No. 1,536,907 to J. Mills, May 5, 1925.

Relays 1, 2 and 3 and the equipment associated therewith are utilized to put the transmission path L in condition for transmission and to disable said path when desired. The voice operated equipment which is bridged across the path L ahead of the delay network 4 and which comprises the amplifier 5, detector 6, band-pass filter 7, and detector 8 has been shown for purposes of illustration only, as the present invention is not dependent on the use of any particular type of detector circuit. Detector circuits with which the present invention may be advantageously employed are disclosed in U. S. Patent No. 1,749,841 granted to H. Nyquist March 11, 1930.

Relays 1, 2 and 3 are preferably polar relays. Relay 1 comprises a yoke 10, a permanent magnet 12 associated with the yoke, windings 11, and 13, an armature 15, and contacts 16 and 17, between which the armature is arranged to swing. The armature 15 is biased, by a retractile spring 14, or other suitable means, away from the yoke leg 18, which biasing normally maintains armature 15 in connection with contact 17.

Relay 2 comprises a yoke 20, a permanent magnet 22 associated with the yoke, windings 21 and 23, an armature 25 and a contact 27. The armature 25 is biased, by a retractile spring 24 or other suitable means, away from the yoke leg 28, which biasing normally maintains the armature 25 in connection with contact 27.

Relay 3 comprises a yoke 30, a permanent magnet 32 associated with the yoke, a winding 31 and an armature 35 and a contact 37.

The armature 35 is biased, by a retractile spring 34 or other suitable means, away from the yoke leg 38, which biasing normally maintains the armature 35 in connection with contact 37.

Winding 11 on relay 1 and winding 21 on relay 2 are connected in series to the output of the detector circuit 8. Winding 13 on relay 1 and winding 23 on relay 2 are connected in series from ground through a condenser 40 on one side and through a resistance 41 to armature 25 on relay 2 on the other side. Contact 27 on relay 2 is connected to one side of a battery 42, the other side of which battery is connected to ground. The resistance 41 is connected to one side of a resistance 43, the other side of which resistance 43 is connected to ground. The armature 15 on relay 1 is connected to one side of the line L and to ground, and the armature 35 on relay 3 is connected to the other side of line L. Contacts 17 on relay 1 and 37 on relay 3 are connected together. The winding 31 on relay 3 is shunted by a resistance 44, condenser 45 and resistance 46 connected in series. Contact 16 on relay 1 is connected to the junction of resistance 46 and winding 31 on relay 3. The junction of condenser 45 and resistance 44 is connected to the junction of the battery 42 and contact 27.

The operation of the system is as follows.

With the relays 1, 2 and 3 unenergized in the positions shown, the line L is short-circuited by the connection from one side of line L through armature 15 and contact 17 on relay 1 and contact 37 and armature 35 on relay 3 to the other side of line L. When the first impulse of the detected currents, derived from the speech frequency currents transmitted over line L, are transmitted from the output of detector 8 through winding 11 on relay 1 and winding 21 on relay 2, the armatures 15 and 25 on relays 1 and 2 respectively are moved from their normal positions shown, armature 15 breaking its connection with contact 17, thereby removing the short circuit from across the line L, and armature 25 breaking its connection with contact 27.

As soon as armature 25 breaks its connection with contact 27, condenser 40 discharges through the circuit from ground, condenser 40, winding 13 on relay 1, winding 23 on relay 2, resistances 41 and 43 to ground, thereby aiding the armatures 15 and 25 in moving toward the yoke legs 18 and 28 respectively.

Complete operation of relay 1 causes its armature 15 to make connection with contact 16, thereby completing a circuit from ground through armature 15, contact 16, winding 31 of relay 3, resistance 44 and battery 42 to ground, which causes relay 3 to operate and break the connection between armature 35 and contact 37.

As soon as the impulse from detector 8 approaches zero amplitude and the condenser

40 has discharged, relays 1 and 2 will release. When the armature 25 on relay 2 connects with contact 27, a circuit is completed from ground through battery 42, contact 27, armature 25, resistance 41, winding 23 on relay 2, winding 13 on relay 1, and condenser 40 to ground, thereby causing condenser 40 to charge. This charging current holds the armatures 15 and 25 on relays 1 and 2 respectively against their corresponding contacts 17 and 27 without contact chattering taking place between the armatures and the contacts. After condenser 40 has fully charged, the biasing means 14 and 24 hold armatures 15 and 25 respectively in their normal positions shown until the next impulse is received from the detector 8. The charging time of condenser 40 can be made shorter than its discharging time, since it charges through resistance 41 and discharges through resistances 41 and 43 in series. In this manner the relays 1 and 3 are quickly restored to their normal positions and ready to operate on a subsequent impulse from the detector 8.

Relay 3 is arranged to hold in its operated position thereby maintaining the line L in an operative condition, during the operation and releasing of relays 1 and 2, when the time interval between the impulses received from the output of detector 8 is of short duration.

Each time that relay 1 operates, the relay 3 receives a new impulse through the circuit from ground through armature 15 and contact 16 on relay 1, winding 31 on relay 3, resistance 44 and battery 42 to ground. Also, each time relay 1 operates, the circuit from ground through armature 15 and contact 16 on relay 1, resistance 46, condenser 45, battery 42 to ground, causes the condenser 45 to charge up. When relay 1 releases and the circuit is opened at contact 16, the condenser 45 will discharge through resistance 46, winding 31 of relay 3, and resistance 44 thereby holding relay 3 in its operated position, while relays 2 and 3 are periodically operating and releasing as described above.

Relay 3 does not release when the condenser 45 is being charged for at the same time the circuit from ground through battery 42, resistance 44, winding 31, contact 16 and armature 15 on relay 1 to ground, maintains relay 3 in an operated position.

In this manner the line L is put in operative condition as soon as the first impulse is transmitted from the output of detector 8 and is maintained in an operated position as long as impulses are transmitted from the output of detector 8 in sufficiently short recurring intervals.

Referring to Figs. 2 and 2-A, relays 50 and 60 and the equipment associated therewith are utilized to control the transmission path L. The amplifier detector 9 is preferably a double detector circuit such as shown

in Fig. 1 which includes the amplifier 5, detector 6, band pass filter 7 and detector 8.

Relays 50 and 60 are preferably polar relays similar to relays 1, 2 and 3 shown in Fig. 1. Relay 50 has windings 51 and 53, and armature 55, and contacts 56 and 57, between which contacts the armature 55 is arranged to swing. The armature 55 is normally biased, by a retractile spring 54 or other suitable means, away from the yoke leg 58 so that the armature 55 is normally in connection with contact 57 and normally disconnected from contact 56.

Relay 60 has two windings, 61 and 63, an armature 65 and contacts 66 and 67, between which contacts the armature 65 is arranged to swing. The armature 65 is normally biased, by a retractile spring 64 or other suitable means, away from the yoke leg 68 so that the armature 65 is normally in connection with contact 67 and normally disconnected from contact 66.

Winding 51 on relay 50 is connected to the output of the amplifier detector 9. Winding 53 on relay 50 and winding 63 on relay 60 are connected in series from ground through a resistance 70 on one side, and through a condenser 71, contact 57, armature 55, and a battery 72 to ground on the other side. A resistance 73 is connected from contact 57 to ground. The normally open contact 66 on relay 60 is arranged to short-circuit the winding 63 on relay 60 when this contact 66 is in connection with the armature 65 by the operation of relay 60.

Winding 61 on relay 60 is connected from contact 56 on relay 50 through a resistance 74 on one side, and to ground on the other side. A condenser 75 and a resistance 76 are connected in series, from ground to contact 56 on relay 50, so that the series connection of the condenser 75 and resistance 76 is in shunt connection with the winding 61.

The operation of this system is as follows. With the relays 50 and 60 unenergized and their armatures in the position shown, the line L is short-circuited by the normally closed connection through contact 67 and armature 65 on relay 60. The first impulse of the detected current from the output of amplifier detector 9 is transmitted through winding 51 on relay 50, causing the armature 55 to move toward the yoke leg 58, thereby breaking the connection between contact 57 and armature 55. When this connection between contact 57 and armature 55 is broken the condenser 71 discharges through the circuit from ground through resistance 73, condenser 71, winding 53 on relay 50, winding 63 on relay 60 and resistance 70 to ground, thereby assisting the armature 55 on relay 50 to move toward the yoke leg 58 and to make connection with contact 56, and also causing the armature 65 on relay 60 to move toward the yoke leg 68.

When the armature 65 on relay 60 moves toward the yoke leg 68, switch 67 opens, thereby putting line L in an operative condition, and switch 66 closes, thereby effectively short-circuiting the winding 63 on relay 60.

When the armature 55 on relay 50 makes connection with contact 56, a circuit is completed from ground through battery 72, armature 55, contact 56, resistance 74, and winding 61 on relay 60 to ground, thereby holding the relay 60 in its operated position, and another circuit is completed from ground through battery 72, armature 55, contact 56, resistance 76 and condenser 75 to ground, thereby charging condenser 75.

When the current from the output of amplifier detector 9 through winding 51 on relay 50 approaches zero amplitude and the condenser 71 has discharge, the biasing means on relay 50 moves the armature 55 away from the yoke leg 58, thereby breaking the connection between the armature 55 and contact 56. This causes condenser 75 to discharge through the circuit including the winding 61 on relay 60, and the resistances 74 and 76. This condenser discharge current holds the armature 65 on relay 60 in its operated position.

When the armature 55 on relay 50 connects with contact 57, condenser 71 charges through the circuit from ground through battery 72, armature 55, contact 57, condenser 71, winding 53 on relay 50, armature 65, contact 63 and resistance 70 to ground, thereby holding the armature 55 firmly in contact with contact 57 and preventing contact chattering.

When the next impulse is transmitted through winding 51 from the output of amplifier detector 9 relay 50 is again operated in the same manner which holds relay 60 in its operated position and again charges condenser 75 as described above.

In this manner the line L is maintained operative as long as impulses are transmitted from the amplifier detector 9 in sufficiently short recurring intervals.

The invention is also capable of other modifications and adaptations not specifically referred to, but included within the scope of the appended claims.

What is claimed is:

1. A vibrating system including a main polar relay and an auxiliary polar relay, each of said polar relays having an armature, a pair of contacts between which said armature is adapted to swing, and an operating winding and an accelerating winding associated with said armature, said accelerating winding on said main relay connected in series with said accelerating winding on said auxiliary relay across the armature and normally closed contact of said auxiliary relay to supplement the action of the operating windings on the respective relays when the normally closed contact on said auxiliary relay is opened, a third polar relay having a winding which is

energized by a circuit including said last mentioned winding, a high resistance, the normally open contact and the armature of said main relay connected in series across a source of potential when the normally open contact on said main relay is closed, and a slow electrical circuit connected to said third relay to retard the release of said relay.

2. In an electrical communication system, a signal operated device comprising a plurality of relays, windings on certain of said relays connected to said communication system and initially energized by the first signal current impulse transmitted over said system, another winding on each of said certain relays, said last mentioned windings connected in series with the other, a condenser connected in series with said last mentioned windings, means for charging said condenser when said certain relays are unoperated, and means for discharging said condenser through said last mentioned windings when one of said certain relays is operated, thereby fully operating said certain relays, another relay, means for operating said other relay after one of said certain relays has fully operated, means for releasing said certain relays at the cessation of said signal impulse, and a slow electrical circuit connected to said other relay to prevent the release of said other relay as long as impulses are transmitted over said system at a predetermined rate.

3. In an electrical communication system, a voice operated device comprising a main relay and an auxiliary relay, both of said relays arranged to be initially energized by voice currents transmitted over said system, a condenser connected in series with windings on said relays, a source of potential arranged to be connected in series with said condenser through a normally closed contact on said auxiliary relay, a discharging circuit for said condenser including a high resistance, a third relay, a winding on said third relay, said winding connected in series with a source of potential and a high resistance, means for energizing said winding on said third relay, said means including a contact which is closed when said main relay is operated, and a condenser and a high resistance connected in shunt to the winding on said third relay and said second mentioned high resistance.

4. In an electrical communication system, a vibrating relay arrangement including polar relays, each of said polar relays having an armature, and a pair of contacts between which said armature is adapted to swing, said armatures normally resting on one of said contacts, operating windings associated with said armatures of certain of said relays, accelerating windings on said certain relays bridged across the armature and normally closed contacts of one of said certain relays to supplement the action of the operating

windings on said certain relays when the normally closed contact on one of said certain relays is opened, another polar relay, means for operating said other polar relay after one of said certain relays has operated, said means including the normally open contact on one of said certain relays, and a slow electrical circuit connected to said other relay to retard the release of said other relay.

5. In an electrical communication system, a signal operated device, comprising a plurality of relays, windings on certain of said relays connected to said communication system and initially energized by the first signal current impulse transmitted over said system, means for accelerating the operation of said certain relays, said means including a condenser associated with other windings on said certain relays, and means for causing said condenser to discharge through said last mentioned windings, another relay having a winding, means for energizing said winding on said other relay when one of said certain relays is fully operated, means for releasing said certain relays at the cessation of said signal impulse, and a slow electrical circuit comprising capacitance and impedance associated with the winding on said last mentioned relay to hold said last mentioned relay operated as long as impulses are transmitted over said system at a predetermined rate.

6. In a relay circuit, a relay adapted to be operated to and held in its operated position by a succession of current impulses, a winding on said relay, a condenser in circuit with said winding, means responsive to the individual impulses of a succession of impulses for charging said condenser in response to the beginning of an impulse and for sending current through said winding in a direction to operate said relay, said means allowing said condenser to discharge through said winding on the cessation of an impulse in a direction to hold the relay operated, said means comprising a relay having a plurality of windings thereon, one of said last mentioned windings being connected to the source of current impulses for operating said last mentioned relay at the beginning of an impulse, and another of said windings being connected in series with a second condenser and a second winding on said first mentioned relay for assisting the operation of both of said relays.

7. In a transmission system, a transmission line, a relay adapted to be operated to and held in its operated position by a succession of current impulses, a winding on said relay, a condenser in circuit with said winding, means including an auxiliary relay having an armature kicked back and forth in response to the individual impulses of a succession of impulses for charging said condenser in response to the beginning of an impulse and for sending current through said winding in a

direction to operate said relay, said means allowing said condenser to discharge through said winding on the cessation of an impulse, in a direction to hold said first mentioned relay operated, a contact on said auxiliary relay normally in connection with said armature on said auxiliary relay, normally closed contacts on said first mentioned relay, connections from said last mentioned contacts to said transmission line through said armature and said contact normally in connection therewith on said auxiliary relay, for rendering said transmission line inoperative when both of said relays are unoperated and for rendering said transmission line operative when said normally closed contacts on said first mentioned relay are open.

In witness whereof, I hereunto subscribe my name this 3d day of June, 1929.

BJORN G. BJORNSON.