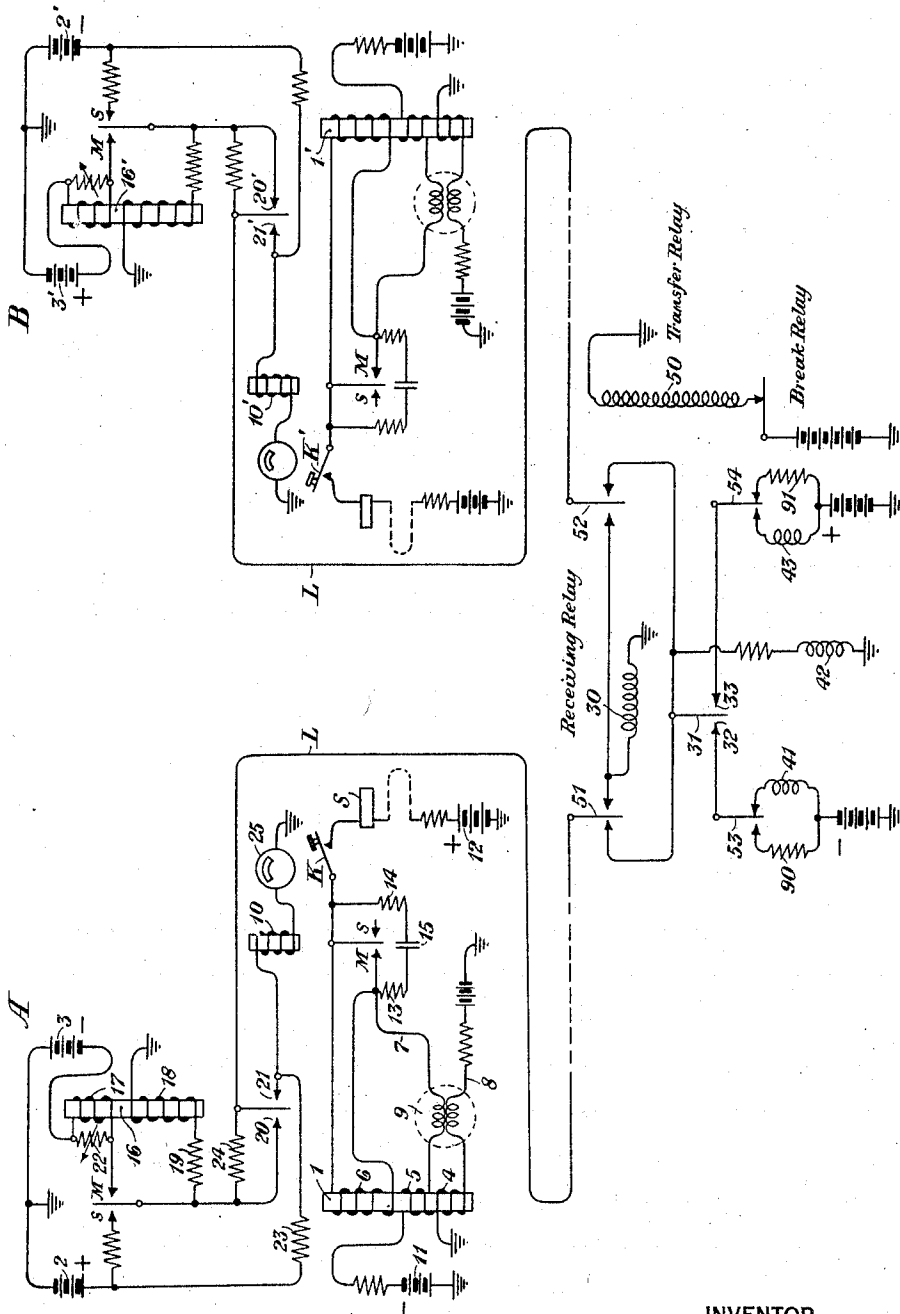


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TELEGRAPH REPEATER CIRCUITS

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This invention relates to an improved arrangement of through type telegraph repeaters.

The repeater device of the invention consists essentially of a one way repeater which is automatically switched in the direction of transmission by means of an auxiliary or "break" relay. The operation of this relay depends upon the reduction in line current when an opposing battery is connected at the distant end of the line for purposes of "breaking" the operator at the other terminal station. Telegraph systems in which the "breaking" feature at the terminal stations is controlled by the application of opposing battery at the distant station are illustrated and described in the Patents #1,548,088, August 4, 1925 and #1,519,202, December 16, 1924 in the name of J. Herman and reference is had thereto. While the telegraph repeater of this invention is particularly suitable for use in a system utilizing terminal stations of the type described in said above-mentioned patents it is understood that its use is not so limited but that it may be utilized in other types of systems. It is understood that the type of repeater embraced in this invention is suitable for both open wire lines and full metallic circuits and for both small and large gauge cable circuits.

The invention may be more fully understood from the accompanying drawing in the figure of which is illustrated a circuit diagram embodying the invention.

In the drawing is shown a telegraph line L inter-connecting two stations A and B. As the apparatus at each of the stations A and B is substantially the same, similar reference characters with the added designation "prime" are utilized to denote like parts at both stations. At station A is shown a pole changer relay 1 with the positive and negative batteries 2 and 3 respectively on its spacing and marking contacts designated as S and M respectively. The pole changer relay 1 has three windings 4, 5 and 6. 4 and 5 are balanced windings, 4 being connected into a biasing circuit 8, and 5 being connected into the loop circuit 7. The third winding 6 consists of a large number of turns

connected across the armature and a contact of the receiving relay 10. It serves as a holding winding for the pole changer during the operation of the receiving relay 10. This arrangement has been disclosed in detail in a Patent #1,519,202, December 16, 1924 in the name of Joseph Herman, and reference is had thereto. The loop circuit includes the batteries 11 and 12, the sounder S, the key K and the armature and contacts of the receiving relay 10. In the loop circuit 7 and the biasing circuit 8 are also shown the windings of a balanced meter 9. Associated with the marking contact and the armature of the receiving relay 10 in the loop circuit is the spark killer device, comprising the resistances 13 and 14 and the condenser 15 for purposes which will be pointed out hereinafter. There is also provided a break relay 16. This relay has two windings, 17 and 18. The winding 17 consists of a small number of turns connected in series with the marking battery 3. The winding 18 consists of a large number of turns connected in a leak circuit 19 from the armature of the pole changer relay 1 to ground. The armature of relay 16 is connected to the line L, and the contacts 20 and 21, which are termed the sending and receiving contacts respectively, are connected to the pole changer armature and the winding of receiving relay 10. An additional leak circuit 24 with a suitable resistance connects the armature of relay 16 to the armature of relay 1. In series with relay 10, there is also shown a meter 25. There is also provided a variable shunt resistance 22 around the winding 17.

Current flowing through the winding 17 tends to hold the armature of the break relay against the sending contact 20. Current through the winding 18 in the leak circuit 19 opposes the effect of winding 17 when the armature of the pole changer 1 is on the marking contact, but aids it when the armature is on the spacing contact. By properly proportioning the shunt 22 across the winding 17 and the resistance in the leak circuit 19, the normal line current flowing through the series winding 17 can be made to overpower the effect of the leak winding 18.

Under this condition, the armature of the break relay 16 will always stay on the sending contact 20, even though the armature of the pole changer 1 travels back and forth between its two contacts.

The receiving relay 10 has one winding, one end of which is connected to the receiving contact 21 of the break relay 16, and the other end to ground. A leak circuit 23 from the spacing battery 2 to the receiving contact 21 of the break relay serves to hold the armature of the receiving relay 10 to its marking contact, thereby closing the loop circuit when the local subscriber at A is sending. The leak circuit 24 from the marking battery 3 through the armature of the pole changer 1 to the line L neutralizes the effect of the holding leak circuit 23 when the armature of the break relay is on the receiving contact 21. Accordingly, the only current flowing through the receiving relay 10 under this condition is that from the distant end of the line. If desired, one of the leak circuits 23 or 24 may be made variable, thereby permitting the receiving relay 10 to be biased to counteract ground potentials and biased signals. The meter 25 in series with the receiving relay will be found helpful in such cases.

The apparatus at station B is substantially the same as that at station A with the exception that oppositely poled batteries from those utilized at station A are provided for sending marking and spacing impulses. In other words, if the battery 3 at station A, utilized for marking impulses, is negative, then the battery 3', utilized at station B for marking impulses, will be positive, and, similarly, if spacing battery 2 at station A is positive, then spacing battery 2' at station B will be negative. The reasons therefor will appear more fully from the following detailed description of the operation of the device.

If the local subscriber at A is sending, the line L will be grounded at the distant station B through the receiving relay. The local receiving relay 10 will then be held on its marking contact under the influence of the holding leak circuit 23, and the pole changer 1 will be operated under the influence of the subscriber's key K. When the armature of the pole changer 1 rests on its spacing contact, the armature of the break relay 16 will be held against the sending contact 20 under the influence of the current through the winding 18 in the leak circuit 19. When the armature of the pole changer 1 rests on the marking contact, the leak winding 18 will tend to operate the break relay armature to the receiving contact 21, but will be prevented from so doing by the line current flowing through the winding 17 to the marking battery 3 and overpowering the effect of the leak winding 18. The local subscriber at A, therefore, can continue to send.

When the local subscriber at A is receiving,

the armature of the break relay 16 will have been tripped to its receiving contact 21 in a manner to be pointed out hereinafter. When the armature of relay 16 is on the receiving contact 21, the line current is completely disconnected from the windings 17 and 18. These two windings will then be in series with the marking battery 3. Under these conditions, the effect of the winding 18 will be sufficient to overpower the effect of the winding 17 and will serve to hold the armature against the receiving contact 21. The armature of the transmitting relay 1 will be held on its marking contact under the influence of its loop and holding windings 5 and 6 respectively. The holding current in the receiving relay 10 from the circuit 23 will be neutralized by an equal and opposite current over the circuit 24 and armature and marking contact of relay 1 to the marking battery 3. Accordingly, the receiving relay 10 will only be affected by the line current from the distant station B which will flow through said relay to ground, operating said relay.

If the subscriber at A is sending, and the distant subscriber at B wishes to break the sending subscriber, he opens his key K'. The opening of key K' causes the armature of the pole changer relay 1' to move to the spacing contact, and accordingly negative spacing battery 2' will be connected to the line. If the local subscriber at A is at that time sending a spacing signal his pole changer armature will be on positive battery 2, and nothing will happen except that the line current will be doubled. When the local subscriber at A now closes his key to send a marking impulse, his pole changer armature will move to the marking contact and connect the negative marking battery 3 to the line. With negative battery thus connected to both ends of the line, the line current will be reduced practically to zero, and practically no current will flow through the winding 17. The negative current, however, will flow through the leak circuit 19 and the winding 18, and will accordingly trip the armature of the break relay 16 from the sending contact 20 to the receiving contact 21. As soon as this occurs, the distant spacing battery will operate the local receiving relay 10 to the spacing contact, thereby opening the loop circuit and energizing the holding winding of the pole changer. The leak winding 18 of the break relay 16 will continue to hold the armature of the break relay against the receiving contact 21 as long as the subscriber at A keeps his key closed to receive signals from the distant station B. This it can do, because, as has been previously pointed out, the line current is completely disconnected from the pole changer armature and from the winding 17, and the windings 17 and 18 are connected in series with the battery 3. Under these conditions, the winding 18

will overpower the winding 17 and render the latter winding ineffective.

To illustrate how battery was put on the line by the distant subscriber at B, assume that the local subscriber at A, after receiving a few signals, now intends to break the distant subscriber. He opens his key K, which deenergizes both the loop and holding windings of the pole changer 1, thereby operating the armature of the pole changer 1 to the spacing contact S. The current from the spacing battery flowing through the leak winding 18 of the break relay will operate the armature of that relay to the sending contact 20, thereby disconnecting the line from the receiving relay 10 and connecting it to the armature of the pole changer 1. The local spacing battery 2 will therefore be connected to the line, and will trip the distant break relay 16' in the same manner as already described with respect to relay 16.

Because of the fact that both the holding winding 6 and the loop winding 5 are deenergized by the opening of the subscriber's key K, the sending subscriber might not receive a clear break signal. This break relay will be operated to the sending contact 20 when he opens his key, and to the receiving contact when he closes his key, as long as the breaking subscriber maintains spacing battery on the line. This might produce short clicks in the sending subscriber's loop circuit, which would be very confusing and prevent satisfactory operation of the system. To avoid this, a lag is introduced in the operation of the holding winding 6 of the pole changer, so that this winding fails to release, in the interval between markings and spacings, of ordinary sending. This is accomplished by connecting the spark killer device, consisting of the resistances 13 and 14 and the fairly large condenser 15, across the holding winding circuit. The operation of the holding winding is then as follows:

Assume that the local break relay 16 has just been tripped by the distant spacing battery as the local subscriber at A closes his key to send a marking impulse. The receiving relay will open up, connecting the holding winding in series with the loop. The spark killer will then be charged to a high potential, due to the effect of the loop batteries 11 and 12. The holding circuit, it is pointed out, has such a large resistance compared to the loop that practically the full voltage of the batteries is impressed across it. If one of the loop batteries is then disconnected by the opening of the subscriber's key, the spark killer will discharge through the holding winding and keep it energized during the period in which the subscriber keeps his key open. The pole changer will therefore fail to release, and a clean break will result.

From the above description it will be seen that in a system employing terminal stations

of this type the "breaking" features at each station is controlled by the application to the line at the distant station of an opposing battery to that at the first station and the attendant reducing of the line current practically to nothing. This may be done as different batteries are used for marking and spacing at one station than are used for marking and spacing at the other station, as has been pointed out heretofore.

In the drawing the telegraph repeater of the invention is shown as interconnecting sections of the line L terminating at the stations A and B. The repeater itself comprises a receiving relay having a winding 30, a break relay having windings 41, 42, and 43, and a transfer relay having a winding 50. The break relay controls the transfer relay. The transfer relay controls the armatures 51, 52, 53, and 54. The receiving relay controls the armature 31. In the drawing the B station is shown using negative battery for spacing and the A station utilizing positive battery. With the transfer and break relay contacts as shown the line to station A is connected to the receiving relay winding and the line to station B is connected to the receiving relay armature 31 and to ground through the break relay winding 42. Negative and positive batteries are provided which may be connected to the armatures 53 and 54 respectively through either the break relay windings 41 and 43 or the balancing inductances 90 and 91. Signals coming from station A operate the receiving relay which in turn repeats signals into the line to station B. When the operator at A sends a mark negative battery is connected to the line to B and when a space is sent from A the operation of the receiving relay will cause positive battery to be connected to the line to B. The winding 41 of the break relay is connected in series with a negative transmitting battery and serves to hold the break relay against the proper contact during the transmission of a marking signal.

To transmit a break signal the operator at B opens his key, thereby connecting negative battery to the line. As soon as the subscriber at A sends a mark, the line to station B is connected to negative battery at the repeater station, thereby reducing the line current practically to zero. The effect of the winding 41 is thereby destroyed and the break relay will operate to the other contact under the influence of the winding 42. The operation of the break relay causes a transfer relay to operate and connect the line to station B to the receiving relay winding 30 and the line to station A to the receiving relay armature 31. At the same time the winding 41 will be disconnected from the negative battery tap and a similar winding 43 is connected into the positive battery tap. This is necessary because the positive battery will be

marking battery when transmitting to the subscriber at A. After the transfer relay has operated, the receiving relay will still be on the negative contact, because the negative spacing battery from the line to station B will take the place of the negative marking battery from line to station A. Consequently, the receiving relay armature 31 will remain on negative battery and this battery will be connected to the line to station A and will trip the break relay thereat in the manner previously pointed out. When the subscriber at B begins to send, the winding 43 of the break relay will hold the break relay to the proper contact until a break signal is received from the subscriber at A.

While the invention has been disclosed in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many other and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. In a telegraph system, a repeater station for interconnecting two line sections comprising a single receiving relay, switching means whereby said relay may be connected to either of said line sections, sources of current of different polarity, means controlled by said receiving relay for connecting said sources to said switching means, a break relay, and a transfer relay controlled by said break relay, said transfer relay controlling said switching means.

2. In a telegraph system, a repeater station for interconnecting two line sections comprising a single receiving relay, switching means associated with each of said line sections whereby said receiving relay may be connected to either of said line sections and the armature of said receiving relay may be connected to the other of said line sections, sources of current of different polarity associated with said armature, a break relay, and a transfer relay controlled thereby, said transfer relay being adapted to reverse said switching means.

3. In a telegraph system, a repeater station for interconnecting two line sections comprising a receiving relay, switching arrangements associated with each of said line sections whereby said receiving relay may be connected to either of said line sections and the armature of said receiving relay may be connected to the other of said line sections, sources of current of different polarity associated with said armature, a break relay, the operation of said break relay being dependent upon a reduction below normal in the line current in the line section with which said receiving relay armature is connected, and a transfer relay controlled by said break relay, said transfer relay being adapted to reverse said switching arrangements.

4. In a telegraph circuit, a one way polar telegraph repeater, and switching means controlled by the telegraph line currents for connecting said repeater into the circuit in the direction of transmission.

5. A telegraph system comprising two distant stations, means at each of said stations for transmitting break signals, a one-way telegraph repeater for interconnecting said stations, and means for setting said repeater for transmission in either direction, said means being controlled by the transmission of break signals from said stations.

In testimony whereof, I have signed my name to this specification this 18th day of January, 1928.

JOSEPH HERMAN.