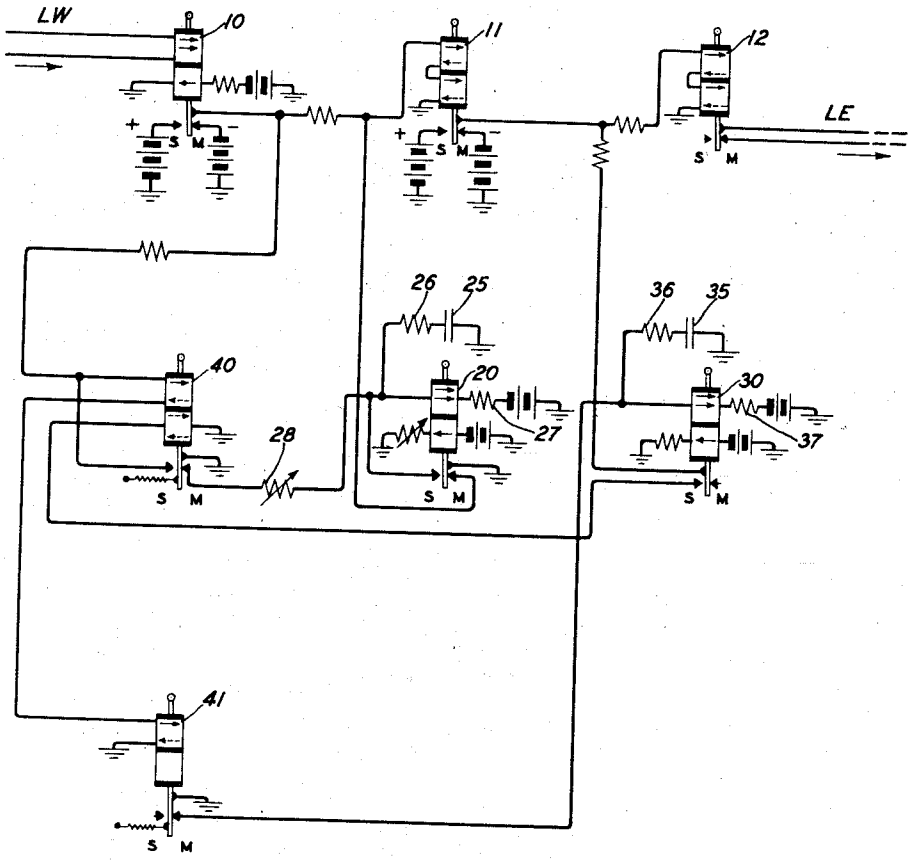
April 18, 1939. F. S. KINKEAD 2,154,623

REGENERATIVE TELEGRAPH REPEATER

Filed July 16, 1937



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Patented Apr. 18, 1939 2,154,623

UNITED STATES PATENT OFFICE

2,154,623

REGENERATIVE TELEGRAPH REPEATER

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Application July 16, 1937, Serial No. 153,878

10 Claims. (Cl. 175—320)

This invention relates to regenerative telegraph repeaters of the start-stop type and more especially to the timing means associated with repeaters of this type. The invention is particularly related to improvements in timing means of the relay type.

In repeaters of this type, vibrating relay circuits are used as timing means in lieu of rotating distributors. One vibrating relay circuit is timed to vibrate once for each impulse of a start-stop signal series, and another relay is timed to vibrate once only for each start-stop series to stop the fast relay circuit at the end of each series. A circuit of this type has been disclosed in United States Patent 1,771,445, issued to Parker-Vernam on July 29, 1930.

It is an object of the invention to provide a vibrating relay circuit capable of producing short distinct impulses, of definite length and accurately spaced apart.

In accordance with the invention, an unsymmetrical vibrating relay circuit is provided which uses a polar relay in combination with a condenser, the armature of the relay being connected to a single polarity of potential for control of the oscillations.

In accordance with a further feature of the invention, the relay is permanently biased in one direction, say, toward spacing, and has an operating winding for operation in the other direction, say, toward marking.

In accordance with a further feature, the operating winding is fully energized, say, in spacing position, and quickly interrupts itself by operating the armature to marking position, whereupon a condenser, in charging, continues the operating current for a time, ultimately permitting the biasing means to again operate the relay to spacing position. These operations will then be repeated at regular intervals. One or the other of the relay contacts is connected to an output circuit for producing accurately timed impulses.

In accordance with another feature of the invention, the repeater circuit includes additional relay means for starting and stopping the timing circuit for each signal series.

The invention will now be described in connection with a specific embodiment comprising a telegraph repeating system such as is illustrated in the accompanying drawing, to which reference will be made in the following description.

A number of arrows have been applied to the various relay windings in the drawing to make understanding of the operations easier. The arrows which are drawn in full lines indicate the direction in which the particular winding tends to operate the relay armature under the particular circuit conditions shown in the drawing, whereas the arrows shown in dotted lines indicate the direction in which the winding will operate the armature under alternate conditions. A double arrow indicates that the winding is more strongly energized than the associated winding marked with a single arrow and thus indicates that the former winding is capable of preventing operation of the relay by the latter winding.

The regenerative repeating system is shown connected between an incoming line circuit LW and an outgoing line circuit LE. Signals incoming over the line west LW operate the receiving relay 10 which operates the retransmitting relay 11 which in turn operates the line relay 12; line relay 12 impresses the repeated signals upon the line east LE.

In this specific embodiment the receiving relay 10 has a permanent biasing winding and has an operating winding responsive to opening and closing of the line west. The line relay 12 transmits signals into the line east by opening and closing the line. The sources of current are assumed to be located at the distant end of both line circuits. In case it should be desired to retransmit the signals into line east as polar signals, relay 12 may be omitted and one line conductor of the line east connected to the armature of retransmitting relay 11.

The timing circuit comprises the elementary timing relay 20 and the character timing relay 30. Relay 20 normally connects ground through its marking contact to short-circuit the operating windings of relay 11, thereby preventing response by relay 11 to operations of relay 10. During signaling, relay 20 oscillates in synchronism with signals incoming over line west. For a short interval during each oscillation relay 20 operates to spacing, thereby removing the short circuit for relay 11 and permitting this relay to respond either to marking or spacing potential at relay 10. After relay 11 has assumed its position its winding is again short-circuited and the short-circuiting current tends to hold the relay in position without chattering. The relay 11 may be of a type which has sufficient remanent magnetism to normally hold the relay firmly against its contacts in either position; however, if desired, one of the operating windings may be disconnected from the operating circuit and connected through a suitable resistance to the armature of the relay for the purpose of self-locking in both positions, as is well known.

For the purpose of controlling the timing circuits a set of starting relays 40 and 41 are provided. In their normal position these relays apply ground to the operating windings of the timing relays 20 and 30, respectively, thereby locking the latter relays in their marking position and preventing them from oscillating. When the receiving relay 10, in response to a start impulse, operates to spacing, relays 40 and 41 operate to spacing, thereby opening the locking circuits for relays 20 and 30. In spacing position, relay 40 short-circuits the operating windings of relays 40 and 41 which remain in spacing position in response to suitable biasing means, such as a light spring attached to the armature.

Relays 20 and 30 then commence their cyclic operations, relay 20 with a frequency such that it will complete a cycle once for each incoming impulse of a signal series representing a character, and relay 30 with a frequency such that it will complete one cycle in a period slightly shorter than the duration of a complete signal series.

The timing relay 20 has fixed biasing means, such as a biasing winding, continuously energized and tending to operate the armature to spacing. The upper operating winding is normally energized over the marking contact of relay 40; the condenser 25 and resistance 26 are short-circuited in this circuit. When relay 40 opens its marking contact, the condenser 25 gradually becomes charged through the operating winding of relay 20 and thus for a time serves to hold this relay to marking. When the charging current has decreased sufficiently, the biasing winding will overcome the operating winding and operate the armature to spacing. At this moment ground at the spacing contact is applied to this circuit, the condenser will be quickly discharged and full operating current will be restored in the operating winding and the relay will quickly operate to marking, again permitting condenser 25 to become charged through the operating winding. Under these conditions the armature of relay 20 will continue to oscillate and will be in its spacing position for only a small fraction of its cycle thus producing highly biased impulses by its contacts. By proper adjustment of resistance 27 this fraction can be varied and by proper adjustment of condenser 25 and resistance 26 the frequency can be adjusted to coincide with the impulse frequency of the signals.

The orienting resistance 28, in causing a certain potential to be applied to condenser 25, serves to normally establish a certain charge on condenser 25 so that the first operation to spacing by relay 20 will take place after a given interval upon opening of the marking contact of relay 40 or in other words, upon the arrival of a start impulse over line west. By proper adjustment of resistance 28 the short spacing periods of relay 20 may thus be oriented with respect to incoming signals in such a manner that relay 11 will be permitted to respond to relay 10 only during that part of each incoming impulse which has least distortion.

Timing relay 30 also has a permanent biasing and its operating winding is normally energized over the marking contact of relay 41; condenser 35 and resistance 36 are normally short-circuited in this circuit. When relay 41 responds to a start impulse, condenser 35 begins to charge through the operating winding of relay 30, thereby holding the relay to marking. Condenser 35 and resistances 36 and 37 may be so adjusted that the operating current will not be sufficiently reduced to permit the biasing winding to operate the armature to spacing until about the time the last character impulse has been completed and the stop impulse commences. At this time relay 30 goes to spacing and completes a circuit from the armature of relay 11 to the lower winding of relay 40. If at this time relay 11 happens to be in spacing position relay 40 will be held in spacing position. However, if relay 11 should be in marking position relay 40 will be operated to marking and will stop the cyclic operations of relay 20. Relay 11 being in marking position, relay 10 must also be in marking position at this time, so that, when relay 40 operates to marking, relay 41 will be operated to marking and will stop the oscillations of relay 30.

Assuming the arrival of a start-stop signal series over the line west, the operations of the system will be as follows:

Line west and line east normally carry current and all the relays will normally be in the positions shown in the drawing. When a start impulse arrives, line west will be currentless and relay 10 operates to spacing, closing a circuit from battery at its spacing contact through the upper windings of relays 40 and 41, thereby operating these relays to spacing; these windings will now be short-circuited at the spacing contact of relay 40 and the armatures will be held to spacing by the biasing springs.

When the marking contact of relay 40 opens, condenser 25 begins to charge through the upper operating winding of relay 20; similarly when the marking contact of relay 41 opens, condenser 35 begins to charge through the upper operating winding of relay 30. Due to the orienting adjustment of resistance 28 condenser 25 already had a certain charge, so that, after a comparatively short time, the charging current will be reduced to a value at which the biasing winding will operate relay 20 to spacing. This will occur shortly before the arrival of the peak or center of the start impulse, at which time relay 10 is firmly positioned in response thereto. When relay 20 goes to spacing the short circuit at its marking contact is removed from the windings of relay 11 which now is given a short interval in which to respond to the position of relay 10 and operate to spacing. Immediately after the passing of the peak of the start impulse, relay 20 will return to its marking position, thereby effectively preventing relay 11 from being disturbed by the next operation of relay 10. Relay 20, as previously explained, receives full operating current in spacing position and, depending upon the value of resistance 27, is quickly returned to marking where it will be held by the charging current from condenser 25.

Relay 11 in its spacing position causes relay 12 to operate to spacing and thus to send a start impulse out over line east by opening of the line.

When the first character impulse arrives over line west relay 10 responds thereto. Due to the short circuit about their windings, relays 40 and 41 remain unaffected by operations of relay 10.

By the time the peak of the first character impulse arrives, relay 20 will again operate to spacing and back to marking for a short instant, permitting relay 11 to respond to the position of relay 10 just at the time when relay 10 can be expected to be firmly in position. Relay 11 operates relay 12 correspondingly and a corresponding character impulse will be impressed upon line east.

For each of the five character impulses of the

signal series the operations will be repeated as just described for the first character impulse.

The last impulse, or stop impulse, of each signal series being a marking impulse, it is evident that in those instances where the last, or fifth, character impulse is also a marking impulse, all the transmission relays 10, 11 and 12 will perform no transition between these two impulses, so that it will be necessary only to time the operations in response to the fifth impulse. This fact is taken advantage of to provide a greater margin for the restoration of relay 30 to marking position near the end of a signaling series, thereby requiring less accuracy in the adjustment of relay 30.

Relay 30 has been held to marking by charging current from condenser 35 until some time after the timing operation of relay 20 in connection with the fifth character impulse; at this moment the charging current is sufficiently reduced to permit the biasing winding to operate relay 30 to spacing. If at this moment relay 11 is in marking position, whether this be due to the fifth character impulse or to the stop impulse, negative battery will be applied over the marking contact of relay 11 and spacing contact of relay 30 through the lower winding of relay 40 to operate relay 40 to its marking position. Relay 40 now stops the oscillations of relay 20 so that relay 11 will be prevented from operating until the next start impulse has been received over line west. The marking potential at relay 10 now operates relay 41 to marking, which in turn causes relay 30 to return to marking, thereby restoring the circuit to normal in readiness for reception of the next start impulse.

However, if at the time relay 30 was ready for operation to spacing transmitting relay 11 had been in spacing position due to the reception of the fifth character impulse as a spacing impulse, spacing potential would have been applied over the contacts of relays 11 and 30 to the lower winding of relay 40, thereby holding relay 40 in spacing position.

When now the stop impulse arrives over line west to operate relay 10 to marking, relay 20 will perform its cyclic operation in the same manner as in timing the preceding impulses of this series, and relay 11 will be allotted a short interval in which to respond to the position of relay 10 and operate to marking, whereupon relay 20 returns to marking position commencing a new cycle. Relay 11 operates relay 12 and the stop impulse is transmitted over line east.

Relay 11 now being in marking position, it will apply marking potential over the spacing contacts of relay 30 to the lower winding of relay 40 which operates and prevents further operations of relay 20. Relay 10 being in marking position, relay 41 will be restored to marking and will in turn operate relay 30 to marking, thereby reconditioning the circuit for the next signal series.

Reference is made to my application for United States Patent, Serial No. 153,879, filed on even date herewith and relating to the same subject-matter as the present application.

What is claimed is:

1. A timing circuit comprising relay means having contact means, an operating winding and continuous biasing means, and capacitance means connected to be slowly charged through said winding and to be quickly discharged over said contact means when the charging current is sufficiently reduced for the operating winding to be overcome by said biasing means for operation of said contact means, and said operating winding being energized over said operated contact means to overcome said biasing means and restore said contact means.

2. An impulse producing relay circuit comprising a polar relay having substantially constant biasing means for operating said relay to one position and having a series operating circuit including inductance and capacitance for operation of said relay to its other position and having contact means including contacts connected to said operating circuit for periodically controlling the charging and discharging current through said capacitance means, said contact means being connected to produce highly biased impulses in an output circuit.

3. A polar relay having continuous biasing means for operating said relay into one position, a self-interrupting series circuit including contact means and an operating winding of said relay and a source of unidirectional current for operating said relay into the other position, capacitance means bridged across said contact means to become discharged in said one position and to become charged in said other position to hold said relay in said other position until the charging current has diminished to a predetermined value to permit operation of said relay by said biasing means.

4. An oscillating system as defined by claim 3 further comprising a bridge circuit across said capacitance means including resistance means and starting contact means adapted to complete in normal position said bridge circuit to maintain a holding current in said operating winding and to maintain a limited charge on said capacitance means and to open in the other position said bridge circuit to permit oscillation of said system, said resistance means being adjustable to vary the period between the operation of said starting contact means from normal position and the first operation of said system.

5. An unsymmetrical timing circuit for producing highly biased impulses in an output circuit which comprises a polar relay having contact means, having substantially constant biasing means for operating said relay into one position and having an operating winding for operating said relay into the other position; a series circuit including capacitance means, a source of unidirectional current and said winding for holding said relay in said other position during the greater part of the charging period of said capacitance means; said contact means being connected to bridge, in said first position, said capacitance means to quickly restore said relay to said other position.

6. A self-interrupted relay circuit for producing highly biased impulses comprising a polar relay having continuous biasing means for operating the relay into one position, having contact means, and having a winding connected through said contacts in said one position to a current source for quick operation into the other position, and capacitance means connected to be charged through said winding to hold the relay in said other position for a predetermined time and connected to said contact means to be discharged in said one position.

7. A timing circuit comprising start relay means, a start circuit, timing relay means and capacitance means; said timing relay means having contact means, substantially constant biasing means and operating winding means for over-

coming said biasing means to open said contact means; said start relay means having contact means connected through said start circuit to said winding means to normally hold said first contact means open and to open said start circuit in response to an incoming start impulse; said capacitance means being connected to be charged through said operating winding means for holding said first contact means open when the charging current is heavy; and said first contact means being connected to close a discharge circuit for said capacitance means and to close a circuit for said operating winding means, for quick reopening of said discharge circuit.

8. An impulse producing relay circuit comprising a capacitance circuit, and a polar relay having a winding for operating said relay in one direction, having contacts connected in circuit with said winding and having biasing means for constantly biasing said relay in the opposite direction to close said contacts for energizing said winding characterized in this that said capacitance circuit is connected to be charged through said winding to temporarily hold said relay in said one position.

9. An impulse producing relay circuit comprising a capacitance circuit, and a polar relay having a winding for operating said relay in one direction, having contacts connected in circuit with said winding and having biasing means for constantly biasing said relay in the opposite direction to close said contacts for energizing said winding characterized in this that said capacitance circuit and said winding are serially included in a permanently closed circuit for charging said capacitance circuit through said winding to temporarily hold said relay in said one position.

10. An impulse producing relay circuit comprising a capacitance circuit, and a polar relay having a winding for operating said relay in one direction, having contacts connected in circuit with said winding and having biasing means for constantly biasing said relay in the opposite direction to close said contacts for energizing said winding characterized in this that said capacitance circuit and said winding are serially included in a permanently closed circuit for charging said capacitance circuit through said winding to temporarily hold said relay in said one position and that said contacts furthermore are connected for discharging said capacitance circuit when closed for energizing said winding.

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