

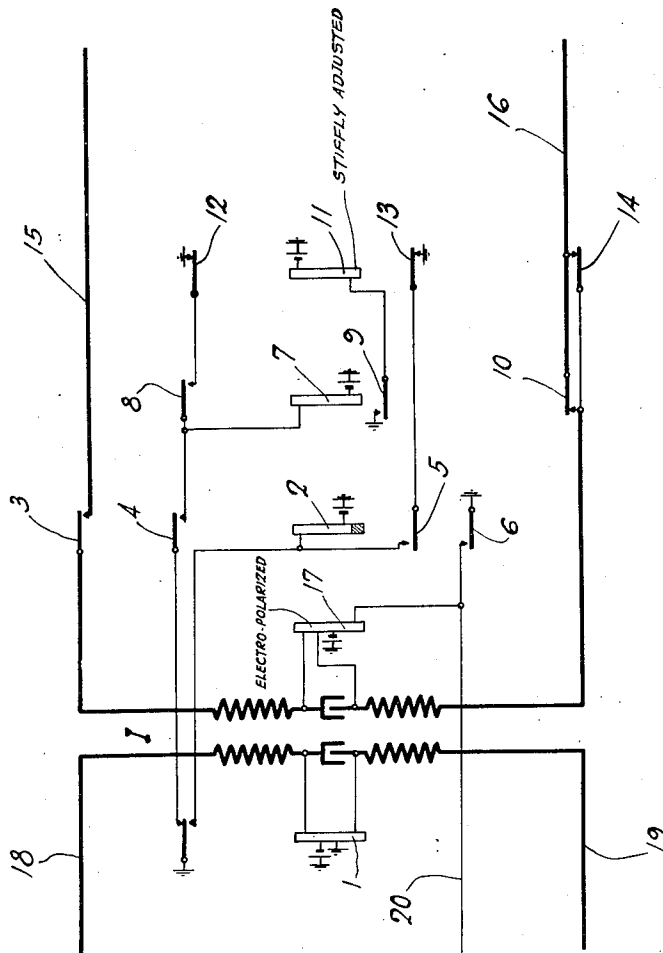
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IMPULSE REPEATER

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IMPULSE REPEATER

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The present invention relates to impulse repeaters in general, but, is concerned more particularly with impulse-correcting repeaters; and the main object is the production of a new and useful impulse-correcting repeater especially suitable for use in an automatic telephone system to repeat impulses over inter-exchange trunk lines, although certain of its features are not limited specifically thereto.

pulse-correcting repeater of this invention situated in what is assumed to be an inter-exchange trunk line in an automatic telephone system. All other equipment has been omitted from the drawing since the invention may be readily understood without the showing thereof and since it does not constitute a part of the present invention.

General description

A feature of the improved repeater is that it operates to lengthen impulses that are too short and to shorten impulses that are too long, whereby all impulses are of uniform length after having passed through the correcting repeater.

Another feature is concerned with the arrangement whereby repetition of impulses is controlled jointly by two relays, one of which begins each impulse and the other of which terminates each impulse.

Another feature of the invention is that the length of a repeated impulse is determined by the time required for a stiffly-adjusted relay to completely operate.

Another feature of the invention is embodied in the arrangement whereby the first relay, that which begins the impulses upon operating, operates the stiffly-adjusted relay, that which terminates the impulses, and locks itself through break contacts of the stiffly-adjusted relay to assure complete operation of that relay each time the first relay operates.

Another feature is contained in the arrangement whereby the slow-acting release relay of the repeater receives corrected impulses from the repeating relays during impulse transmission to maintain the previously established connection.

Still another feature is found in the arrangement whereby the repeater is made less sensitive to voltage fluctuations in the operating battery by arranging the repeating relays to perform their functions upon the energization thereof.

In explanation of this last feature, it has been found, by experimentation, that the time required for a relay to energize sufficiently to attract its armature, when current flow is started through the relay winding, varies less with minor fluctuations in the voltage of the operating battery than does the time required for a slow-to-release relay to retract its armature upon the cessation of current flow through its winding under similar conditions.

The associated drawing diagrammatically depicts, by means of the usual symbols, the im-

Detailed description

The impulse-correcting repeater is accessible to automatic switches in the exchange in which the repeater is located over the end of the inter-exchange trunk line denoted by reference numerals 18, 19, and 20. The portion of the trunk line outgoing from the repeater to another exchange of the system is denoted by the reference numerals 15 and 16. The conductors 15 and 16 terminate in the line relay of an automatic switch in the other exchange.

It might be well to mention, at this time, that the term "impulse", as generally used in the art, applies both to the momentary closing of an open circuit and to the momentary opening or interrupting of a closed circuit. Although the present repeater is arranged to transmit corrected impulses of the latter type, it is to be understood that repeaters arranged to transmit impulses of the first type fall within the scope of the present invention.

Seizure of this trunk by an automatic switch, in the well-known manner for the extension of a call, results in the closing of the circuit of line relay 1 of the repeater over the conductors 18 and 19, whereupon relay 1 energizes and attracts its armature, completing the obvious circuit of slow-acting release relay 2. Thereupon, relay 2 operates; at its armature 4, preparing the impulsing circuit to relay 7; at armature 5, locking itself to ground by way of armature 13 and resting contact of relay 11; at armature 6, completing the circuit of the lower, polarizing winding of relay 17 and connecting ground to the release trunk conductor 20 to prevent, in the well-known manner, intrusion in the trunk 18—20 and to hold the connection thus far established; and, at its armature 3, completing the loop circuit of the line relay of the automatic switch at the other exchange by way of conductor 15, make contact and armature 3, upper right-hand winding of repeating coil I, upper winding of electro-polarized relay 17, lower right-hand winding of repeating coil I, resting contact and armature 10 of relay 7, and conductor 16.

As is well understood, the construction of the

electro-polarized relay 17 is such that the energization of its lower winding alone is insufficient to cause the relay to attract its armatures, but, is sufficient to attract its armatures with the assistance of the upper winding. However, when the circuit of the upper winding is completed as just described, the direction of the current flow there-through is such as to cause the winding to oppose the influence of the lower winding. This condition exists until the direction of current flow through the upper winding is reversed, in the well-known manner, upon the response of the called party, whereupon, the two windings cooperate to attract the armature to reverse the direction of the current flow in the trunk conductors 18 and 19. The armatures and contacts of relay 17, by means of which this latter reversal is accomplished, have been omitted since their function is well known.

Relay 1 will follow the impulses transmitted thereto over the trunk conductors 18 and 19 and with each impulse will retract its armature momentarily to complete the circuit of relay 7 by way of armature 4 and make contact of slow-to-release relay 2. As is well-known in actual practice, there are likely to be considerable variations in the durations of the impulses received by relay 1. Therefore, in order that impulses of uniform length will be repeated over the trunk conductors 15 and 16 to the other exchange, the impulse repeating and correcting relays 7 and 11 are employed.

Relay 7 energizes immediately when its circuit is completed upon each deenergization of relay 1 and attracts its armatures 8, 9, and 10, at armature 8, locking itself to ground by way of armature 12 and resting contact of relay 11; at armature 9, completing the circuit of relay 11; and, at armature 10, opening the loop circuit of the trunk line 15—16 to start the impulse. The time required for relay 7 to energize sufficiently to attract its armatures, after the completion of its circuit by relay 1, varies so slightly with slight variations in the contact pressure and minor voltage variations that this "operate" time may be considered constant for all practical purposes. Therefore, the starting of the repeated impulses is definitely established with respect to the start of the impulse transmitted by relay 1. Relay 7 is given a weak adjustment in order to reduce the "operate" time to a minimum.

Relay 11 energizes when its circuit is completed by relay 7 and attracts its armatures 12, 13, and 14; at armature 12, opening the locking circuit of relay 7; at armature 13, opening the locking circuit of the slow-to-release relay 2; and, at armature 14, closing the trunk line 15—16 independently of the contacts of relay 7. Relay 11 is given an adjustment stiff enough to cause it to take sufficient time to energize and terminate the impulse begun by relay 7 that the impulse will be of sufficient length to assure proper response of the automatic switch to which the impulse is transmitted over the trunk line.

By having relay 7 lock itself through break contacts of relay 11, complete energization of relay 11 is assured for every response of relay 7 to the impulses repeated by relay 1. Inasmuch as the "operate" time of relay 11 remains substantially constant even though there are slight variations in voltage of the energizing current, each impulse repeated by the relays 7 and 11 over trunk line 15—16 is of the same duration as every other impulse repeated thereby.

Relay 7 deenergizes instantly when its ener-

gizing circuit is opened by the energization of relay 11, whereupon the circuit 11 is opened and that relay instantly deenergizes and again completes the circuit of slow-to-release relay 2.

In order that release relay 2 might not restore and release the trunk during impulse transmission when the impulses repeated by relay 1 are very long, it has been arranged for relay 2 to lock itself through break contacts of relay 11 so that, unless the connection is released or one of the impulses repeated by relay 1 is abnormally long, relay 2, being slow-acting cannot restore during impulse transmission. Therefore, the relays 7 and 11 can also be considered to correct the impulses transmitted to relay 2 by relay 1 during impulse transmission to keep that relay energized.

Upon the release of the trunk 18—20 upon the termination of the connection by the calling party, relay 1 will permanently deenergize, completing the circuit of relay 7 and opening the energizing circuit of relay 2. When relay 11 operates following the operation of relay 7, at its armature 13 it opens the locking circuit of relay 2, and, at armature 12, opens the locking circuit of relay 7. Since, at this time, relay 1 is deenergized, relay 2 will deenergize after a short interval and open the energizing circuit of relay 7, whereupon relay 7 deenergizes and causes the deenergization of relay 11 by opening its circuit at armature 9. The repeater is now in the condition shown in the drawing, that is, in condition to be taken into service.

It will be appreciated that relays 7 and 11 can be employed apart from the arrangement shown. In such a case, the impulses will be delivered directly to the relay 7, which relay will then cooperate with relay 11 to repeat impulses of the correct length.

The invention having been thus described what is considered new and is desired to have protected by Letters Patent will be pointed out in the claims which follow.

What is claimed is:

1. In an impulse repeater, a line relay, a slow-releasing control relay, repeating apparatus controlled by said line relay to deliver impulses, and a circuit for said control relay controlled directly and individually by said line relay and said repeating apparatus.

2. In an impulse repeater, a line relay, a slow-releasing control relay, repeating apparatus controlled by said line relay to deliver impulses, and a circuit for said control relay controlled directly by contacts of said control relay and by contacts of said repeating apparatus.

3. In an impulse-correcting repeater, an incoming and an outgoing circuit, a line relay arranged to be operated normally over said incoming circuit and to momentarily restore responsive to each momentary interruption of the incoming circuit, a slow-acting release relay maintained operated by said line relay for maintaining the repeater in repeating condition, a pair of auxiliary relays, circuit connections whereby at each momentary restoration of said line relay said pair of relays transmits an impulse of a definite duration over said outgoing circuit, and other circuit connections, controlled by said pair of relays, whereby during impulse transmission said release relay is maintained operated by additional impulses of definite duration.

4. In an impulse repeater, a first relay arranged to energize responsive to each incoming impulse, 150

a second relay stiffly adjusted with relation to the first relay and energizing responsive to each energization of said first relay, an outgoing repeating circuit, contacts on said first relay included in said repeating circuit for starting a repeated impulse upon the energization of that relay, and contacts on the second relay also included in said repeating circuit for terminating each started impulse upon the complete energization of the second relay.

5. In an impulse repeater, a first relay arranged to energize responsive to each incoming impulse, a second relay stiffly adjusted with relation to the first relay and arranged to energize responsive to each energization of the first relay, an outgoing impulse circuit, contacts on said first relay included in said impulse circuit for starting the repetition of an impulse over said outgoing circuit each time said first relay energizes responsive to an incoming impulse, contacts on said second relay also included in said impulse circuit for terminating the repeated impulse started by the first relay each time said second relay completely energizes, and means controlled by said first relay for insuring complete energization of said second relay each time said first relay energizes.

6. An impulse correcting repeater arranged to receive a continuous series of incoming impulses and to repeat corrected impulses over an outgoing impulse circuit, said repeater comprising a first relay energizing responsive to each incoming impulse, a holding circuit for said first relay, contacts on said first relay for starting the repetition of an impulse over said outgoing circuit each time said first relay energizes, other contacts on said first relay for completing said holding circuit each time said first relay energizes, a second relay stiffly adjusted with respect to said first relay and energizing responsive to each energization of said first relay, contacts on said second relay for terminating the impulse started by said second relay upon each complete energization of said second relay, and other contacts on said second relay for opening said holding circuit only upon the complete energization of said second relay, whereby, complete energization of said second relay is assured each time said first relay energizes and impulses of constant length are repeated regardless of the variations between certain limits in the speed of the incoming impulses.

7. An impulse correcting repeater comprising a first relay arranged to receive incoming impulses, a second relay stiffly adjusted relative to the first relay, contacts on the first relay for closing an energizing circuit each time said first relay energizes responsive to the reception of an incoming impulse, locking contacts on said first relay for completing a locking circuit to maintain a flow of current through the winding of said first relay independent of the sending source, contacts on the second relay for opening said locking circuit each time said second relay completely energizes, whereby said first relay is always main-

tained energized until said second relay completely energizes, an outgoing impulse circuit, contacts on said first relay for opening said outgoing circuit each time said first relay energizes responsive to an incoming impulse, and contacts on said second relay for directly closing said outgoing impulse circuit independent of said first relay contacts each time said second relay completely energizes to terminate each impulse started by said first relay.

8. In an impulse-correcting repeater, a normally energized line relay arranged to deenergize responsive to each of a series of received impulses, a pair of auxiliary relays, a slow-to-release relay, an energizing circuit for said slow-to-release relay completed at a front contact of said line relay, a holding circuit for said slow-to-release relay completed at front contacts thereof, an energizing circuit for the first relay of said pair prepared at front contacts of said slow-to-release relay and complete at back contacts of said line relay each time said line relay deenergizes, an energizing circuit for the second relay of said pair completed at front contacts of said first relay, circuit connections controlled jointly by said pair of relays whereby an impulse of definite duration is transmitted each time said pair of relays energize responsive to a deenergization of said line relay, and back contacts of said second relay for opening said holding circuit each time said second relay energizes, whereby said slow-to-release relay is restored responsive to a prolonged deenergization of said line relay.

9. In a controlling system, an impulse receiving relay, a slow-to-release relay, an energizing circuit for said slow-to-release relay completed at one contact of said impulse receiving relay, a holding circuit for said slow-to-release relay completed at front contacts of that relay, slow-to-operate means for opening said holding circuit, and an operating circuit for said slow-to-operate means completed at the alternate contact of said impulse receiving relay, whereby said holding circuit is opened and said slow-to-release relay is restored responsive to a prolonged operation of said impulse receiving relay.

10. In a controlling system, an impulse receiving relay, a slow-to-release relay, an energizing circuit for said slow-to-release relay completed at a front contact of said impulse receiving relay, a holding circuit for said slow-to-release relay completed at a front contact of that relay, slow-to-operate means for opening said holding circuit, and an operating circuit for said slow-to-operate means prepared at a front contact of said slow-to-release relay and completed at a back contact of said impulse receiving relay, whereby said slow-to-operate means opens said holding circuit responsive to a prolonged restoration of said impulse receiving relay, whereupon said slow-to-release relay restores and opens the operating circuit of said slow-to-operate means.

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