

July 17, 1928.

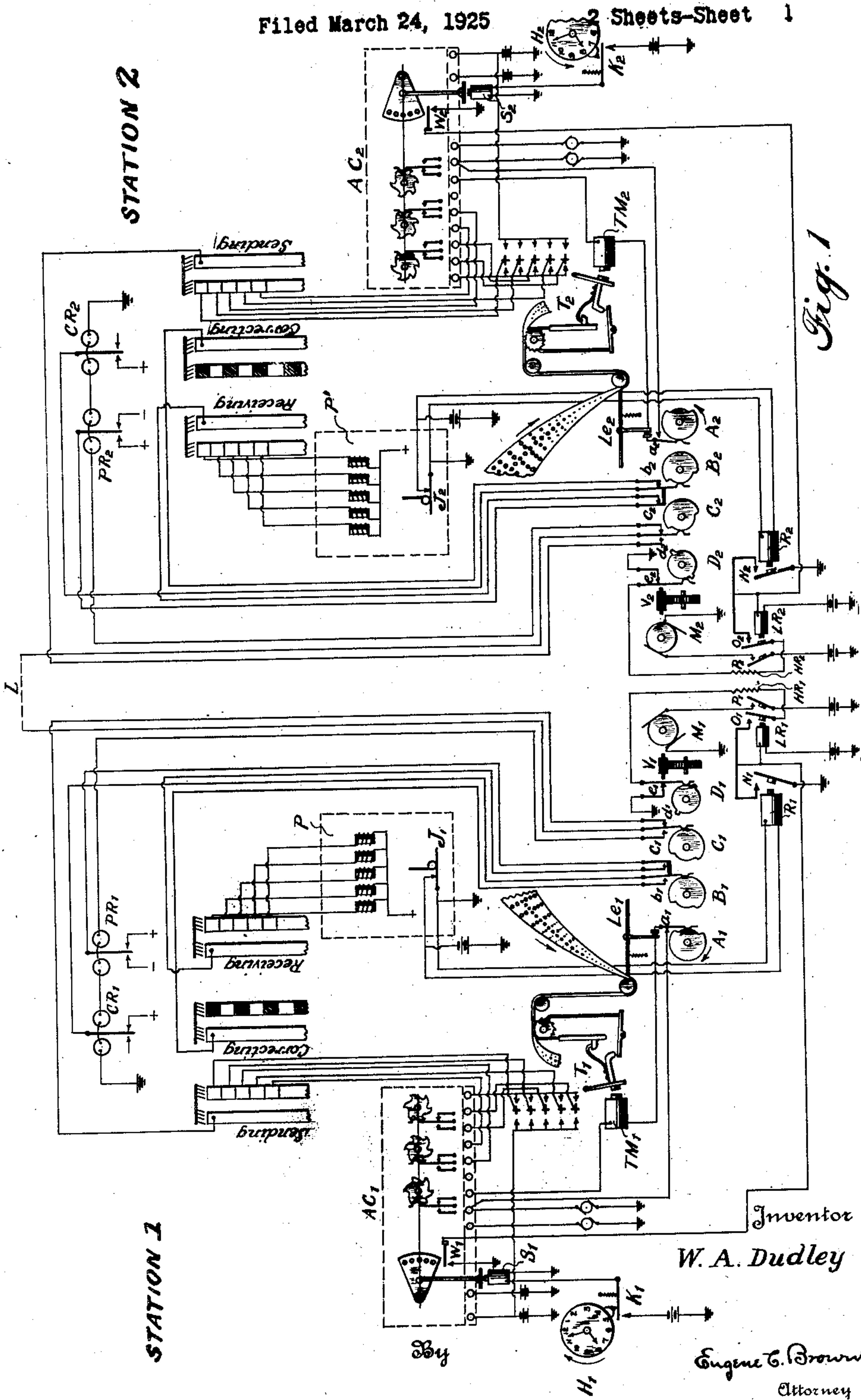
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AUTOMATIC REVERSING SYSTEM FOR MULTIPLEX CIRCUITS

Filed March 24, 1925

2 Sheets-Sheet 1



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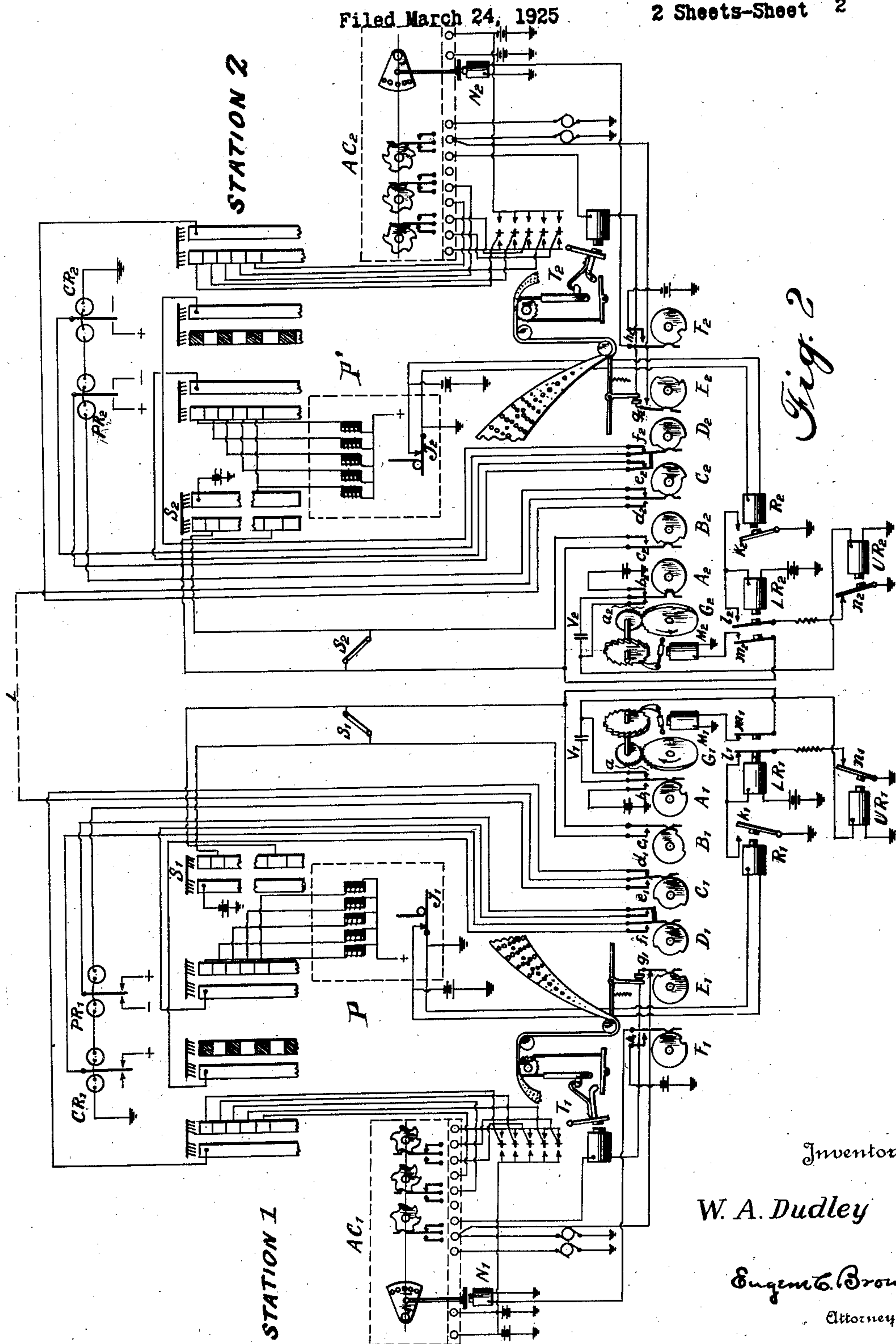
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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AUTOMATIC REVERSING SYSTEM FOR MULTIPLEX CIRCUITS.

Application filed March 24, 1925. Serial No. 17,986.

My invention relates generally to automatic telegraph systems, and particularly to an automatic reversing switch for automatic telegraph circuits, more especially circuits of multiplex printing telegraph systems of the Baudot and similar types. It comprises means whereby the direction of operation of an automatic telegraph circuit may be automatically reversed with a minimum of lost time and in a manner which will insure correct continuity of a message regardless of when the switching may occur.

The patent issued to W. A. Houghtaling, No. 1,275,559 dated Aug. 13, 1918, illustrates and describes a multiplex printing telegraph system of the type with which the invention is intended to be used, as may be seen in the accompanying description and drawings, but my invention is by no means restricted to use with that particular type of system.

The multiplex system of automatic telegraphy, as usually applied, provides for from one to four separate transmissions in one direction or in both directions simultaneously over a single line wire. The latter practice calls for a duplexed line and must, therefore, employ an artificial line at each terminal for balancing purposes. Occasionally, however, line conditions are encountered which are so unstable that the use of an artificial line and consequently the duplex principle becomes impractical. In such cases a greater circuit output can be obtained by operating in only one direction at a time, using as many channels of transmission as desired.

When operating a circuit in only one direction at a time it becomes desirable to reverse the direction of transmission periodically and at frequent intervals, in order to give each terminal an equal opportunity to discharge its business with a minimum of delay. The device described below is designed to automatically reverse the direction of operation of the circuit at predetermined intervals, to make possible adjustment of the length of the transmission period for either station in order to take care of varying traffic requirements, to accomplish the switching without causing false operation of the receiving and correction apparatus or mutilation of the message being transmitted

at the moment when switching occurs, and to insure correct sequence and least possible delay in the operations necessary to effect the switching. The construction of the device is, moreover, of such a nature, that when more than one channel of a multiplex system is provided with the automatic reversing switch of my invention, the additional apparatus required is a minimum.

According to my invention, I control the direction of operation of the circuit through that portion of the system which is known in the art as the "auto control". The auto control is described in detail on pages 9 and 10 of the patent to Houghtaling, already mentioned, and comprises auxiliary transmitting means adapted to communicate automatically to the distant station requests for reruns, repunches, and other signals incidental to tape transmission of the message proper. The distant receiving station includes auxiliary receiving means for these incidental signals which is operated through the receiving printer. In accordance with my invention, I provide a plurality of cam members, one of which operates a pair of contacts in the auto stop circuit of the auto control, and the second a plurality of pairs of contacts in the tongue circuits of the receiver and corrector relays respectively; the third cam transfers connection of the line from the receiver and corrector relays to a ring of the transmitting distributor, and the fourth operates contacts in the circuit of a relay which in turn controls operation of the cam-driving means. In one embodiment of my invention the automatic switching operations are initiated by energization of a relay at the station then transmitting and subsequent operation of cam driving motors at both stations. The energizing circuit of this relay is established at predetermined intervals by a pair of clock controlled contacts. In the second embodiment, the clock and motor are dispensed with, and the synchronous distributors act as synchronized timing devices to control, through their local segments, a magnet which actuates a ratchet and pawl device, this in turn causing rotation of the system of cams.

Fig. 1 shows that embodiment of my invention which utilizes a clock control and a cam driving motor.

Fig. 2 shows a second embodiment of the invention which utilizes the synchronous distributors to control initiation of the switching operations, and a pawl and ratchet device for rotating the cams.

In the following detailed description, the same letter is used to designate corresponding elements at the two stations, the subscripts indicating the particular station at which the element is found.

Fig. 1 shows two terminals joined by a line L with contacts in the proper positions for station 1 to transmit to station 2. The usual transmitter, of the type disclosed in the patent to G. R. Benjamin, No. 1,298,440 dated Mar. 25, 1919, is schematically indicated at T₁ as comprising five separate sets of contacts, each of the sets of contacts being arranged to produce current reversals. The sets of contacts are connected to segments of a synchronous distributor in the well known manner, and to the auxiliary signaling apparatus AC₁, in the manner disclosed in the patent to Houghtaling. The eleven terminals indicated at the bottom of the dotted line rectangle AC₁ corresponds to terminals a, b, c . . . l in Fig. 1^a of that patent.

PR₁ represents the usual printer relay associated with the usual printer P through the usual receiving distributor segments. CR₁ is a corrector relay forming part of the usual phase correcting mechanism, which may be of the type disclosed in the patent to Rothermel 1,253,889, dated Jan. 15, 1918.

T₂, AC₂, PR₂, P', and CR₂ represent corresponding apparatus at station 2.

In accordance with my invention additional switching apparatus is provided at station 1 in the form of a plurality of cams A₁, B₁, C₁, and D₁ and a motor M₁, which is connected through reduction gears V₁ to a shaft carrying the cams. Cam A₁, through a pair of contacts a₁, controls the circuit of the usual transmitter magnet TM₁ so that when a₁ is closed TM₁ is permitted to operate. The energizing circuit of TM₁ also passes through the contacts of an automatic stop device Le₁ controlled by the tension of the transmitter tape.

Cam B₁ simultaneously opens, or closes, two pairs of contacts b₁ in circuits which lead to the tongues of the printer relay PR₁ and corrector relay CR₁. When these contacts are opened the printer and corrector relays are rendered inoperative, and by this means the printer and corrector mechanisms are safeguarded from false operation.

Cam C₁ by its contacts c₁ and d₁ is adapted to connect line conductor L to a conductor leading to the printer and corrector relays, or to a conductor connected to the transmitting distributor ring. It is obvious that when c₁ is open, d₁ is closed, and vice versa.

Cam D₁ through its contact e₁, controls a circuit of relay LR₁, which, in turn, through forward movement of its armature contact P₁, closes the circuit of motor M₁. Relay LR₁ may be energized during either the transmission period or the reception period, this being dependent upon which station is at the time initiating the reversing operations. For this purpose it is provided with three circuits, the third being a locking or holding circuit closed through its armature contact O₁. The clock H₁ can be set to stop or prevent operation of the transmitter at any desired time. This clock through its contact K₁ controls the energization of a magnet S₁. Magnet S₁ causes the auto control AC₁ to send a one bell signal to the distant station, and also to close a contact W₁ in a circuit leading to LR₁. When, however, station 1 is the receiving station to which the one bell signal is sent, relay LR₁ is energized through a circuit controlled by relay R₁. Relay R₁ is normally shortcircuited by contacts J₁ in printer P. Upon receipt of a one bell signal, however, contacts J₁ are opened with consequent energization of relay R₁, and, through it, of relay LR₁. In either case, the energization of relay LR₁ results in the establishment of a locking circuit, which, as indicated above, is opened by cam D₁ after the lapse of a predetermined short interval of time.

Station 2 is equipped with switching apparatus like that at station 1.

From the preceding discussion of the functions of the various parts of the automatic switching apparatus, the manner of operation of the system of Fig. 1 will be apparent in the following description:

The signals set up by transmitter T₁ pass through the sending rings of the distributor at station 1 and contacts d₁ to line L, then through contacts e₂ at station 2, printer relay PR₂ and corrector relay CR₂ to ground. As the contacts at b₂ are closed, the circuit from the tongue of the printer relay PR₂ through contacts b₂ and the receiving rings of the distributor at station 2 to printer P' is complete, and the signals are received at station 2 by the printer.

The circuit from the tongue of the corrector relay CR₂ through contacts b₂ to the correcting rings is also complete, allowing the correcting mechanism at station 2 to function and maintain the synchronism of the circuits. As is usual, the distributor at station 2 runs slightly faster than the distributor at station 1, and the corrector at station 2 steps the brushes backward.

At the receiving terminal, the transmitter T₂ is prevented from operating because of the open contacts a₂ in the auto stop circuit, i. e. the circuit through transmitter magnet TM₂ and the contacts of rod Le₂. When this circuit is open the tape feed is

stopped and the transmitter tongues are held against their spacing contacts, in the manner disclosed in the patent to Benjamin.

It will be noted that during transmission from station 1 the tongue circuits of printer relay PR_1 and corrector relay CR_1 are open at b_1 so that neither the printer P nor the correcting mechanism at station 1 can be affected by these idle relays while the station is sending.

In order to reverse the direction of the circuit it is necessary to stop the transmission from station 1, open the printer and corrector relay circuits at station 2, switch the line from sending to receiving at station 1 and from receiving to sending at station 2, then close the printer and corrector relay tongue circuits at station 1 and start the transmitter at station 2. These operations must occur in the proper sequence and with a minimum of lost time.

The intervals between reversals of operations are controlled by clocks H at the terminals but each switching is initiated and controlled by the transmitting station.

After the circuit has been operating in the direction shown for a predetermined length of time, a contact K_1 in the clock H_1 closes, completing a circuit from battery through contacts K_1 and magnet S_1 to ground. The magnet S_1 , being energized, attracts its armature which draws forward with it the finger wheel of the auto-control AC_1 a distance sufficient to transmit one bell signal. In accordance with the well known manner of operation of the auto-control, as the finger wheel starts to move forward a contact arm within the auto control (as in the patent to Houghtaling) opens the auto stop circuit, thus stopping the transmitter in such a way that the last character set up in the transmitter is completed without regard to the instant when the contacts open. This feature of the auto control is described in detail in lines 84 to 126, page 12 of the patent to Houghtaling.

At this point it may be noted that though it is old to prevent mutilation of a transmitted signal by automatically delaying the opening of a transmitter circuit until the last transmitted character has been completed, my invention comprises a novel combination of such mutilation prevention means in a system designed to automatically reverse the direction of operation of a simplex cable.

The finger wheel having caused the stopping of the transmitter by its initial forward motion, further forward motion closes contacts W_1 and completes a circuit from ground through contacts W_1 and relay LR_1 to battery. When the relay LR_1 is energized the contacts O_1 are closed to establish a locking circuit for LR_1 in which the locking current flows from ground through the

closed contacts e_1 , resistance HR_1 , contacts O_1 and relay LR_1 to battery.

Energizing relay LR_1 also closes contacts P_1 and permits current to flow from the battery through contacts P_1 and motor M_1 to ground, and the shaft carrying cams A_1 , B_1 , C_1 , and D_1 is thereby caused to rotate.

As the cams start to rotate in the direction shown by the arrows, contacts K_1 in clock H_1 opens, deenergizing magnet S_1 and permitting the finger wheel of auto control AC_1 to start its return motion step by step as controlled by a local segment of the distributor. This step by step operation of the finger wheel is described on page 10 of the patent to Houghtaling. As the finger wheel moves backward, contacts W_1 are opened but the energization of relay LR_1 is maintained by the said locking circuit.

As the backward motion of the finger wheel continues, the characters "figures", "bell", and "letters" are transmitted to the line, after which the auto stop contacts inside the auto control are closed and would permit the transmitter to again function normally were it not for the fact that contacts a_1 , also in the auto stop circuit had in the mean time been opened by the action of cam A_1 . With the auto stop circuit open at a_1 the transmitter T_1 remains inoperative with its tongues against their spacing contacts, and as a consequence successive spacing impulses are transmitted following the "letters" character.

When the bell signal is received at station 2, contacts J_2 in the printer P' are opened, causing current to flow from battery through relay R_2 to ground. Relay R_2 being energized attracts its armature closing contacts N_2 and permits a current to flow from battery through relay LR_2 and contacts N_2 to ground. Relay LR_2 locks up and closes the circuit of motor M_2 in the same manner as described for station 1.

With both cam shafts in motion the next action which takes place is at b_2 which opens the tongue circuits of printer relay PR_2 and corrector relay CR_2 . This action is delayed until after the printer P' has received the "letters" signal transmitted from auto control AC_1 and occurs while the succeeding spacing impulses are being received. As spacing impulses do not affect the printer, the printer relay tongue circuit may be opened at any time during the selection without introducing false characters and the printer will be stopped in position to receive the next character, which transmitter T_1 will transmit after the circuit is restored to its original condition, i. e., sending from station 1 to station 2. Opening the tongue circuit of the corrector relay prevents false operation of the corrector while the receiving apparatus at station 2 is idle.

As soon as contacts b_2 are opened, the line at station 1 is switched from sending to the receiving position by opening contacts d_1 and closing contacts c_1 and the line at station 2 is switched from receiving to sending by opening contacts c_2 and closing contacts d_2 . This reverses the previous condition, i. e., station 2 now sends spacing impulses from its transmitter T_2 through contacts d_2 to the line and thence through contacts c_1 , relay PR_1 and CR_1 to ground. These spacing impulses are insured by the open contacts a_2 in the auto stop circuit of the transmitter T_2 . These impulses cannot yet reach the printer P , however, as the tongue circuit of printer relay PR_1 is open at b_1 . While these spacing impulses are still being received at station 1, the tongue circuits of the printer and corrector relays PR_1 and CR_1 are closed at b_1 . This action can in no way throw false characters into the printer P as the spacing impulses have no effect upon it. Closing the tongue circuit of the corrector relay permits the correcting mechanism at station 1 to operate and maintain the synchronism of the circuit. As previously stated, the distributor at station 1 is revolving slightly more slowly than the distributor at station 2, therefore the corrector at station 1 must be arranged to step the brushes ahead rather than backward as is the customary practice. It is obvious that the speeds of the two distributors must be matched closely enough so that they will remain phased within the margin of the corrector during the brief interval when neither corrector is operative.

Now station 1 is in position to receive any signals which may be transmitted from station 2 and the movement of the cams at this station is stopped by cam D_1 which opens contacts e_1 , thus deenergizing relay LR_1 . This allows contacts O_1 and P_1 to open, thus removing the operating current from the motor M_1 and opening the locking circuit of relay LR_1 at a second point O_1 . The momentum of the motor M_1 is sufficient to carry the protrusion on cam D_1 far enough to again close contacts e_1 , thus leaving station 1 in the receiving position with the cams moved to the positions shown on the drawing for station 2.

With station 1 receiving impulses transmitted from station 2, it is now only necessary to start the regular transmission from station 2 in order to completely reverse the condition originally assumed. This is accomplished by the closing of contacts a_2 in the auto stop circuit of the transmitter T_2 when normal operation of this transmitter is resumed. This action completes the switching, and the motion of the cams at station 2 is stopped by opening contacts e_2 which deenergizes relay LR_2 and stops the motor M_2 in the manner described for M_1 .

Transmission will continue in this direction, i. e. from station 2 to station 1, for a predetermined length of time, when contacts K_2 , controlled by the clock H_2 at station 2 will close to again start the switching process in the reverse direction.

It is apparent that when additional channels are used, it is only necessary to employ one additional contact for each added channel. These added contacts are used to control the auto stop circuits of the transmitters and serve to start and stop their operation as described for the ones shown on the drawing. One channel is all that is necessary to control the switching of the circuit.

Use of the clocks rather than motors to determine the sequence of switching operations is not practical, as any departure from perfect synchronism would introduce that amount of lost time in the switching process. Used as they are, any discrepancy between the clocks will serve only to give one station slightly more transmitting time than the other, which is in no sense a loss.

The clock contacts can be arranged so that by simple manual adjustments the periods of transmission can be lengthened or shortened for either station to take care of varying traffic requirements.

While the foregoing is given with specific reference to the multiplex system, its application is in no sense limited to that system.

The operation of the system of Fig. 2 is similar to that of Fig. 1 except in so far as it is modified by the substitution of a pawl and ratchet device for the motor, and of a cam operated contact for the clock controlled contact. In this alternate system, instead of four, there are six cams, A, B, C, D, E and F, in each system of cams, the additional two controlling contacts, one in the circuit of a magnet N operating the finger wheel of the auto control and the other in the energizing circuit of the magnet M , which circuit extends from battery through the local distributor rings, armature contacts of relay LR and the winding of magnet M to ground, contacts m being held closed by the locking circuit of relay LR . This energizing circuit is supplied with current twice per revolution of the distributor and, through gears G , causes motor M to rotate the cam system step by step by means of a pawl and ratchet device. Unlike the first method described, this method provides that the cams at the transmitting station shall be in motion during the entire transmitting period.

The cams continue in motion without change in the positions of the contacts for the entire transmitting period. At the end of this time (which must be predetermined) contacts h are closed, thus energizing magnet N_1 which pulls the finger wheel of the

auto control AC_1 a distance sufficient to send one bell signal, after which the magnet N_1 is deenergized. While the finger wheel is returning, contacts g_1 open, preventing the transmitter T_1 from operating and causing spacing impulses to be transmitted after the finger wheel has returned to its back stop.

The bell signal from auto control AC_1 when received by the printer P' momentarily opens the bell contacts J_2 permitting a current to flow through relay R_2 to ground. The energization of relay R_2 closes contacts K_2 permitting current to flow through K_2 and relay LR_2 thus energizing relay LR_2 which closes contacts l_2 and m_2 and causes relay LR_2 to lock closed through contacts l_2 .

Contacts m_2 being closed, magnet M_2 is operated through the local rings of the distributor and motion of the cams at station 2 commences.

At station 2, after the "figures", "bell" and "letters" signals have been received by the printer P' , and while the spacing impulses are being received, contacts f_2 are opened, thus opening the tongue circuits of the printer and corrector relays PR_2 and CR_2 preventing further reception or correction at that station.

Following this, the line is switched from sending to receiving at station 1 and from receiving to sending at station 2. This is accomplished by opening contacts d_1 and e_2 and closing contacts d_2 and e_1 . As the auto stop circuit of transmitter T_2 is open at g_2 , station 2 now sends spacing impulses to station 1, and while these spacing impulses are being received at station 1 contacts f_1 are closed, completing the receiving circuits for station 1.

Station 1 is now in position to receive, and the motion of the cams at this station is stopped by cam A_1 which closes contacts b_1 , giving a momentary charging current through relay UR_1 into the condenser V_1 . The momentary energization of UR_1 opens contacts n_1 in the locking circuit of LR_1 long enough to deenergize relay LR_1 and allow contacts l_1 and m_1 to open. Thus the circuit through magnet M_1 is broken and motion of the cams at station 1 ceases.

The cams at station 2 will continue in motion and contacts g_2 are closed, restoring the auto stop circuit of transmitter T_2 , and completing the sequence of switching operations. Motion of the cams at station 2 continues for the full period of transmission, after which the sequence is repeated in the reverse direction. It will be noted that before the condensers V_1 and V_2 are charged, they are completely discharged by closing contacts a_1 and a_2 .

Switches S_1 and S_2 may be opened manually to double the period of transmission, for with these switches open, magnets M_1

and M_2 can receive only one impulse per revolution of the distributor.

Cams B_1 and B_2 with their contacts c_1 and c_2 are used to insure that the actual switching operations take place at the high rate of speed (i. e., with a minimum of lost time) regardless of the position of the switches S_1 and S_2 .

This method, like the first, is not limited in its application to the multiplex system.

What I claim as my invention is:

1. A printing telegraph system adapted for alternate operation in both directions, comprising a plurality of stations, an automatic transmitter and a receiving printer at each station, means at each station to automatically and periodically reverse the connection of the line from the transmitter to the receiver, and additional means at each station operative through the printer at the distant station to reverse the connection of the line at the distant station from receiver to transmitter.

2. A printing telegraph system adapted for alternate operation in both directions, comprising a line extending between an automatic transmitter and a receiving printer, a relay normally shortcircuited by a pair of contacts in the receiving printer, and means under control of the relay for disconnecting the printer from the line.

3. An automatic telegraph system comprising a line, a receiving printer connected thereto, a plurality of switching elements arranged to perform a plurality of switching operations in a given order, a system of cams adapted to operate the switching elements in the required order, a magnet and means for periodically energizing it to operate the cam driving mechanism, a control relay for said magnet under control of the receiving printer, a locking circuit for said control relay and means for momentarily breaking the locking circuit to deenergize said magnet.

4. A printing telegraph system comprising a line conductor, automatic transmitting means therefor, a receiving printer and auxiliary signal receiving means, auxiliary signal transmitting means arranged to operate the auxiliary receiving means through the receiving printer, a reversing switch, a magnet adapted to actuate said switch, and means controlled by operation of the auxiliary transmitting and receiving means to prepare a circuit for said magnet.

5. A printing telegraph system comprising a line conductor, automatic transmitting means therefor, a receiving printer and auxiliary signal receiving means, auxiliary signal transmitting means arranged to operate the auxiliary receiving means through the receiving printer, a reversing switch, a magnet adapted to actuate said switch, means

controlled by operation of the auxiliary transmitting and receiving means to prepare a circuit for said magnet, and means to periodically energize said magnet by completing the prepared circuit.

6. A printing telegraph circuit comprising a line conductor extending between an automatic transmitter and a receiving printer, auxiliary transmitting means associated with the automatic transmitter, means controlled by the printer and responsive upon operation of the auxiliary transmitting means to disconnect the printer from the line.

7. A printing telegraph circuit comprising a line conductor adapted for operation in both directions, a plurality of stations, an automatic transmitter and a receiving printer at each station, auxiliary signal transmitting means associated with the automatic transmitter, and means controlled by the printer and responsive upon operation of the auxiliary transmitting means to disconnect the printer from the line and connect the automatic transmitter thereto at the station distant from the auxiliary transmitting means.

8. A printing telegraph system comprising a line conductor, an automatic transmitter therefor, auxiliary transmitting means at the same station, a magnet controlling said auxiliary means, and means for periodically and automatically energizing said magnet to operate said auxiliary transmitting means.

9. A telegraph circuit adapted for alternate transmission in both directions comprising a line conductor, a system of cams at each station arranged to reverse the direction of transmission over said line, means for rotating said cams, a magnet controlling said rotating means, and means to close an energizing circuit for said magnet from either station.

10. A telegraph circuit adapted for alternate operation in both directions, comprising a line conductor, a system of cams at each station arranged to reverse the connection of the line from the transmitter to receiver and vice versa, means for rotating said cams, a magnet controlling said rotating means a circuit for said magnet including the armature contact of a control relay, means to close the circuit of said control relay from either station, a holding circuit for said control magnet and an additional cam member adapted to break the holding circuit upon completion of the reversing operation.

11. A printing telegraph system comprising a line conductor extending between two stations, an automatic transmitter at each station, means at each station to maintain one transmitter inoperative while the other is operative, an auxiliary automatic trans-

mitter and controlled means periodically actuating said auxiliary means to render operative the inoperative transmitter.

12. A printing telegraph system comprising a line conductor extending between two stations, an automatic transmitter and a receiving printer at each station, means at each station to maintain one transmitter inoperative while the other is operating, an auxiliary automatic signal transmitter, controlled means periodically actuating said auxiliary means to control said printer, and means controlled by said printer to render operative the inoperative transmitter.

13. In a printing telegraph system, a line conductor, a plurality of stations therefor, an automatic transmitter and a receiver at one station adapted to permit operation of the conductor in either direction, auxiliary signal transmitting means associated with the automatic transmitter, and means including said auxiliary transmitting means for automatically reversing the direction of operation at will.

14. An automatic telegraph system comprising a line conductor extending between two stations, an automatic transmitter and a receiving printer at each station, switching means to open the operating circuit of the transmitter at the first station, switching means to open the circuit of the printer at the distant station, switching means to reverse connection of the line from transmitter to printer at the first station and from printer to transmitter at the second station, switching means to close the circuit of the printer at the first station, switching means to close the transmitter circuit at the second station, a plurality of cams arranged to operate the switching means in the order given, a motor at each station arranged to rotate said plurality of cams, and means at the station transmitting for causing energization of the motors at both stations.

15. An automatic telegraph system comprising a line conductor, a plurality of stations therefor, an automatic transmitter and a printer at each station, a plurality of switching contacts adapted to reverse the direction of operation of the system, a system of cam members at each station arranged to operate the switching contacts, motors at each station for rotating the systems of cams, an auxiliary transmitting means at one station adapted to cause energization of both motors, an automatic starting circuit for said auxiliary means, and clock controlled contacts in said starting circuit adapted to be operated to initiate the reversal automatically and intermittently.

16. An automatic telegraph system comprising a line conductor extending between two stations, an automatic transmitter and a receiving printer at each station, a plurality of switching contacts adapted to reverse the

direction of operation of the system, a system of cam members at each station arranged to operate the switching contacts, a ratchet and pawl device at each station adapted to cause rotation of the system of cams, a magnet controlling actuation of the ratchet and pawl device, an energizing circuit for said magnet, and additional switching contacts and an actuating cam therefor arranged to cause a break in the energizing circuit of the magnet when the reversal of operation has been completed.

17. An automatic telegraph system comprising a line conductor extending between two stations, an automatic transmitter and a receiving printer at each station, a plurality of switching contacts adapted to reverse the direction of operation of the system, a system of cam members at each station arranged to operate the switching contacts, a ratchet and pawl device at each station adapted to cause rotation of the system of cams, a magnet controlling actuation of the ratchet and pawl device, a distributor at each station and an energizing circuit for said magnet extending through the local ring of the distributor at the station.

18. An automatic telegraph system comprising a line conductor extending between two stations, an automatic transmitter and a receiving printer at each station connected to line through a distributor, a plurality of switching contacts adapted to reverse the direction of operation of the system, a system of cam members at each station arranged to operate the switching contacts, a ratchet and pawl device adapted to cause rotation of the system of cams, a magnet controlling actuation of the ratchet and pawl device, an energizing circuit for said magnet extending through the local ring of the distributor, a pair of normally open contacts in said ener-

gizing circuit and means to control closing of said contacts from either station.

19. An automatic telegraph system comprising a line conductor extending between two stations, an automatic transmitter and a receiving printer at each station connected to line through a distributor, a plurality of switching contacts adapted to reverse the direction of operation of the system, a system of cam members at each station arranged to operate the switching contacts, a ratchet and pawl device adapted to cause rotation of the system of cams, a magnet controlling actuation of the ratchet and pawl device, an energizing circuit for said magnet extending through the distributor comprising a pair of normally open contacts, an auxiliary transmitter at one of said stations and means operative through the auxiliary means and the receiving printer at the distant station to cause closing of said normally open contacts.

20. A printing telegraph system adapted for alternate operation in both directions, comprising a line conductor extending between two stations, an automatic transmitter, a receiving printer and a synchronously operating distributor at each station, means for locking the transmitter at the first station upon its spacing side thereby causing the distributor to send spacing impulses over the line conductor, means for disconnecting the printer at the second station while said spacing impulses are being transmitted, means for thereafter reversing the connections of the transmitters and printers at both stations and simultaneously locking the transmitter at the second station upon its spacing side and means for thereafter unlocking the transmitter at the second station.

In testimony whereof I affix my signature.

WILLIAM A. DUDLEY.