

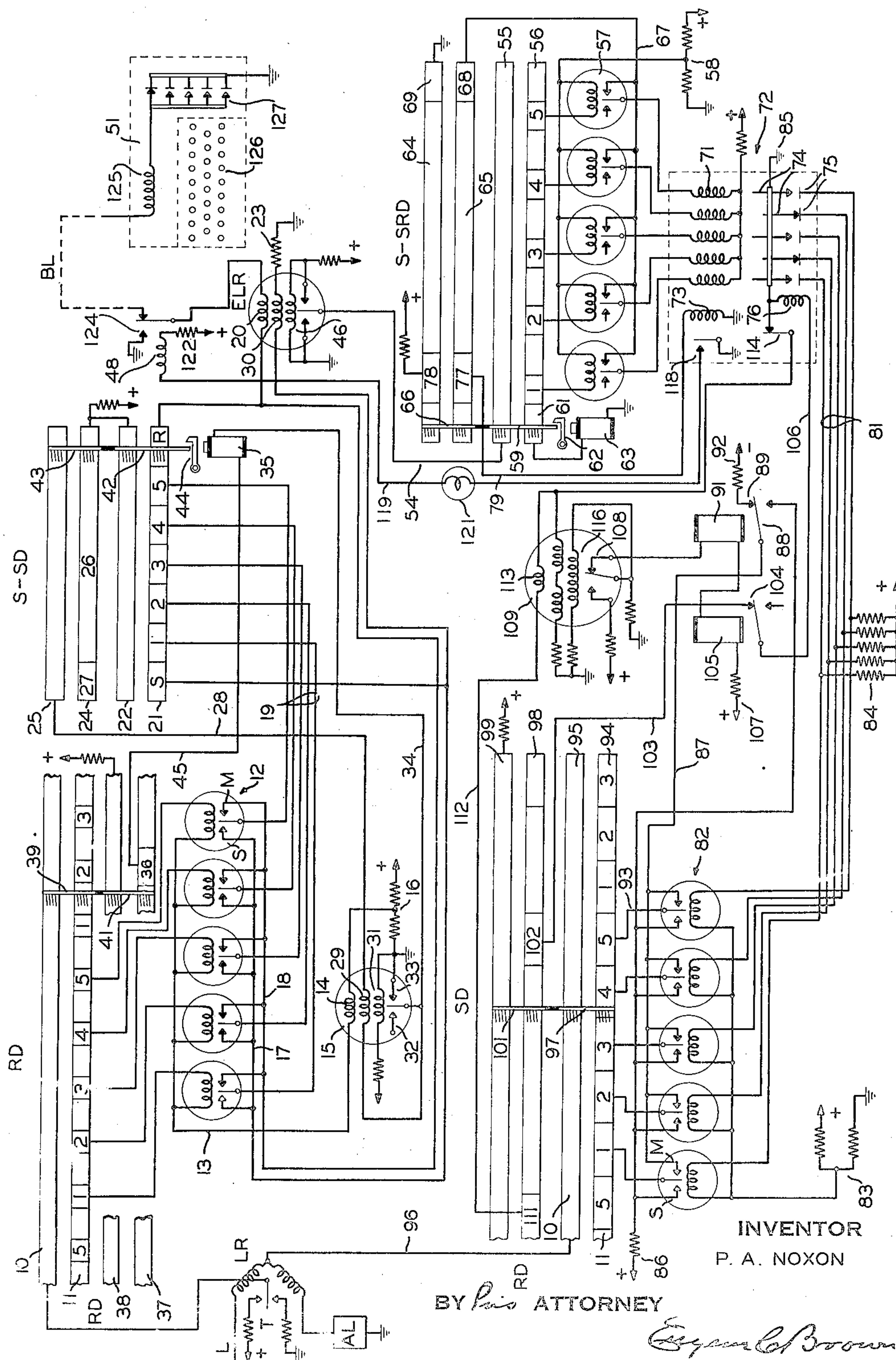
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EXTENDED CHANNEL SYSTEM

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EXTENDED CHANNEL SYSTEM

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This invention relates to a multiplex extended channel system and comprises means whereby one or more channels of a multiplex circuit may be extended to or continued from a start-stop telegraph system, which for instance, may connect the multiplex terminal with a branch office, or subscriber's station.

There is often a limited amount of business between a branch telegraph office connected to one central office and a branch office connected to another central office which is insufficient to warrant the establishment of a direct multiplex circuit between such branch offices. In such cases, the messages received at the main office from the various branch offices are retransmitted to the second main office over multiplex circuits and at the second main office they are distributed by telephone, pneumatic tubes or branch lines to the branch office for which the message was intended. This involves the handling of such messages a number of times with consequent delay, increased cost and possibility of error.

In many instances there is a sufficient volume of business between branch offices to fill one channel of a multiplex circuit, at least for a portion of the day.

It is one of the objects of the present invention, in such cases, to provide a system whereby the business originating at one branch office or subscriber's station may be repeated directly therefrom, over one channel of a multiplex circuit extending between main stations, and thence directly to the branch office for which the message is ultimately intended, without intermediate handling.

Another object is to enable signals to be repeated directly from the multiplex circuit to the simplex printer circuit or vice-versa, with single line operation on the simplex circuit, that is, without necessitating the use of duplex equipment on the branch office extension.

Other objects and advantages of the invention will appear as the detailed description of the invention proceeds.

The present invention, broadly speaking, comprises apparatus at a main station whereby signals received over one channel of a multiplex circuit may be repeated by means

of a start-stop distributor, over a simplex printer line to a branch office or subscriber's station and whereby the start-stop signals received from the branch office or subscriber's station operate a storage transmitter or other device for repeating the signals over one channel of a multiplex system.

In order that various features of the invention will be fully understood, reference will be had to the accompanying drawing in which:

The single figure illustrates, diagrammatically, the equipment and circuit arrangement at one main station and a branch station, assembled in accordance with the present invention.

The incoming main line L, which connects the main station with a distant main station is terminated in a line relay LR, which is shown duplexed. The marking and spacing contacts of the relay LR are connected, respectively, to ground and to positive battery and the tongue T is connected to the solid ring 10 of a receiving multiplex distributor RD.

The multiplex distributor may provide for any desired number of channels, usually three or four. One channel only is shown complete, which for convenience may be termed the A channel, this channel being utilized for messages which are to be extended directly to the branch office. The other channels of the multiplex distributor, ordinarily termed B, C and D channels may be operated in connection with regular multiplex equipment or other extended channel equipment, as desired.

The segmented receiving ring 11 is provided with five segments for each channel, the segments for the A channel being connected individually to one terminal of the windings of a series of polarized relays 12. The opposite terminals of each of the windings of the relays 12 are connected, by a conductor 13 to the operating winding 14 of a polarized relay 15 and thence to the midpoint of a potentiometer 16, the opposite ends of which are connected to ground and to positive battery respectively.

The spacing and marking contacts, S and M, of each of the polar relays 12 are con-

connected to the bus bars 17 and 18 respectively and the tongue of each of these relays is connected by an individual conductor 19 to segments numbered 1 to 5 of the segmented ring 21 of a start-stop distributor S—SD. The ring 21 is also provided with a rest segment R connected to the marking bus bar 18 and a start segment S connected to the spacing bus bar 17.

The marking bus bar 18 is connected to the extended channel or branch line BL through one coil 20 of the extended channel line relay ELR and the tongue and back contact of a neutral relay 48. The spacing bus bar 17 is connected to a grounded resistance 23 through the other coil 30 of the extended channel line relay ELR. The value of the resistance 23 is such that the current in this circuit is approximately equal to the current in the extended line. The solid transmitting ring 22 of the start-stop distributor is connected to positive battery.

Assuming the proper phase and speed relations to exist between the multiplex distributor RD and the start-stop distributor S—SD and the receiving simplex printer 51 at the branch office, it is evident that as the sending brushes of the distributor S—SD pass over the segments of ring 21, the tongues of the storing relays 12, which rest on their marking contacts, will cause marking signals to be sent over the line and those which rest on their spacing contacts will cause spacing signals or open line conditions to be transmitted to the branch office, where the character is selected and recorded by the simplex printer 51. It may be seen that while the relay tongues which rest on their spacing contacts interrupt the circuit from ring 22 to the line BL, thereby causing open or spacing signals to be sent over the line, they complete the circuit from ring 22 to the locking winding 30 of relay ELR, thus causing current to flow through the locking winding to hold the relay steadily on its marking contact and thereby prevent the signals from being repeated back over the multiplex line, as will more fully appear hereinafter.

The start-stop distributor is provided with local rings 24 and 25, the former having a live segment 26 connected to a source of positive potential and a dead segment 27, corresponding to the start segment S of ring 21. The solid local ring 25 is connected by a conductor 28 to the locking winding 29 of relay 15 and thence to the tongue of the relay. The relay is also provided with a biasing winding 31 which tends to maintain the tongue on its insulated or left hand contact 32. The windings 14 and 29 are arranged, when a marking signal is received, to position the tongue of the relay on its right hand or grounded contact 33. The tongue of the relay is also connected, by means of conductor 34, to the winding of the start magnet

35 of the start-stop distributor, the opposite terminal of which is connected through a conductor 45 to segment 36 of the local ring 37 of the multiplex receiving distributor RD. The opposite local ring 38 is provided with positive potential.

The receiving rings 10 and 11 of the multiplex distributor are traversed by brushes 39 and the local rings 37 and 38 are traversed by brushes 41. The transmitting rings 21 and 22 of the start-stop distributor are traversed by brushes 42 and the local rings 24 and 25 are traversed by brushes 43. The brushes of the multiplex distributor rotate continuously in synchronism with the incoming signals, as is well understood by those versed in the art, and cross the segments of channel A once during each revolution. The brushes 42 and 43 of the start-stop distributor are normally held at rest upon the rest segment R by means of a latch 44.

When the A channel is idle, spacing battery only is received over this channel, and in such case, as the brush 39 passes over the segments of the A channel, spacing battery from the relay LR is applied to the windings of the relays 12 and to the winding 14 of the relay 15, thereby maintaining the tongue of the latter relay upon its insulated contact 32. Consequently, the circuit for the start magnet 35, of the distributor S—SD, is not completed and the brushes 42 and 43 are held stationary. At this time, continuous marking battery is directly applied to the branch line BL from the rest segment R.

When intelligence signals are transmitted over the A channel, at least one of the selecting impulses will be of marking character and will operate the relay 15 to its right hand or grounded contact 33. When this occurs, the tongue is locked in its shifted position by battery supplied from the live segment 26 of ring 24, brush 43, ring 25, conductor 28, locking winding 29 and the tongue and contact 33 of the relay to ground. At the same time, the marking signals are set up on the segments of the ring 21 by the relay group 12. After the brush 39 of the multiplex distributor RD passes off of the segments of channel A, that is, after the received signals have been set up on the segments of the start-stop distributor, the brush 41 engages the local segment 36 completing a circuit for the start magnet 35 from battery at the local segment 38, brush 41, segment 36, conductor 45, start magnet 35, conductor 34 and the tongue and contact 33 of relay 15, to ground. Consequently, the brushes 42 and 43 are released and pass on to the start segment S and the dead segment 27, respectively.

As the brush 43 passes onto the dead segment 27 the circuit for the locking winding 29 of relay 15 is interrupted and the relay is restored to its insulated contact by the biasing winding 31, in readiness for the next

signal group. As the brush 42 traverses the segments S and 1 to 5, a start signal and five intelligence signals are repeated from the bus bars 17 and 18 over the branch line BL.

5 The brush comes to rest on the rest segment R at the end of the revolution.

10 The communication in the opposite direction, that is between the branch station and the distant main station, over the line L, will now be described. Signals originating at the simplex transmitter, diagrammatically shown at 51 at the branch station, are transmitted directly over the branch line BL to the line relay ELR at the main station.

15 The relay ELR is normally biased towards its spacing side or right side by biasing winding 46 which exerts approximately half the force of either the main line winding 20 or the locking winding 30. The marking signal from the branch office exerts a force approximately twice that of the biased circuit and so overcomes it to move the relay tongue to its marking contact.

25 The relay ELR has one of its contacts grounded and its opposite contact connected to positive battery. The tongue of the relay is connected by a conductor 54 to the solid ring 55 of the start-stop receiving distributor S—SRD.

30 The ring 56 of this distributor has its segments, numbered 1 to 5, connected individually to one terminal of the windings of a group of polarized relays 57, the opposite terminals of the relay windings being connected to the mid-point of a potentiometer 58, the opposite ends of which are connected to ground and to positive battery respectively. The brush 59 of the rings 55 and 56 is normally held upon segment 61 by a latch 62.

40 Segment 61 is connected through the winding of the start magnet 63 to ground.

When the sending simplex 51 at the branch station is idle the tongue of relay ELR is continuously held on its marking or grounded contact by current through either the main line winding 20 or the marking winding 30. Consequently the start magnet 63 is unenergized. When signals are transmitted through the transmitter 51, the first or start impulse is of spacing character, interrupting the line BL and causing the tongue of relay ELR to move to its positive contact by the biasing winding 46, thereby energizing the start magnet 63 to release the brush 59. The brush 59 passes over the segments 1 to 5 in synchronism with the transmitted intelligence impulses and serves to operate the relays 57 either to their marking or spacing contacts in accordance with the signal combination received. At the end of the revolution the brush 59 again comes to rest on segment 61. The distributor S—SRD is also provided with local rings 64 and 65, traversed by a brush 66.

65 The left or spacing contacts of the relay

group 57 are insulated and the right or marking contacts are connected by a common conductor 67 to one segment 68 of ring 65, the corresponding segment 69 of ring 64 being grounded. The tongues of the relays 57 are connected individually to the setting-up magnets 71 of a storage transmitter 72 which may be of the type shown in patent to Wheeler & Dirkes, No. 1,576,167 granted March 9, 1926.

Briefly the storing transmitter comprises a drum having a multitude of rows of radially extending pins which may be moved inward or outward with respect to the surface of the drum. Each row of pins corresponds to one group of intelligence signals and the setting thereof corresponds to the code combination. As each code combination is set up on the pins of the drum the setting-up arm is stepped ahead, by means of a magnet diagrammatically represented at 73, in position to receive the next signal group. After the pins have been set up they are engaged by a traveling transmitting arm which serves to repeat the combinations to a transmitting distributor. The transmitting arm and the setting-up mechanism operate independently and at different speeds. The transmitting pins are diagrammatically represented at 74 and the contacts of the transmitting arm at 75. After each code combination is transmitted the transmitting arm is stepped forward by a magnet 76 in position to transmit the succeeding signal group.

In the position shown in the figure the pins 74 are set up with numbers 1, 3 and 5 in spacing position and 2 and 4 in marking position.

It will be noted that, as the brush 59 sweeps over the segments 1 to 5, the code combination is not immediately transferred to the pins through the setting up magnet 71, only the tongues of the relays 57 being set at this time. After the last impulse of the group has been received, that is, the No. 5 impulse, brush 66 engages segments 68 and 69 of the local rings to apply ground to the tongues of the relays of group 57 which are in their marking position, thereby energizing the corresponding setting-up magnets of the storage transmitter to set the corresponding pins. At the beginning of each revolution of the brushes 59 and 66, the latter brush passes on to live segments 77 and 78 completing a circuit from negative battery through segment 78, brush 66, segment 77 and conductor 79, to the stepping magnet 73, by which the setting-up arm is advanced into position before the row of pins on which the next code combination is to be recorded.

At the transmitting side of the storage transmitter, the transmitting contacts 75 are connected by individual conductors 81, to one terminal of the windings of a second group of polarized relays 82. The opposite

terminals of the windings of relays 82 are connected to the mid-point of a potentiometer 83 the opposite ends of which are connected to ground and to positive battery respectively. Positive battery is also applied to each of the conductors 81 through a series of resistances 84. The transmitting pins 74, when selected, are grounded at 85. Consequently, as the transmitting arm moves into contact with a row of pins, the relays of group 82 corresponding to pins which are retracted, that is, the pins 1, 3 and 5 in the illustration, are moved to their spacing side by battery supplied through the resistances 84 and those relays associated with pins which have been moved outwardly to engage the contacts 75 are moved to their marking side by battery from the potentiometer 83, through the windings of the relays and to ground at 85.

The left or spacing contacts of the relays 82 are connected directly to a source of positive potential at 86 and the right or marking contacts are connected by a conductor 87 through the tongue 88 and front contact 89 of a relay 91 to negative battery at 92. Consequently, with the relay 91 energized, the potential applied to the tongues of the relays 82 corresponds to the signal combination set up on the pins of the storage transmitter.

The tongues of the relays 82 are individually connected by conductors 93 to the segments 1 to 5 of one channel of the transmitting ring 94 of the multiplex sending distributor SD. The solid ring 95 of distributor SD is connected to the apex of the line relay LR by means of a conductor 96. The rings 94 and 95 are traversed by a brush 97.

The distributor SD is also provided with local rings 98 and 99 traversed by brush 101.

The brush 97 as it passes over segments 1 to 5 of the A sending channel transmits the signals previously set up on the segments of the A channel directly over the outgoing line L. As the brush 97 engages the last segment 5 of this group the brush 101 engages a segment 102 of ring 98, whereby completing a circuit from positive battery through the solid ring 99, brush 101, segment 102, conductor 103, front contact 104 and tongue of a neutral relay 105, and conductor 106 to the winding of the stepping magnet 76 of the transmitting arm and thence to ground at 85. The energization of the magnet 76 does not immediately step the transmitting arm ahead but advances the stepping pawl of the mechanism so that as the brush 101 passes off of segment 102, the transmitting arm is advanced into the next position, thereby setting up a new combination on the segments of channel A.

The neutral relays 105 and 91 are normally energized from a source of potential 107, by a circuit traced through the windings of the relays in series, right hand contact 108 of an

auto-stop relay 109 and to ground through the tongue of the relay. The tongue of the relay is normally positioned on the contact 108 each time the brush 101 revolves, by a circuit completed from the solid ring 99, brush 101, segment 111 of ring 98, conductor 112, winding 113, thence by normally closed auto-stop contact 114 to ground at 85. The relay 109 is locked on its contact 108 throughout the remainder of the revolution by locking winding 116, under normal conditions.

The purpose of the neutral relays 91 and 105 is to interrupt the operation of the transmitting arm and restore spacing conditions to the segments of the transmitting multiplex distributor SD in case the transmitting arm gains on the setting-up arm due to the transmission of signals over the multiplex circuit at a faster rate than they are received over the simplex circuit. This feature, however, forms no part of the present invention and, therefore, the operation thereof will not be described herein. A complete description thereof is set out in application of Duerr and Broyles, Serial No. 549,762, filed July 9, 1931, patented Oct. 4, 1932, No. 1,880,906, and entitled "Multiplex extended channel system".

Likewise the stop warning contact 118 of the storage transmitter is provided for the purpose of interrupting the transmission of signals to the storage device and for signaling the operator at the branch stations in case the storage transmitter ultimately reaches the limit of its storage capacity, due to the transmission of signals from the branch office at a faster rate than they are repeated over the multiplex circuit. The contact 118 is normally open and closes whenever the storage device operates within a definite number of characters of full storage capacity. One contact of the switch 118 is grounded and the other is connected by a conductor 119 through a signal lamp 121 to one terminal of the relay 48, the opposite terminal of which is connected to a source of potential through the resistance 122. When this circuit is completed by closing of the contact 118, the light 121 glows, thus indicating to the attendant at the main station that the storage transmitter is reaching the limit of its capacity. At the same time the relay 48 draws its tongue 123 to the front contact 124, applying ground to the relay winding 20 and at the same time opening the branch line BL.

The branch line being disconnected from the operating winding of line relay ELR, this relay is held on its grounded side by the winding 20, thereby precluding the operation of the start magnet 63 of the distributor S—SRD, so that no additional signals will be applied to the storage transmitter until the transmitting side thereof has gained somewhat on the receiving side.

With the branch line BL open at relay 48, a spacing or starting condition will be contin-

uously applied to the printer magnet 126 of the simplex printer-transmitter 51, causing the printing cam shaft to rotate continuously or race without printing being accomplished.

5 The transmitting attendant is notified by this unusual operation of the printing mechanism, that the branch line is open. Since all signals transmitted from the keyboard 126 operate the printing mechanism of the
10 printer-transmitter 51 as long as the line is closed, to produce an outgoing record, the transmitting operator can determine by inspection of his own printed tape which character signal was the last to get through to
15 the storage transmitter. When the line is again closed he may continue from the last character recorded by his printer.

If, during the transmission to the branch station from the multiplex circuit, the branch
20 office operator desires to break in to transmit over the line, he may do so merely by operation of his transmitter in the usual manner. The resulting opening and closing of the branch line at the transmitting contacts 127
25 causes irregular operation of the line relay ELR at the main station, which in turn repeats jumbled signals to the start-stop distributor S—SRD for repetition back over the multiplex line. The printer at the distant end
30 of the multiplex line, or at the end of the simplex line extended therefrom, will then be actuated to produce jumbled printing, indicating to the attending operator that the operator at the opposite end desired to break in.

35 If desired, suitable switching arrangements may be provided as shown in the Duerr et al. application whereby the signals received from the branch office may be recorded on simplex apparatus at the main office or repeated over the multiplex channel; whereby
40 signals originating in a simplex transmitter at the main office may be transmitted either to the associated branch office or directly over the multiplex circuit; and whereby signals
45 received over the multiplex circuit may be recorded on simplex printers at the main office or repeated directly to the branch office.

It will be noted with the arrangement provided that the signals repeated from the
50 multiplex line to the simplex printer line do not affect the operation of the start-stop receiving distributor S—SRD since the tongue of the relay ELR is continuously held on its marking contact by both marking and spacing
55 signals transmitted from the start-stop distributor S—SD but whenever the A channel of the multiplex system is idle the start-stop distributor brush 42 remains on its rest segment R supplying continuous battery
60 through the line winding 20 of the relay ELR, the circuit to the locking winding 30 being interrupted. Consequently, the relay ELR responds to the signals originating at the simplex printer 51 at the branch office
65 and serves to repeat such signals to the start-

stop receiving distributor S—SRD for transmission over the multiplex circuit. Therefore, duplexing of the branch line BL is not required. This feature is of considerable importance since it eliminates the use of line
70 battery at the branch office as well as the expense of duplex equipment, the only equipment required at the branch office being a combined simplex transmitting and printing
75 machine and if desired, a calling key to enable the branch office operator to break in on the line.

Obviously, many changes and variations may be made in the system disclosed without departing from the invention and, therefore, I do not desire to be limited to the exact details shown except in accordance with the appended claims.

What I claim is:

1. In a telegraph system, a multiplex circuit terminating at a main station, a simplex circuit arranged for non-duplexed or single line operation only, also terminating at said station, means for transmitting corresponding marking and spacing conditions over said
85 multiplex circuit when marking and spacing conditions are received over the simplex circuit, means for transmitting corresponding marking and spacing conditions over said simplex circuit when marking and spacing
90 conditions are received over said multiplex circuit and means for preventing the repeating of said last marking and spacing conditions back over said multiplex circuit.

2. In a telegraph system, a multiplex circuit terminating at a main station, a simplex circuit arranged only for non-duplexed or single line operation, extending from the main station to a distant station, means for transmitting corresponding marking and
100 spacing conditions over said multiplex circuit when marking and spacing conditions are received over said simplex circuit, a start-stop distributor at the main station, means
105 for setting up signals received over one channel of the multiplex system on the contacts of said distributor, means for transmitting said signals from said distributor to the distant station and means for preventing the
110 repeating of said last signals back over the multiplex circuit.

3. In a telegraph system, a multiplex circuit terminating at a main station, a non-duplexed circuit also terminating at said main station, means for transmitting corresponding marking and spacing conditions over said
120 multiplex circuit when marking and spacing conditions are received over said simplex circuit, means for transmitting corresponding marking and spacing conditions over said simplex circuit when marking and spacing
125 conditions are received over the multiplex circuit, a line relay in said simplex circuit, said relay being responsive, when both marking and spacing conditions are repeated from
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the multiplex circuit to the simplex circuit, to hold the relay tongue in a predetermined position.

4. In a telegraph system, a main station, a pair of telegraph circuits terminating at said main station, at least one of said circuits being arranged for non-duplexed or single line operation only, a receiving distributor and a sending distributor at said station for each circuit, means for transferring signals received over either circuit from its receiving distributor to the sending distributor of the other circuit and means for preventing the repeating of said signals back over the circuit from which they were originally received.

5. In a telegraph system, a main station, a plurality of telegraph circuits terminating at said main station, a receiving distributor and a sending distributor at said station for each circuit, means for transferring marking and spacing signal conditions received over one circuit from its receiving distributor to the sending distributor of another circuit, a line relay in said last circuit, said relay having a line winding responding to marking conditions transmitted in either direction over said circuit and a locking winding energized only when spacing conditions are transmitted over said circuit from the sending distributor, said locking winding being poled to maintain the relay on its marking side.

6. In a telegraph system, a main station, a plurality of telegraph circuits terminating at said main station, a receiving distributor and a sending distributor at said station for each circuit, means for transferring marking and spacing signal conditions received over one circuit from its receiving distributor to the sending distributor of another circuit, a line relay in said last circuit, said relay having a line winding and a locking winding applying substantially equal magnetized force in the same direction to said relay when marking and spacing signals respectively are transmitted from said sending distributor over the circuit, whereby said relay will not respond to changes from one signal condition to the other and a biasing winding arranged to apply an appreciably lower magnetizing force in the opposite direction, said locking winding being unenergized when signals are transmitted over the circuit from the distant end only, whereby said relay will respond to said latter signals.

7. In a telegraph system, a main station, a plurality of telegraph circuits terminating at said main station, a receiving distributor and a sending distributor at said station for each circuit, means for transferring marking and spacing signal conditions received over one circuit from its receiving distributor to the sending distributor of another circuit, a line relay in said last circuit, said relay

having a line winding responding to marking conditions transmitted in either direction over said circuit and a locking winding energized only when spacing conditions are transmitted over said circuit from the sending distributor, said locking winding being poled to maintain the relay on its marking side and the receiving distributor for said last circuit being controlled by said relay, to repeat the signals over a desired circuit.

8. In a telegraph system, a multiplex circuit terminating at a main station, simplex circuit also terminating at said main station, means for transmitting corresponding marking and spacing conditions over said simplex circuit when marking and spacing conditions are received over the multiplex circuit, a line relay in said simplex circuit, said relay being responsive to both marking and spacing conditions repeated from the multiplex circuit to hold the relay tongue in a predetermined position, means for continuously interrupting the circuit to said locking winding during the transmission of signals over the simplex circuit to the main station and means controlled by said relay for repeating said last signals over said multiplex circuit.

9. In a telegraph system, a main station, a multiplex circuit and a simplex circuit terminating at said station, a receiving distributor for the multiplex circuit and a sending distributor for the simplex circuit, a storage device having a plurality of sets of marking and spacing contacts associated with said receiving distributor adapted to store the signals received over one channel of the multiplex circuit, said marking contacts being included in said simplex circuit and said spacing contacts being included in a second circuit, the sending distributor serving to complete in succession the circuit including one contact of each set in accordance with the stored signal combination, a relay having an operating winding arranged in said simplex circuit and a locking winding in said second circuit, both of said windings being similarly poled, whereby the relay tongue is continuously maintained on the same contact regardless of whether marking or spacing conditions are applied to the simplex circuit.

10. In a telegraph system, a main station, a multiplex circuit and a simplex circuit terminating at said station, a receiving distributor for the multiplex circuit and a sending distributor for the simplex circuit, a storage device having a plurality of sets of marking and spacing contacts associated with said receiving distributor adapted to store the signals received over one channel of the multiplex circuit, said marking contacts being included in said simplex circuit and said spacing contacts being included in a second circuit, the sending distributor serving to complete in succession the circuit including one

contact of each set in accordance with the stored signal combination, a relay having an operating winding arranged in said simplex circuit and a locking winding in said second circuit, both of said windings being similarly poled, whereby the relay tongue is continuously maintained on the same contact regardless of whether marking or spacing conditions are applied for interrupting the circuit to said locking winding independently of the position of the contacts of said storage device, when no signals are being received over the multiplex channel and a biasing winding poled oppositely to said main and locking windings and exerting a substantially lower magnetizing force, whereby the relay will respond to signals transmitted to the main station over the simplex circuit.

11. In a telegraph system, a main station, a multiplex circuit and a simplex circuit terminating at said station, a receiving distributor for the multiplex circuit and a sending distributor for the simplex circuit, a storage device having a plurality of sets of marking and spacing contacts associated with said receiving distributor adapted to store the signals received over one channel of the multiplex circuit, said marking contacts being included in said simplex circuit, and said spacing contacts being included in a second circuit, the sending distributor serving to complete in succession the circuit including one contact of each set in accordance with the stored signal combination, a relay having an operating winding arranged in said simplex circuit and a locking winding in said second circuit, both of said windings being similarly poled, whereby the relay tongue is continuously maintained on the same contact regardless of whether marking or spacing conditions are applied to the simplex line, means for interrupting the circuit to said locking winding independently of the position of the contacts of said storage device, when no signals are being received over the multiplex channel, a biasing winding poled oppositely to said main and locking windings and exerting a substantially lower magnetizing force, whereby the relay will respond to signals transmitted to the main station over the simplex circuit, a receiving distributor at the main station for said simplex circuit, said last distributor being controlled by said relay and means for transferring the signals received on said last distributor to the multiplex circuit.

12. In a telegraph system, a main station, a multiplex circuit and a simplex circuit terminating at said station, a receiving distributor for the multiplex circuit and a sending distributor for the simplex circuit, a polarized relay for each impulse of a signal group, said relay being associated with the receiving distributor for operation by the signals re-

ceived over one channel of the multiplex circuit, the tongues of said relays being connected individually to the corresponding segments of the sending distributor, the marking contacts of the relays being included in said simplex circuit and the spacing contacts being included in a second circuit, the sending distributor serving to apply a source of potential to the relay tongues in succession, whereby to complete one of said circuits, depending upon the position of the relay tongues, a line relay having an operating winding in the simplex circuit and a locking winding in the second circuit, both of said windings being similarly poled, whereby the relay tongue is maintained on the same contact irrespective of whether marking or spacing conditions are set up on the tongues of the storage relays, said line relay being responsive to signals transmitted over the simplex line in the opposite direction.

13. In a telegraph system, a multiplex circuit terminating at a main station, a simplex circuit extending from the main station to a distant station, a storage device at the main station for storing signals received over the simplex circuit and repeating them to the multiplex circuit and means for interrupting the transmission of signals to the storage device when the characters stored therein exceed a predetermined number.

14. In a telegraph system, a multiplex circuit terminating at a main station, a simplex line extending from the main station to a distant station, a storage device at the main station for storing signals received over the simplex line and repeating them to the multiplex circuit and means for opening said simplex line to interrupt the transmission of signals to the storage device when the characters stored therein exceed a predetermined number.

15. In a telegraph system, a multiplex circuit terminating at a main station, a simplex line extending from the main station to a branch office, a transmitter and an outgoing record printer at said branch office, a storage device at the main station for storing signals received over the simplex line from the branch office and repeating them to the multiplex system and means for interrupting the operation of said outgoing record printer at the branch office when the characters in the storage device exceed a predetermined number.

16. In a telegraph system, a multiplex circuit terminating at a main station, a simplex line extending from the main station to a branch office, a transmitter and an outgoing record printer at said branch office, a storage device at the main station for storing signals received over the simplex line from the branch office and repeating them to the multiplex system and means for interrupting the transmission of signals to the storage device and

interrupting the operation of the outgoing record printer at the branch office whenever the characters in the storage device exceed a predetermined number.

5 17. In a telegraph system, a pair of telegraph lines terminating at a main station, a storage device at said station for storing signals received over one telegraph line and repeating them to the second telegraph line

and means for interrupting the operation of the receiving side of the storage device and signalling the distant operator when the characters in the storage device exceed a predetermined number.

In testimony whereof, I affix my signature.

PAUL A. NOXON.

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