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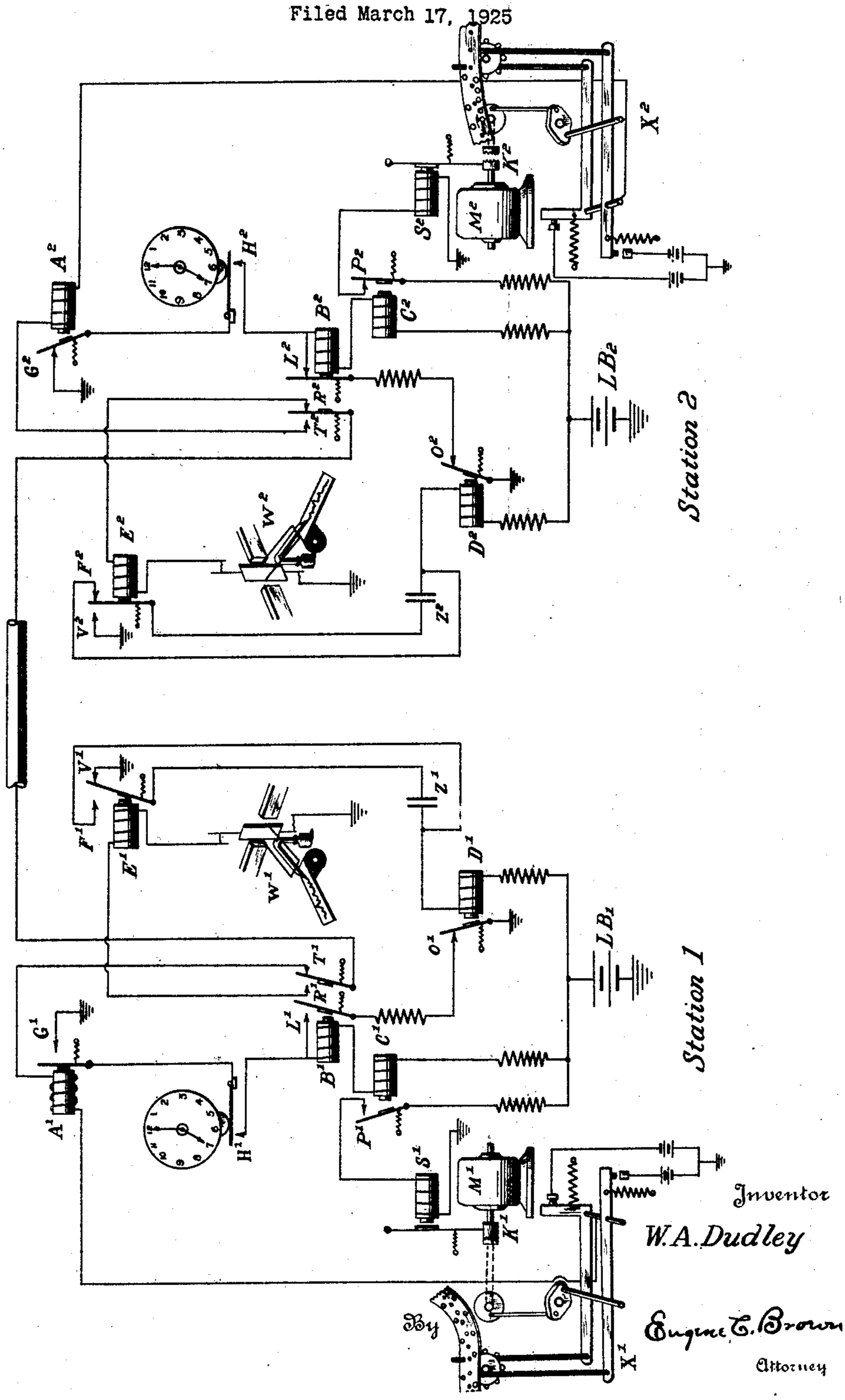

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AUTOMATIC REVERSING SYSTEM FOR TELEGRAPH CIRCUITS.

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My invention relates generally to cable telegraphy. Specifically, it concerns a method for automatically and periodically reversing the direction of operation of a simplex cable circuit and is intended to apply in cases where duplex operation is impracticable.

In a cable system the sending apparatus consists of a motor-driven transmitter which, by means of a perforated tape, is caused to send to the cable the code signals consisting of dots, dashes and spaces. The receiving apparatus is essentially a sensitive galvanometer with its armature arranged to control an ink siphon in contact with a moving tape. The impulses from the cable passing through the galvanometer cause this siphon to move, thus recording the signals in the form of undulations on the tape.

The dots and dashes forming the code are of equal length but are opposite in polarity. Spaces are periods of no current, and, between letters, are made the same length as a dot (i. e. one unit). Spaces between words however, are made three times as long as the spaces between letters (i. e. 3 units).

It is obvious that the end of a word is a logical time for reversing the direction of operation, and the long space following a word forms a ready means of selecting the moment for switching to take place.

It is an object of my invention to provide such a selecting means which shall operate, to initiate the switching operations, at a moment when the long space following a word occurs.

In particular, I contemplate the provision of selecting means at the transmitting station automatically responsive to a no-current condition of the line lasting for an interval greater than one unit, and selecting means at the receiving station responsive only after an interval greater than three units.

It is also an important object of my invention to cause the switching to take place automatically and at will, that is, to permit transmission in a given direction to continue uninterruptedly for any desired length of time but to automatically terminate the transmission upon the lapse of a predetermined time interval.

The figure shows my invention applied to a simplex circuit using the usual perforated tape transmitter.

The operation of the system is as follows: With the apparatus connected as shown in the drawing, station 1 is sending to station 2. Signals from the transmitter X_1 pass through the winding of relay A_1, contacts T_1 of relay B_1, to the cable and thence to contacts R_2 of relay B_2, through the winding of relay E_2 and through recorder W_2 to ground. At station 1 the receiving apparatus is disconnected from the cable by open contacts R_1 of relay B_1, and at station 2 the transmitting apparatus is disconnected from the cable by open contacts T_2 of relay B_2. Relays B_2 and C_2 are energized through a circuit extending from ground at relay D_2 through contacts O_2, contacts L_2, winding of relay B_2, winding of relay C_2, and through the local battery LB_2 to ground. A circuit is also completed through contacts P_2 of relay C_2 which energizes magnet S_2 from local battery LB_2. Magnet S_2 operates to disengage the clutch K_2 to disconnect motor M_2 from the transmitter X_2 and to apply a brake (not shown) to the transmitter, thus preventing it from operating.

Relay A_1, as well as relay A_2, is so adjusted that its contacts will not close except for no-current periods of greater than unit length; in other words, the contacts will close on a word space but not on a letter space. Relay E_2, as well as relay E_1, is adjusted by means of a suitable and well known mechanical delay to prevent contacts V_2 from closing except on no-current periods greater than three units in length, that is, greater than a word space.

While signals are being transmitted from station 1, the circuits remain unchanged except that the contacts G_1 close after each word; however, this has no effect since the circuit is open at clock contacts H_1. The switch operating mechanism of the clock at station 1 has previously been set to permit transmission from this station for a predetermined length of time. At the end of this time, clock contacts H_1 close to prepare a circuit to energize relays B_1 and C_1 from local battery LB_1; however, this circuit will not be completed until the following word space is transmitted, to permit contacts G_1 to close.

When this occurs, contacts P_1 of relay C_1 close to energize magnet S_1 which in turn disconnects the motor M_1 from the transmitter X_1 and applies a brake (not shown) to the transmitter to stop the transmission. Thus, it will be noted that through the

action of relay A_1 the transmission will be stopped only at the end of a completed word, and, if a word is being transmitted at the time contacts H_1 are closed, the circuits will remain otherwise unaltered, and transmission will continue until the word is completed. Relay B_1 opens contacts T_1 and closes contacts R_1 thereby disconnecting the transmitter X_1 from the cable and connecting recorder W_1 to the cable through the winding of relay E_1. Relays B_1 and C_1 are locked in closed position by a holding or locking circuit extending from local battery LB_1 through contact L_1 of relay B_1 and contacts O_1 of relay D_1 to ground. The transmitter at station 1 has now been disconnected from the cable and the receiving apparatus is ready to receive from station 2.

A prolonged no-current period follows after the transmitter is disconnected and relay E_2 at station 2 releases to close contacts V_2, thereby causing a momentary charging current to flow through condenser Z_2 from local battery LB_2 by a circuit which includes the winding of relay D_2. This charging current is sufficient to energize relay D_2 to momentarily break its contacts O_2, thereby causing relays B_2 and C_2 to be deenergized. The locking circuit of relays B_2 and C_2 is opened at contacts L_2 and will not be closed again until relay B_2 is energized from the clock circuit. The opening of contacts R_2 and the closing of contacts T_2 operates to switch the cable at station 2 from receiving apparatus to transmitting apparatus. At the same time, opening of contacts P_2 deenergizes magnet S_2 to engage clutch K_2 and release the transmitter brake, thereby starting the transmitter X_2. Transmission will now take place from station 2 to station 1, and operation will continue in this direction until the clock at station 2 closes contacts H_2 to again reverse the direction.

Contacts F_1 and F_2 are provided on relays E_1 and E_2 for the purpose of discharging condensers Z_1 and Z_2 during a receiving period, in order that they will be in a condition to draw a charging current at the end of each receiving period, and thereby effect certain switching operations as described above.

In the above described operation, at the instant contacts R_1 and T_1 operate to switch the cable from transmitting to receiving, a cable of considerable length will be charged with a series of impulses which will discharge through the receiver at both stations. This will not affect the operation at station 2, except that, of course, the switching will be delayed until the discharge is completed. At station 1, however, following this discharge there will be a prolonged period of no-current, equal to the lag of the cable, before the first signals transmitted from station 2 reach station 1. This will allow the contacts V_1 of relay E_1 to close, and a momentary charging current will flow through condenser Z_1 to energize relay D_1 and thereby break the holding circuit of relays B_1 and C_1 momentarily at contacts O_1. If relays B_1 and C_1 were to become deenergized their contacts would fall back to place station 1 again in transmitting position; however, in order to avoid this, the clock switch H_1 is arranged to remain closed for a longer period than the lag of the cable, and relays B_1 and C_1 will be kept energized over this period by the clock circuit including contacts H_1 and G_1. Thus, station 1 is maintained in receiving position until the signals from station 2 arrive, and after this, relay E_1 will not be deenergized except for no-current periods greater than a word space. The lag on any existing cable may be taken care of in this way by arranging contacts H_1 to remain closed for a period of 3 seconds. This period, of course, may be increased if necessary. After this period has expired, and contacts H_1 have opened, the apparatus at station 1 will be in condition to respond to the next prolonged no-current period, transmitted for the purpose of switching, through the action of relay E_1.

While I have described my invention in connection with a simplex or single channel circuit it will be evident that it is equally applicable to a multiple channel system operating in one direction at a time.

I claim:

1. In a cable system in which signals are transmitted as impulses of positive and negative sign separated by spacing periods of no current, a cable, a transmitter connected to said cable at one station, switching apparatus for disconnecting the transmitter effective only upon the establishment in the cable of a no-current condition of given duration, and means to permit the no-current condition to cause operation of said switching apparatus only after a clock-controlled transmission interval.

2. In a cable system in which signals are transmitted as impulses of positive and negative sign separated by spacing periods of no current, a cable, a transmitter connected to said cable at one station, switching apparatus for disconnecting the transmitter effective only upon the establishment in the cable of a no-current condition of given duration, and adjustable clock-controlled means to permit the no-current condition to cause operation of said switching apparatus after any desired predetermined transmission interval.

3. In a cable circuit, an automatic transmitter, a selective relay connected thereto adapted to release its armature upon the occurrence of a word space in the automatic transmission, a switching relay and a circuit

therefor including said armature when released, means to prevent operation of the switching relay comprising a pair of normally open contacts in said switching circuit, and clock-controlled means to close said contacts after a predetermined interval of transmission.

4. In a cable circuit, an automatic transmitter, a selective relay connected thereto adapted to release its armature upon the occurrence of a word space in the automatic transmission, a switching relay and a circuit therefor including said armature when released, means to prevent operation of the switching relay comprising a pair of normally open contacts in said switching circuit, and clock controlled means to automatically close said contacts after a predetermined interval of transmission.

5. In an automatic cable circuit, an automatic transmitter including a clutch, a magnet adapted to open the clutch, control circuits for said magnet including a pair of normally open contacts, clock-controlled means for closing said contacts automatically after a predetermined transmission interval to prepare a control circuit for said magnet, and means to delay operation of the magnet until the occurrence of the next word space in the signal transmission.

6. In a cable circuit, an automatic transmitter, a selective relay connected thereto adapted to release its armature upon the occurrence of a word space in the automatic transmission, a transmitter magnet adapted to control operation of the automatic transmitter, an intermediate relay controlling said transmitter magnet, and a circuit for the intermediate relay including the armature of the selective relay when released, and clock-controlled means to prevent operation of the transmitter magnet until after a predetermined transmission interval said means comprising a pair of normally open contacts in the circuit of the intermediate relay.

7. A cable circuit comprising a cable, an automatic transmitter connected thereto, a receiver, switching apparatus for disconnecting the transmitter and connecting the receiver to the cable, clock controlled means adapted to prepare a circuit for the switching apparatus at a predetermined moment of time, and means responsive to the signal transmission to automatically complete the prepared circuit at a predetermined instant in the signal transmission.

8. A cable system arranged for alternate operation in both directions, comprising a transmitting circuit, a selective relay in the transmitting circuit operative to close its armature contact only on zero current impulses greater than unit length, a receiving circuit at a distant station, a second selecting relay in the receiving circuit operative to close its armature contact only on zero impulses greater than three units in length, and switching apparatus controlled by both relays to reverse the direction of operation of the cable.

9. In a cable system a cable, a transmitter circuit connected thereto comprising an automatic transmitter adapted to transmit signal impulses of both polarities and spacing impulses of zero current, a receiver circuit connected to the cable at the distant station including a selective relay responsive to a no-current condition of the cable greater than the spacing impulses, a switching relay including an armature connected to the cable and adapted upon its forward movement to break contact with the transmitter circuit, clock-controlled means to operate the switching relay after a predetermined transmission interval, and means responsive to the operation of the distant selective relay to disconnect the receiver circuit from the cable.

10. A cable telegraph system comprising a cable, a station including an automatic transmitter and means for rendering the transmitter inoperative to send signals over the cable, a distant station comprising a second transmitter and a switching relay in a circuit effective to maintain said transmitter inoperative, a selective relay at the distant station adapted to release its armature upon failure of transmission from the first station, a control relay comprising an armature contact in the switching relay circuit and means to momentarily energize the control relay by way of a circuit including the armature contact of the selective relay.

11. An automatic telegraph system comprising a cable extending between two stations, an automatic transmitter and a receiver at each station, an automatic reversing switch for each station adapted to reverse the direction of operation of the cable, and control apparatus for said switch comprising a selective relay in the transmitter circuit, a second selective relay in the receiver circuit, a control relay under the control of said second selective relay, a switching relay, an energizing circuit for said switching relay under control of the first selective relay, and a locking circuit for said switching relay under control of said second selective and control relays.

In testimony whereof I affix my signature.

WILLIAM A. DUDLEY.