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REPEATER

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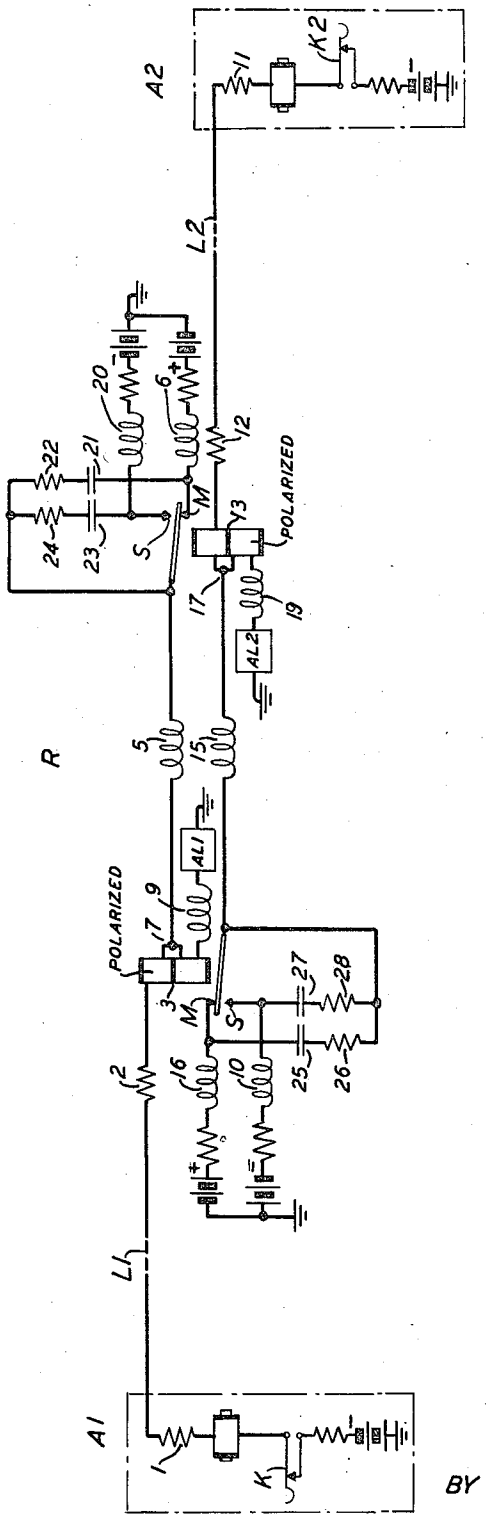

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REPEATER

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This invention relates to repeaters for telegraph and similar impulses.

General objects of the invention are to provide simpler and more effective repeaters of the type employing two relays.

The invention from one aspect may be viewed as an improvement upon Fig. 1 of Patent 1,580,192, issued April 13, 1926 to Fell. In the disclosure of that patent is found a simple type of through repeater provided with a pair of polar relays each having two windings differentially connected. The repeater is connected between two line sections. A terminal of the first winding of each relay is connected to the line while a terminal of the second winding is connected to ground through an artificial line with the apex of the two windings connected to the armatures of the other relay in each case. When the line is closed both relays are energized and the armatures at their marking contacts are connected to a positive source of potential. When either relay releases due to an interruption signal in either line section, the relay in the opposite line section is required to remain energized in order not to send a break signal to the sending station. In such case a tendency has been found for the relay to release falsely due to surges in the line winding under certain line conditions. Since the line sections or loop circuits to which such repeaters are connected often vary considerably in length and electrical characteristics, this tendency may become pronounced and cause the repeaters to operate in an unsatisfactory manner. Accordingly, it is an object of this invention to provide, in repeater sets having one pair of relays arrangements for reducing the tendency to operate falsely.

A further object is to improve the operating characteristics of impulse repeaters of the two-relay type so that they will operate successfully without adjustment upon lines of large difference.

Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the figure of which is illustrated one form of embodiment of the invention.

In the drawing are shown two stations A1 and A2 interconnected by the lines L1 and L2 through a repeater R. The terminal stations comprise printer magnets, transmitting keys and sending batteries. The repeater comprises two polarized relays 3 and 13 having their upper or line windings included in the respective loop circuits including lines L1 and L2 and controlled by key K and negative sending battery at stations A1 and A2. The lower windings are also connected to the loop circuits through artificial lines to ground. The armatures of relays 3 and 13 move between the marking and spacing contacts M and S of said relays thereby alternately connecting oppositely poled batteries to the line. The relays 3 and 13 may be of the magnetically polarized type or they may be polarized electrically; the former type is preferred.

Under normal conditions when no signals are being transmitted, polarized relays 3 and 13 remain operated due to current through their upper line windings. The path for the upper line winding of relay 3 may be traced from negative battery at station A1 through compensating resistances 1 and 2 of line L1, upper winding of relay 3, choke coil 5, tongue of relay 13 and marking contact M, choke coil 6 to positive battery. Similarly the path for the upper winding of relay 13 may be traced from negative battery at station A2 through compensating resistances 11 and 12 of line L2, upper winding of relay 13, choke coil 15, tongue of relay 3 and front contact M, choke coil 16 to positive battery. The lower windings of relays 3 and 13 are connected from the apexes 7 and 17, respectively, to ground through the choke coils 9 and 19 and artificial lines AL1 and AL2, respectively. The current to station A1, therefore, divides at apex 7 of relay 3, part going to the upper winding and part to the lower winding. Similarly, the current to station A2 divides at apex 17 of relay 13, part going to the upper and part to the lower winding. Since the upper and lower windings are differentially connected, the flux in the lower windings opposes the flux in the upper windings, but does not prevent the relays from operating because the current flow through the lower windings is regulated by the artificial line resistances to one-half the current flow in the upper windings.

When station A1 sends a spacing signal by opening break key K the line current drops to zero in the upper winding of relay 3 thus causing it to release assisted by the flux in the lower winding. The tongue of relay 3 thus breaks its contact with positive battery and closes contact with negative battery at contact S. Since station A2 is also connected to negative battery the line current through the upper winding of relay 13 drops to a small fraction of its normal value, for example, .005 ampere and transmits the spacing signal to station A2, but relay 13 does not release because

the flux in the lower winding on negative battery is now aiding the operation of the relay and it remains operated. On closure of the break key K at station A1 to send a marking signal, line current through the upper winding of relay 3 again operates the relay to connect positive battery to the line L2 of the station A2. In a similar manner station A2 may send spacing and marking signals to station A1 whereupon relay 13 releases and reoperates in the manner described for relay 3. If the key K at station A2 is opened while the key at station A1 opens, no effect would be noted at station A1 because the current in line L2 is already practically zero due to negative battery at the tongue and S contact of relay 3 and relay 13 remains operated as previously described. If, however, the key at station A2 remains open until the key at station A1 is again closed to send a marking signal, relay 3 will reoperate and the positive battery at the marking contact M will reverse the current in the lower marking winding of relay 13 and cause it to release and thereby repeat the break signal from station A2 to the station A1. Station A1 then cannot send because line L1 is connected to negative battery at the tongue and S contact of relay 13.

The lower windings of relays 3 and 13 are differentially connected with respect to the upper or line windings and serve a two-fold purpose. Under certain conditions the currents are utilized for holding purposes and under other conditions the currents are utilized for biasing purposes. The constants of the circuit are so arranged that with the keys K closed, current of about .060 ampere flows in the upper windings and a current of about .030 ampere flows in the lower windings. Since the pull of the lower windings is opposite in effect to the pull in the upper windings, the net result is equivalent to a current of .030 ampere in a single coil which acts to hold the tongues of the relays to their marking contacts M. When no current flows in the upper winding of relay 3 as would be the case with key K open at station A1, then the lower winding will act to move the relay tongue to the opposite contact owing to the pull produced by the current of approximately .035 ampere. Relay 13 operates in the same manner when key K at station A2 is sending spacing and marking impulses to station A1.

Assuming now that station A1 sends a spacing signal by opening key K, current in upper winding of relay 3 falls to zero and the lower winding becomes effective in moving the tongue of the relay to contact S. At the moment the tongue breaks the circuit with the front or marking contact M, condenser 25 in series with resistance 26 begins charging and has the effect of prolonging the current flow through choke coil 15 and the two windings of relay 13. Condenser 25 in this case has an increased capacity over that required for contact protection (i. e. spark-killing) thus maintaining a holding current for relay 13 until the tongue of relay 3 makes contact with the S contact. At the instant this occurs current in the upper winding of relay 13 begins to fall to zero and the polarity of the lower winding of relay 13 is reversed thus effectively maintaining relay 13 in an operated condition. When station A1 sends a marking signal by closing key K, current in the upper winding of reay 3 builds up until it overcomes the pull of the lower winding in the opposite direction and the tongue of the relay starts to open the back or spacing contact S. During the travel of the tongue of relay 3 from contact S to the contact M, the lower winding of relay 13 continues to remain energized through the upper winding and line L2 to negative battery at station A2. The capacity of condenser 27 thus is only required to be high enough to absorb the spark at contact S. When relay 3 finally pulls the tongue over to the marking contact M, the current in the upper winding of relay 13 is increased to its normal value and the current in the lower winding reverses direction, and building up slowly does not cause relay 13 to release because of the main line current in the upper winding. The sending of spacing and marking signals from station A2 acts on relays 13 and 3 in the same manner as described for relays 3 and 13, respectively, above. The capacity of condenser 21 in this case is likewise larger than is required for purely contact protection in order to prolong the current flow in windings of relay 3 when relay 13 releases on spacing current from station A2.

Arrangements to prevent radio energy likely to disturb radio receivers in the vicinity of the repeaters may comprise choke coils 5, 6, 9, 10, 15, 16, 19, and 20 which in combination with the condenser-resistance units connected across the M and S contacts of relays 3 and 13 serve to reduce radiation from the relay contacts to such an extent that it will not materially interfere with the operation of radio equipment operating upon broadcasting or shorter wave lengths that may be located nearby.

In the preferred arrangement compensating line resistances 1 and 11 are located at the subscriber's station and resistances 2 and 12 are located at the repeater office. The effect of splitting the resistances in this manner is to counteract the effect of line capacity and thus make for more uniform operation of the repeater relays.

Summarizing, therefore, it is thought that two distinctive features of improvement are found in the present disclosure.

First, the condenser 25 (the same is true of condenser 21) acts to maintain the operating current conditions in the windings of relay 17 while the armature of relay 3 is passing from its marking to its spacing contact; more accurate repetition of impulses is therefore accomplished. When the armature of relay 3 moves from its spacing to its marking contact current conditions in the windings of relay 13 are maintained without assistance from condenser 27. It is emphasized that this current maintaining effect is independent of spark-killing condensers and requires for the condensers 25 and 21 a capacity of a greater magnitude than is employed for spark killing.

A second feature comprises the various choke coils and condenser units which reduce to a large extent the interference of the repeater with sensitive radio sets in the neighborhood by reducing radiation from the relay contacts and/or changing the periodicity of waves or impulses radiated. This is accomplished without affecting the reliability of the device as a telegraphic repeater.

While the invention has been disclosed in certain specific arrangements which are deemed desirable, it is to be understood that it is capable of embodiment in somewhat modified forms without departing from the scope of the invention as defined in the appended claims.

For the purpose of the appended claims the relay 3 will be considered as a transmitting relay from line L1 to the line L2.

What is claimed is:

1. In a telegraphic repeater, two relays for re-

peating each way between two lines, a circuit controlled by the armature of each relay extending through a winding of the other to the receiving line, said armature in operating passing from a contact to another contact over each of which current flows through the windings of said other relay and a condenser connected between said armature and contact of sufficient magnitude to maintain the current flow condition while said armature passes from one contact to the other, said condenser being of greater capacity than a spark protection condenser for the reasons aforesaid.

2. In a telegraph repeater, two relays for repeating each way between two lines, a circuit controlled by the armature of each relay extending through a winding of the other to the receiving line, said armature in operating passing from a marking contact to a spacing contact, sources of different polarity connected to said contacts and a connection from said armature over which current flows through windings of said other relay, and a path including a condenser connected between said armature and said marking contact, said condenser being of sufficient magnitude to maintain the current flow condition previously existing while said armature passes from said marking contact to said spacing contact.

3. In a repeater in accordance with claim 2, a path including a condenser connected between said armature and said spacing contact, said condenser being of considerably smaller capacity than the condenser connected between said armature and said marking contact.

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