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IMPULSE CORRECTING REPEATER

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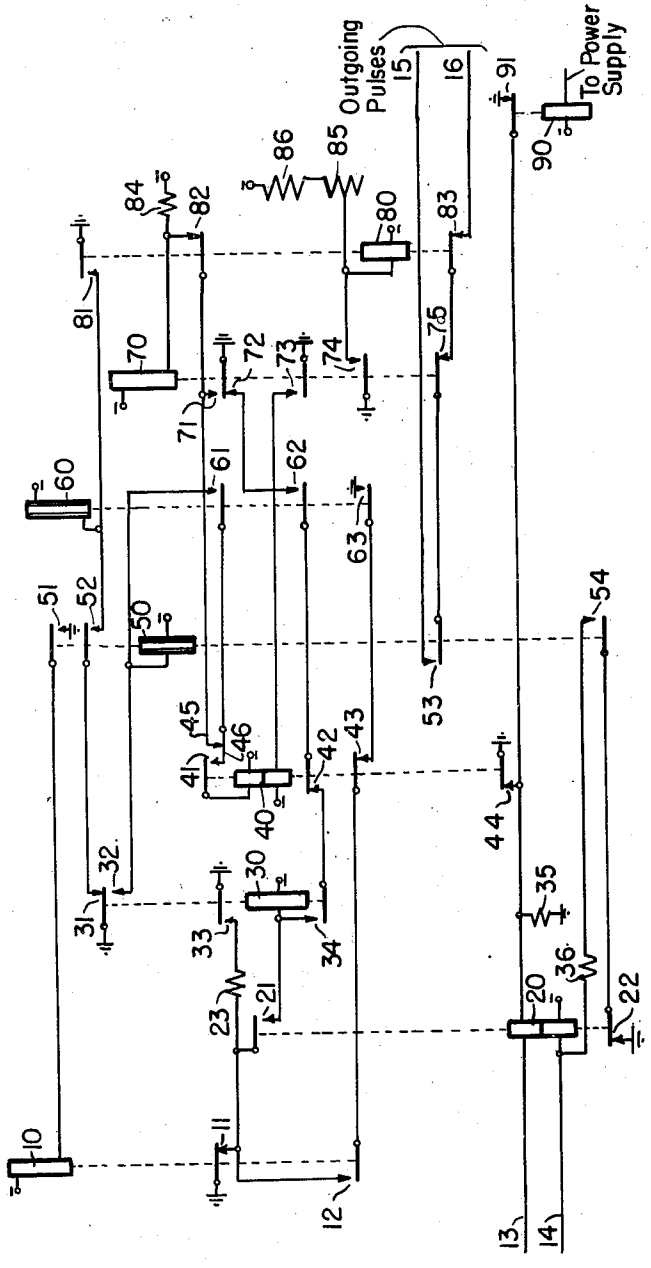

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IMPULSE CORRECTING REPEATER

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9 Claims. (Cl. 179—16)

1

This invention relates in general to automatic telephone systems, and more particularly, to a novel circuit arrangement for an impulse correcting repeater.

The main object of the invention is to provide an improved circuit arrangement for use in conjunction with impulse repeaters in telephone exchanges or other similar systems, whereby correction of impulse transmission may be efficiently accomplished.

A feature of this invention is the manner in which the arrangement repeats a corrected impulse corresponding to an incoming impulse only after the incoming impulse has been terminated. The advantage of this feature is the elimination of the possibility present in some arrangements for transmitting a false impulse.

Another feature of this invention is the manner in which the open interval for each corrected impulse is timed so as to be independent of the length or ratio of make to break of the incoming impulses. In conjunction with this, a further feature provides means for adjusting the open interval for the corrected impulses to any desired value.

A further feature of this invention is the control by a line relay in the repeater, which is responsive upon seizure by an incoming circuit, of means to energize a control relay and a third relay in anticipation of impulse receipt over the incoming circuit.

An additional feature of this invention provides for energization of a fourth relay on receipt of the break period of the first impulse without initiating an outgoing impulse. Both the third and the fourth relay are maintained operated for the duration of impulses by various means.

A still further feature of this invention is the means for preventing the relay which are effective to transmit the corrected impulses, from initiating a false cycle by breaking their operating source immediately after their energization. The relays are also prevented from initiating a second break period before the first is completed by a lock on the control relay.

Another feature of this invention provides for the control relay to be operated a certain minimum length of time during each impulse and to retain the control relay released a certain minimum time during each impulse to insure proper operation of the arrangement.

Another feature of this invention provides for the insertion of a resistance into the circuit of the line relay in instances where the potential of the supply circuit is raised above a particular

2

value and thereby provides a quicker release for the line relay and improved impulse transmission.

An additional feature of this invention provides means for energizing one of the relays at the time impulsing is initiated and assures the relay of reaching a saturated condition on the first impulse so that it will remain operated during a series of impulses. This is accomplished by preventing operation of the control relay during the period of operation of said one relay.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification and the accompanying drawing.

Referring now to the drawing, the arrangement there illustrated consists of an impulse correcting circuit with connections to an incoming line for receiving impulses, connections to an outgoing line for transmitting corrected pulses, and a conductor to the power supply circuit of the associated switchboard.

Essentially, the impulse correcting equipment consists of a line relay **20**, control relay **30**, lock pulse relay **40**, release relay **50** and its slave relay **10**, relay **60**, pulsing relays **70** and **80**, supervisory relay **90**, their associated contacts, and resistances **23, 35, 36, 85, 86**.

In considering the detailed operation of the system, it will first be assumed that the circuit herein is seized by one of commonly employed means which transmit impulses. For illustrative purposes, it is assumed that a connector selector has seized the circuit over conductors **13** and **14** to line relay **20** which energizes and at contacts **21** completes a circuit over contacts **11** to ground for relay **30**, and at contacts **22** further breaks an incomplete circuit to the bottom winding of relay **20**. Relay **30** operates and at its contacts **32** completes a circuit for slow acting release relay **50**, and at its contacts **33** completes a self holding circuit. Contacts **34** close at this time but perform no function. Relay **50** energizes and remains energized for the entire period of circuit seizure, at its contacts **51** completes a circuit to its slave relay **10**, at its contacts **52** prepares a circuit for relay **60**, at its contacts **53** completes the loop of the outgoing pulse conductors **15** and **16**, and at its contacts **54** prepares a circuit to the lower winding of relay **20**. Relay **10** operates and breaks the operating circuit to relay **30** at its contacts **11**. Relay **30** holds over contacts **21** and its own contacts **33** to ground. The set is now in condition to receive a series of impulses

over line 13 and 14. Relays 10, 20, 30 and 50 are energized.

On the first break period of the first impulse received, relay 20 releases and at its contacts 21 breaks the holding circuit for relay 30 and at its contacts 22 completes a starting circuit for itself by connecting resistance 36 over contacts 54 to the line conductor 14 and thereby preparing relay 20 for quick operation on the next make period of the impulse. Control relay 30 releases and at contacts 31 completes an operating circuit to relay 60 over contacts 52 and at its contacts 33 and 34 it further breaks its own holding circuits. Relay 60 operates and at contacts 61 prepares a circuit to relay 70, at contacts 62 prepares an operating circuit for relay 30 and at contacts 63 prepares a further operating circuit for relay 30.

It should be noted that on the first break period relay 30 causes operation of relay 60 which relay at this time operates without effect but enables relay 60 to reach a fully saturated condition so that it will remain operated for the entire series of impulses. Further operating aids are provided for relay 60 during the impulse period by relay 80. A further point of importance is that relay 30 is operated a certain minimum length of time during each impulse as described later and released a certain minimum length of time during each impulse as described above. At this point, relays 10, 50 and 60 are energized.

On the make period of the first incoming impulse, line relay 20 energizes and at its contacts 21 energizes relay 30 over contacts 12, 43 and 63. Relay 30 operates and at its contacts 31 breaks the circuit to relay 60 which is slow to release, at its contacts 32 completes an operating circuit from ground over contacts 61, 46, 45, 82 to relay 70 and at its contacts 33 and 34 completes two holding circuits for itself. If the break period of the impulse were to occur before relay 70 operates, relay 20 would release. Relay 30 however is locked over contacts 34, 42, 62 and 72, until relay 70 operates, this being the previously specified certain minimum length of time during each impulse in which relay 30 is maintained operated. Relay 70 operates and at its contacts 72 opens the locking circuit for relay 30, at its contacts 71 completes its own holding circuit over normally closed contacts 82, at contacts 73 energizes relay 40, at contacts 74 energizes relay 80, and at contacts 75 opens the outgoing loop thereby initiating an impulse. Relay 40 operates and at contacts 46 and 45 breaks the original operating circuit to relay 70 thereby preventing the two pulsing relays 70 and 80 from initiating a second cycle and causing a false impulse. Relay 40 also completes its own holding circuit over contacts 41, 46, 61 and 32 to ground, at contacts 42 further breaks one of the holding paths to relay 30, and at contacts 43 breaks the second holding path to relay 30. Relay 30 holds over contacts 21 and 33 to ground. Relay 40 at its contacts 44 removes ground from the upper winding of line relay 20 and would insert resistance 35 to ground through the winding in the event that relay 90 were energized.

Relay 80, energized over contacts 74, operates and at its contact 81, completes a holding circuit for relay 60, at its contact 82 breaks the operating circuit to relay 70, and at its contact 83 further opens the outgoing pulse conductors 15 and 16. Relay 70 releases in a time interval determined by the value of resistance 84, and at its contacts 71 further breaks its own holding circuit, at contacts 72 prepares the holding circuit

for relay 30, at contacts 73 breaks the original circuit to relay 40, relay 40 being maintained energized over another circuit, at contacts 74 deenergizes relay 80, at contacts 75 closes one point in the outgoing loop. Relay 80 releases in a time interval determined by the values of resistances 85 and 86, and at contacts 81 removes the holding circuit for relay 60, at contacts 82 prepares the operating circuit for relay 70, and at contact 83 completes the outgoing loop terminating the outgoing pulse. Relays 20, 30 and 40 are released by the next break period of the impulse and prepare the set for sending another impulse during the next make period. The cycle is repeated for each of the series of impulses.

It will be noted that the time of the break period of the impulse impressed on conductors 15 and 16 is determined by the interval of time required for the operation of relay 80 plus the time required for the release of relays 70 and 80. The time interval can therefore be adjusted by variable resistor 85.

Relay 90 is connected to the power supply circuit of the switchboard used in conjunction with the circuit and is adjusted to operate when the switchboard voltage exceeds a particular value, generally a value which lies approximately midway between the upper and lower limits of the exchange voltage. In this manner, relay 90, when operated removes a shunt from resistor 35 in the line relay circuit. Removal of the shunt allows relay 40 when operated to insert the resistor 35 into the incoming impulsing circuit. Since relay 40 operates at the time relay 20 is releasing, the resistance 35 reduces the current flow through relay 20 and aids in a quick release. This arrangement is especially advantageous when the circuit is employed with "leaky" lines or lines having a large number of bridged low impedance ringers.

It is characteristic for impulsing relays, especially those using Alleghany Electric metal structures, to momentarily restore when an impedance is inserted into their circuit. In applying resistor 36 by means of relay 20 at its contacts 22 and relay 50 at its contacts 54 to relay 20 at the time the relay 20 is being opened by the incoming impulses, the kicking tendency of the relay may be effectively utilized to improve dialing, especially over leaky lines.

Special attention has been directed herein to the arrangement whereby relay 30 has delayed operation until relay 60 has operated. In dialing this delayed operation will cause a small decrease in the closed period of the first repeated impulse. This effect can be advantageously applied in compensating for the saturation of the impulsing relay to which this circuit is repeating the impulse.

What is claimed is:

1. In combination with a circuit over which impulses are received, each of said impulses having a make period and a break period, the ratio of said make to said break periods being different at different times, an impulse correcting repeater, a line relay responsive to said impulses, a control relay having its energizing circuit controlled by said line relay, a third relay for opening the circuit of said control relay independent of said line relay, means to control said control relay responsive to said third relay to be energized a certain minimum length of time during each impulse, means to control said control relay responsive to said line relay and said third relay to be deenergized a certain minimum length of time during each impulse, and means

in said repeater responsive to each of said incoming impulses to transmit a corresponding corrected impulse only upon termination of such incoming impulse, said means operative to cause each of said corrected impulses to have a constant break interval independent of the make to break ratio of said incoming impulses.

2. An arrangement as claimed in claim 1 in which there is a second means which is operative to control said first means to adjust the length of the open interval of said corrected impulse to any desired value independent of the make to break ratio of said incoming impulses.

3. In an impulse correcting repeater arranged to receive impulses, each of said impulses having a make period and a break period, the ratio of said make to break periods being different at different times, a line relay responsive to said impulses, a control relay having its energizing circuit controlled by said line relay, a third relay for opening the circuit of said control relay independent of said line relay, means to control said control relay responsive to said third relay to be energized a certain minimum length of time during each impulse, means to control said control relay responsive to said line relay and said third relay to be deenergized a certain minimum length of time during each impulse, and additional relay means responsive to each of said incoming impulses to transmit a corresponding corrected impulse only upon termination of such incoming impulse, said additional relay means being operative to determine the break period interval of each of said corrected impulses independent of the make to break ratio of said incoming impulses.

4. In an impulse correcting repeater arranged to receive impulses, a line relay responsive to said impulses, a control relay having its energizing circuit controlled by said line relay, means for opening the circuit of said control relay independent of said line relay, said control relay responsive to said means to energize a certain minimum length of time during each impulse and responsive to said line relay and said means to be deenergized a certain minimum length of time during each impulse, and means responsive to said control relay to transmit a corrected impulse corresponding to each of said received impulses only upon termination of said incoming impulse.

5. In combination with a circuit over which impulses are received, each impulse having a make and break period, an impulse repeater, a line relay in said repeater operated in response to the seizure by said circuit, said line relay deenergized on each of said break periods and energized on each of said make periods, a pair of relays, one of said relays operated responsive to the initial deenergization of said line relay, the other of said relays operated responsive to the initial energization subsequent to the first deenergization of said line relay, both of said relays caused to remain in the effected operated condition for the duration of said impulses, and means responsive to the operation of said relays and said line relay to transmit a corrected impulse corresponding to each incoming impulse.

6. In an impulse correcting repeater arranged for receiving impulses, a line relay operative in response to said impulses, means responsive to the operation of said line relay, a pair of relays, one of said relays operated in response to an initial operation of said means, the other of said relays operated in response to a second operation of said means, both of said relays caused to remain operated for the duration of said impulses, and a second means responsive to said first means and said pair of relays to transmit a corrected impulse corresponding to each incoming impulse.

7. In an impulse correcting repeater arranged to receive impulses having a make and break period, the ratio of said make to break periods being different at different times, a relay responsive to each of said incoming impulses, means responsive to the operation of said relay to transmit a corresponding corrected impulse only upon termination of such incoming impulse, and a relay responsive to the operation of said means to prevent said first relay from responding to said incoming impulses until a predetermined open interval of the corrected impulse has been transmitted, said open period interval being independent of the make to break ratio of said incoming impulses.

8. In combination with a circuit over which impulses are received, an impulse repeater having means arranged to transmit a corresponding corrected impulse for each impulse received, a power supply circuit having varied potentials at various times, a supervisory relay operative responsive to a potential in said supply circuit exceeding a particular lever, a line relay in said repeater responsive to said received impulses, a resistance connected in series with said line relay, means controlled by said relays to enable said resistance connected in series with said line relay to be effective at times to provide a quick release aid for said line relay and improved impulse transmission over leaky lines.

9. In an impulse repeater, a line relay, a line circuit, an outgoing trunk circuit, said line relay energized by the closure of the line circuit and deenergized by subsequent breaks therein, a first relay operated responsive to the first energization of said line relay, means responsive to said first relay to complete said outgoing trunk circuit on initial energization of said first relay, a second relay operated by the first deenergization of said first relay, impulse repeating relays actuated by said first relay for transmitting impulses over the trunk, said repeating relays being operative only after the energization of said first and second relays and operation of said means, and means for maintaining said first and second relays in the operated condition until the repeating operation is completed.

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