

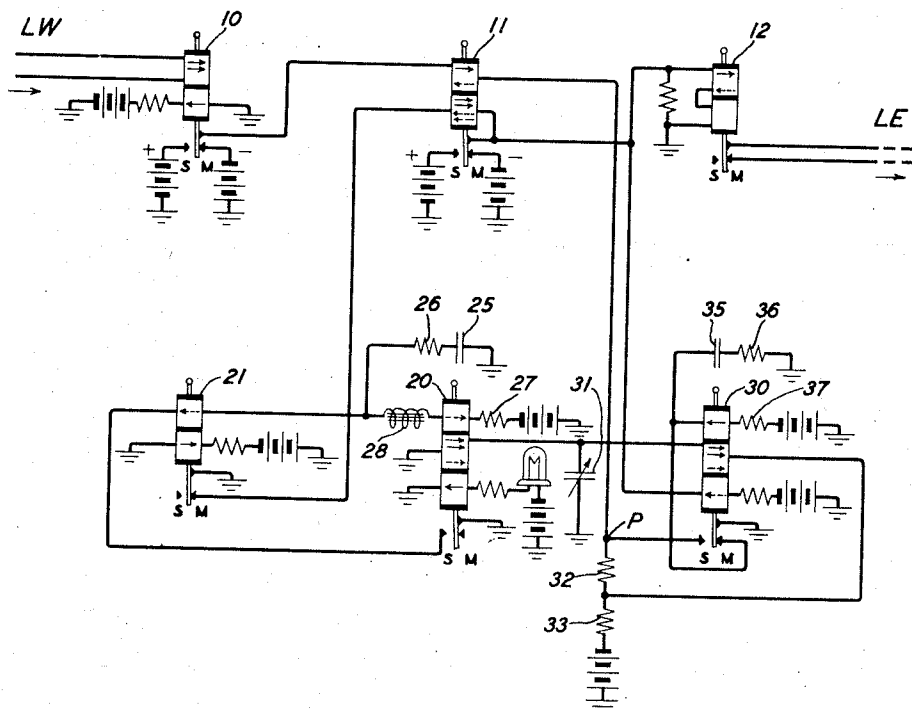
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A. D. DOWD

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REGENERATIVE TELEGRAPH REPEATER

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INVENTOR
A.D. DOWD
BY *J. W. Schmied*
ATTORNEY

UNITED STATES PATENT OFFICE

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REGENERATIVE TELEGRAPH REPEATER

Andrew D. Dowd, Montclair, N. J., assignor to
Bell Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

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5 Claims. (Cl. 178—70)

This invention relates to regenerative telegraph repeaters of the start-stop type, and particularly to vibrating relay circuits for timing the operations of the repeater circuit.

5 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
10 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.

15 It is an object of the invention to provide a fast vibrating relay circuit for control of a repeater circuit, or other similar circuit equipment of the start-stop type which will be highly accurate in its timing operations, and which may
20 readily be adjusted to produce impulses of varying lengths and of varying spacing.

The invention is particularly applicable to the fast vibrating relay circuit in repeaters of this type, which comprises a polar relay having a
25 self-interrupted operating circuit through a winding of the relay, this winding being opposed to constant biasing means for the relay. A capacitance circuit is connected to the operating circuit so that the charging current will temporarily maintain an operating current in said
30 winding of sufficient strength to overcome the biasing means. This relay, thus, has a non-symmetrical operation, being held a comparatively long time on one contact by the operating
35 winding, and being permitted to touch instantaneously only the other contact under the action of the biasing means. Reference is made to patent application Serial No. 153,878 filed July 16, 1937 by F. S. Kinkead, which discloses a vi-
40 brating relay circuit of this general type.

In accordance with a feature of the invention, the accuracy of operation of this circuit is improved by proper inductance means associated with the operating circuit for modifying the
45 wave shape of the charging current so that the time at which the biasing means is able to overcome the operating winding will be more definitely fixed.

In accordance with another feature of the invention, the adjustment of this relay circuit is simplified by the provision of an auxiliary polar relay having contacts for impressing the timing
50 impulses on the signaling circuit. This auxiliary relay is operated by the instantaneous discharge
55 current from the condenser, each time the main

relay is operated by its biasing means. In this manner, very short impulses may be produced, the length of which may be adjusted without affecting the adjustment of the main relay.

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
5 will be made in the following description.

A number of arrows have been applied to the various relay windings in the drawing to make
10 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
15 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.
20 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
25 preventing operation of the relay by the latter winding.

The regenerative repeating system is 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,
30 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
35 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
40 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.
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The timing circuit comprises the code element timing relays 20 and 21 and the character timing relay 30. Relay 21 normally connects ground
50 through its marking contact to the lower locking winding of relay 11, thereby locking this relay in either position to normally prevent it from responding to the operations of relay 10. During signaling, relays 20 and 21 oscillate in synchronism with signals incoming over the line
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west. For a short interval during each oscillation, relay 21 operates to spacing, thereby opening the locking 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 locking winding is again energized by relay 21 and carries a current of sufficient strength in either direction to prevent operation of the relay due to current in its operating winding; the heavy locking current has the effect of preventing undue chattering of the relay contacts.

For the purpose of controlling the timing circuits a start circuit is provided which includes the middle windings of relays 20 and 30 for normally locking these relays against operation. This circuit is controlled through the operating winding of relay 11 from the contacts of relay 10.

On the operation of relay 10, in response to a start impulse, the locking windings of relays 20 and 30 become nearly currentless and these relays 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 somewhat 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 middle start winding is normally energized with a heavy current holding the relay to marking. The upper oscillating winding is connected through the upper operating winding of relay 21 to the spacing contact of relay 20 and this circuit is normally currentless. When relay 20, in response to a start impulse, operates to spacing, the current in the start winding is reduced to a small value and the relay is operated to spacing by means of its biasing winding. The condenser 25 being normally charged over the circuit through retardation coil 28 and upper winding of relay 20, now quickly discharges through the upper winding of relay 21 and over the spacing contact of relay 20; at the same time the oscillating winding of relay 20 is energized and operates the relay back to marking, whereupon condenser 25 begins to charge through the operating winding, thus for a time serving to hold this relay to marking. When the charging current has decreased sufficiently the biasing winding will overcome the operating winding and again operate the armature to spacing. When the spacing contact of relay 20 was momentarily closed for discharging condenser 25 through the operating winding of relay 21, this latter relay operated to spacing, overcoming its constant biasing winding. This operation opened the locking circuit for relay 11 for a short interval, thereby permitting relay 11 to respond to the position of relay 10.

Relay 21 is adjusted so that it will be operated to spacing only during the peak of the discharge current from condenser 25; the adjustment of this discharge current consequently may be varied within limits without affecting the operation of relay 20 and therefore without affecting the synchronism between this timing circuit and the incoming signals. The frequency of operation of relay 20 may be regulated by adjustment of condenser 25 and resistances 26 and 27. The inductance of the charging circuit through relay 20 may be adjusted, as by the inclusion of the inductance 28 in the oscillating circuit. With a low inductance charging circuit the charging

current through condenser 25 and the oscillating winding would have a decided peak followed by a long period of gradual decay. During this period the current would gradually reach the value at which the biasing winding of relay 20 would overcome the oscillating winding and in view of this gradual approach the operating time of relay 20 to spacing would be uncertain and would be likely to vary due to unavoidable slight variations in current supply and other circuit conditions. It has been found that by increasing the inductance of the charging circuit through the oscillating winding of relay 20, the peak of the charging current may be broadened and the subsequent low current value reached more suddenly, thereby insuring more accurate timing of the operating cycle.

Timing relay 30 is also normally operated by its middle or start winding. The upper oscillating winding is normally energized over the marking contact of the relay, this winding tending to operate the relay to spacing; the current in this winding is, however, not sufficient to overcome the effect of the normal current in the start winding. Condenser 35 is normally discharged over the marking contact of relay 30. When relay 10 operates to spacing, the current in the start winding is reduced to a low value, about one-sixth its normal value, permitting the oscillating winding to operate the relay to spacing; condenser 35 then begins to charge, thereby holding the relay to spacing. Ground is now applied over the spacing contact to the point P in the start circuit, thereby fixing the current through the start windings of relays 20 and 30 at its low value independent of subsequent operations by relay 10. Condenser 35 and resistances 36 and 37 should be so adjusted that the charging current through the oscillating winding will not be sufficiently reduced to permit the small current in the start winding to operate the relay back to marking until about the time the last character impulse has been completed and the stop impulse commences. At this time relay 30 should be ready to be operated back to marking. If at this time relays 10 and 11 are in spacing position, as in response to the fifth character impulse, the lowermost winding of relay 30 will be energized from spacing potential at relay 11 to hold relay 30 against its spacing contact. Whenever relays 10 and 11 are in marking position, as during a stop impulse or during a marking fifth character impulse, the lowermost winding of relay 30 will be deenergized, thereby permitting this relay to open its spacing contact and move to marking. Immediately upon opening of the spacing contact of relay 30, full current will be restored in the start windings of relays 20 and 30 from the contacts of relay 10, thereby preventing further operation of the timing relays.

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. Under these conditions the circuit for the start windings of relays 20 and 30 may be traced from ground through the two windings in series and then over two paths in multiple, one path leading over high resistance 33 to negative battery, and the other path over low resistance 32, point P, operating winding of relay 11 to negative battery at the marking contact of relay 10. The current through the start windings is strong enough to

overcome the upper oscillating winding of relay 30 and the lower biasing winding of relay 20 to hold these relays in marking position, as shown. The lower locking winding of relay 11 is energized from negative source at the marking contact of relay 11 to ground at the marking contact of relay 21, this locking current being heavy enough to overcome the normal current in the operating winding of relay 21 to hold this relay in marking.

When the start impulse arrives line west will become currentless and relay 10 operates to spacing, applying positive battery to one of the circuit branches included in the circuit, described above, through the start windings of relays 20 and 30. The resistances in the various branches of this circuit are so adjusted that application thereto of positive battery by relay 10 will reduce the potential of point P to ground potential, thereby reducing the current through the start winding of relay 30 to about one-sixth of the high normal current, this current being sufficient to operate the relay to marking, when required. Relay 11 remains unaffected for the time being and relay 30 operates to spacing. The current through the start winding of relay 20 will for a time be maintained by the discharge current from orienting condenser 31 and will decay to about one-sixth its normal high value in a predetermined time, depending upon the adjustment of condenser 31. Thus after a predetermined delay, relay 20 will be operated to spacing by its biasing winding, thereby applying ground to the circuit through the upper operating winding of relay 21, inductance 28, oscillating winding of relay 20, resistance 27 to negative battery. The grounded condenser 25 will now discharge over resistance 26, through the operating winding of relay 21, to ground at relay 20. The combined currents during the peak values of the discharge current will quickly operate relay 21 to spacing, thereby opening the locking circuit for relay 11; as soon as the peak of the discharge current has passed, relay 21 is returned to marking by its biasing winding, again locking relay 11 against operation. It will be noted that the operations of relays 20 and 21 should be oriented by means of condenser 31 so that the temporary operation of relay 21 will coincide with the center or peak of the start impulse in the line circuit LW so that relay 11 will be rendered responsive to relay 10 only when the latter is firmly positioned in response to that portion of the incoming impulse which is least subject to distortion. Relay 11, having been operated to spacing, applies spacing potential to relay 12, which in turn transmits a start impulse over the line east by opening its marking contact.

The current through the oscillating winding of relay 20 is sufficient to overcome the biasing winding and operate the relay back to marking, whereupon condenser 25 begins to charge through the oscillating winding, thereby holding the relay to marking; after a predetermined time the charging current decays sufficiently to again permit the biasing winding of relay 20 to operate the relay to spacing.

In the meantime, the first selecting impulse arrives and operates relay 10 correspondingly; however, this has no effect until relays 20 and 21 have completed one cycle, relay 20 again closing its spacing contact, thereby causing relay 21 to briefly interrupt the locking circuit of relay 11.

With proper synchronization and orientation the unlocking of relay 11 takes place when the center

of the first selecting impulse arrives and relays 11 and 12 will be correspondingly operated for repeating the first selecting impulse over line east.

These operations will be repeated for each of the subsequent selecting impulses of the signal series.

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 selecting 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 has been taken advantage of to provide a greater margin for the restoration of relay 30 to marking position near the end of the signaling series, thereby requiring less accuracy in the adjustment of relay 30.

Relay 30 has been held to spacing by charging 20 current from condenser 35 until some time after the timing operation of relays 20 and 21 in connection with the fifth selecting impulse; at this time the charging current is sufficiently reduced to permit the start winding to operate the relay to marking. If at this moment relay 11 happens to be in marking position, whether this be due to the fifth selecting impulse or to the stop impulse, negative battery will be applied over the marking contact of relay 11 through the lowermost hold-over winding of relay 30 against negative battery applied to the other side of this winding which thus will be currentless. Relay 30 therefore is operated to marking by its start winding, thereby removing ground from point P and permitting the full normal current to flow through the start windings of relays 20 and 30. Due to the presence of condenser 31, the current in the start winding of relay 30 will quickly build up before the current through the oscillating winding builds up over the marking contact and thus will hold relay 30 in marking until the next start impulse arrives.

The current in the start winding of relay 20 will build up to aid the decaying current in the oscillating winding in holding relay 20 in marking. The circuit thus is restored to normal in readiness for reception of the next start impulse.

However, if at the moment relay 30 was ready for operation to spacing, transmitting relay 11 had been in spacing position, due to the reception of the fifth selecting impulse as a spacing impulse, spacing potential would have been applied over the spacing contact of relay 11 to the hold-over winding of relay 30, thereby supplying this winding with sufficient current to prevent operation of relay 30 to marking by its start winding.

When now the stop impulse arrives over line west to operate relay 10 to marking, relays 20 and 21 will perform their cyclic operation in the same manner as they did 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 relays 20 and 21 return to marking position commencing a new cycle. Relay 11 operates relay 12 and a stop impulse is transmitted over line east.

Relay 11 now being in marking position, it will apply marking potential to the hold-over winding of relay 30 which thus becomes currentless and permits the start winding to operate the relay to marking. Upon removal of ground from point P by this operation, normal current is again applied to the start winding of relay 30 from the

marking contact of relay 10 and over resistance 33, thereby locking relay 30 in marking. The rising current in the start winding of relay 20 will hold this relay in marking position, thereby reconditioning the circuit for the next signal.

What is claimed is:

1. A relay circuit for producing nearly instantaneous impulses at definite intervals which comprises capacitance means, biased oscillating relay means and biased impulse relay means having impulse producing contact means, a slow charging circuit for said capacitance means including an operating winding of said oscillating relay means, a quick discharging circuit for said capacitance means including an operating winding of said impulse relay means and contacts on said oscillating relay means.

2. A relay circuit for producing accurately spaced short impulses which comprises capacitance means, oscillating relay means and impulse relay means, a slow charging circuit for said capacitance means including a current source and an operating winding for holding said oscillating relay means in the normal position, continuous biasing means for operating said oscillating relay means to the alternate position, a by-pass circuit for said capacitance means and including contact means of said oscillating relay means for operation of said oscillating relay means to the normal position and for quick discharge of said capacitance means, impulse relay means having continuous biasing means and contact means for producing impulses, and having an operating winding opposed to said biasing means and included in said by-pass circuit to overcome said biasing means during the peak only of the quick discharges of said capacitance.

3. A relay circuit in accordance with claim 2 further comprising inductance means serially

connected with the operating winding of said oscillating relay means in said charging circuit and giving an inductance value to said charging circuit to cause a quick decay of the charging current through the said winding to below the value of the charging current at which the biasing means of said oscillating relay means overcomes the operating winding for operation to the alternate position, thereby insuring that this operation take place at definite intervals during successive operating cycles of said relay circuit.

4. An impulse producing relay circuit comprising a capacitance circuit, biased relay means having contact means for discharge of said capacitance and having a winding connected to carry the charging current through said capacitance for operation of said contact means, inductance means for rounding the wave shape of the charging current through said winding, and biased impulse relay means having impulse contact means for producing impulses in a circuit and having a winding connected to carry the discharge current through said capacitance for nearly instantaneous operation and return of said impulse contact means.

5. An impulse producing relay circuit comprising a polar relay biased to marking and having an operating winding and marking and spacing contacts, and a capacitance circuit connected to said winding and spacing contacts characterized in this that an inductance is connected to modify the wave shape of the charging current through said operating winding to secure distinct operation of the relay to marking, and that an auxiliary relay is included to receive quick discharge current in the circuit to the spacing contact of said first relay to produce short timing impulses.

ANDREW D. DOWD.