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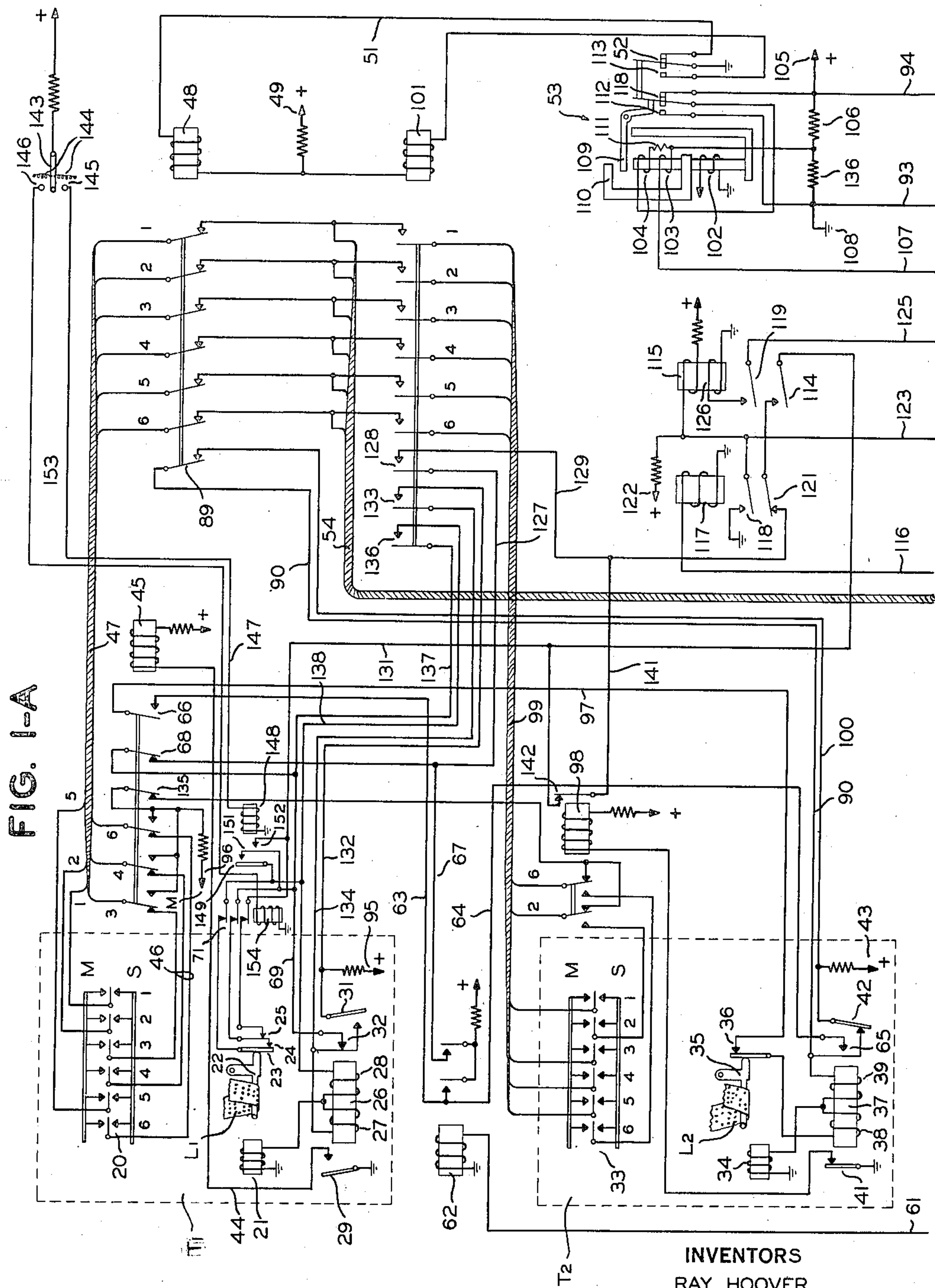
R. HOOVER ET AL

1,983,905

DIVIDED CHANNEL SYSTEM

Filed Dec. 7, 1932

4 Sheets-Sheet 1



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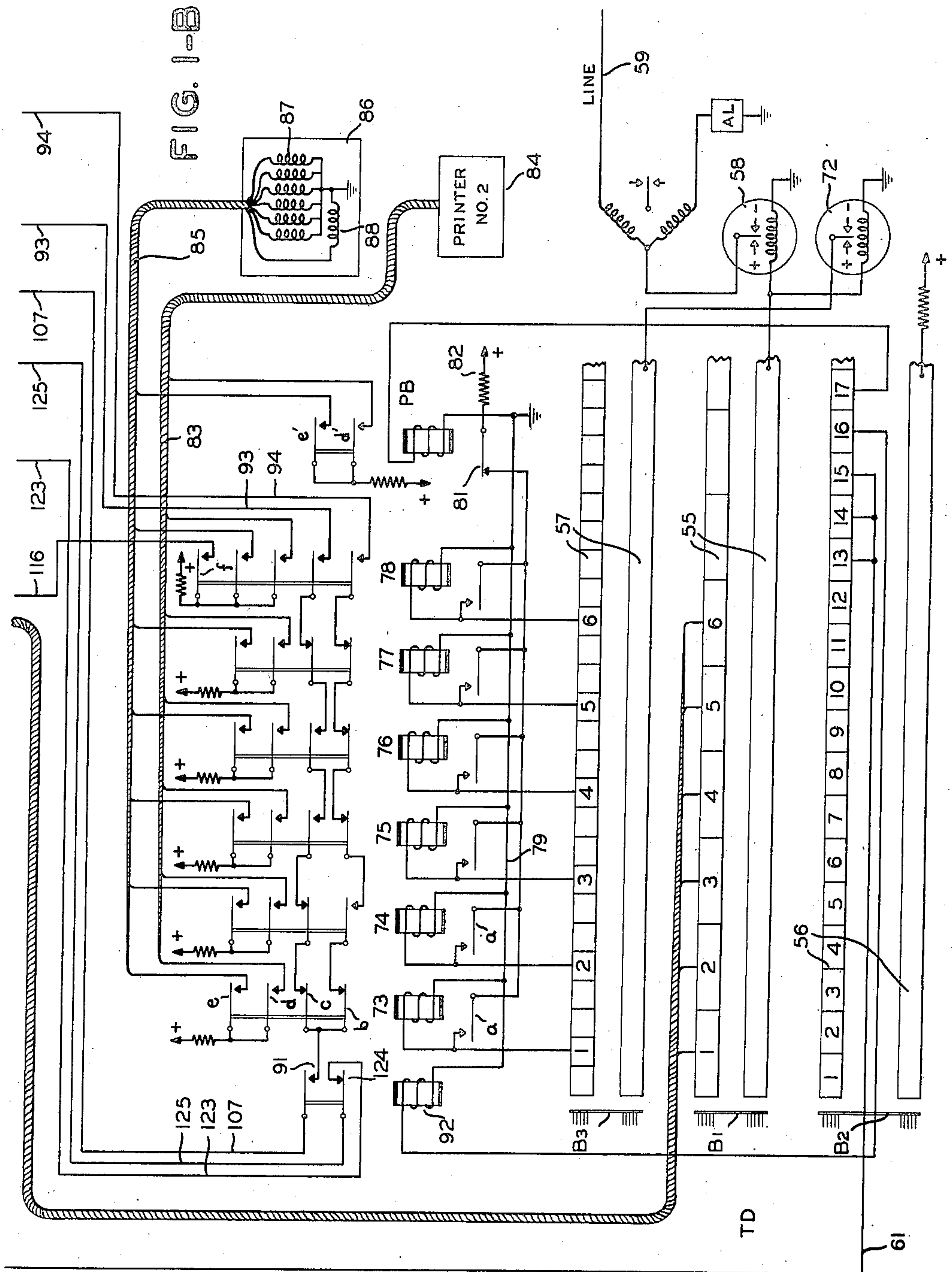
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4 Sheets-Sheet 2



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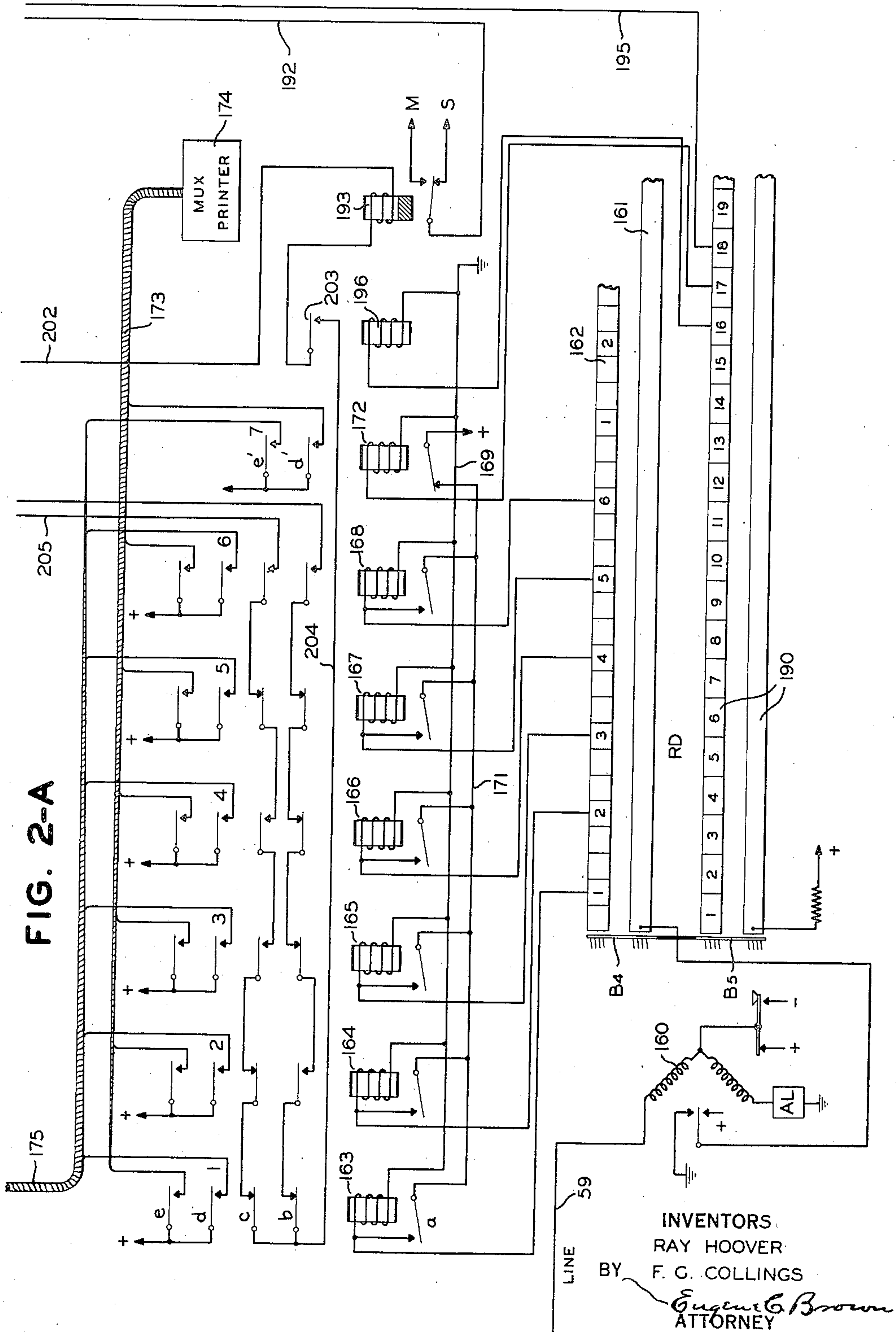
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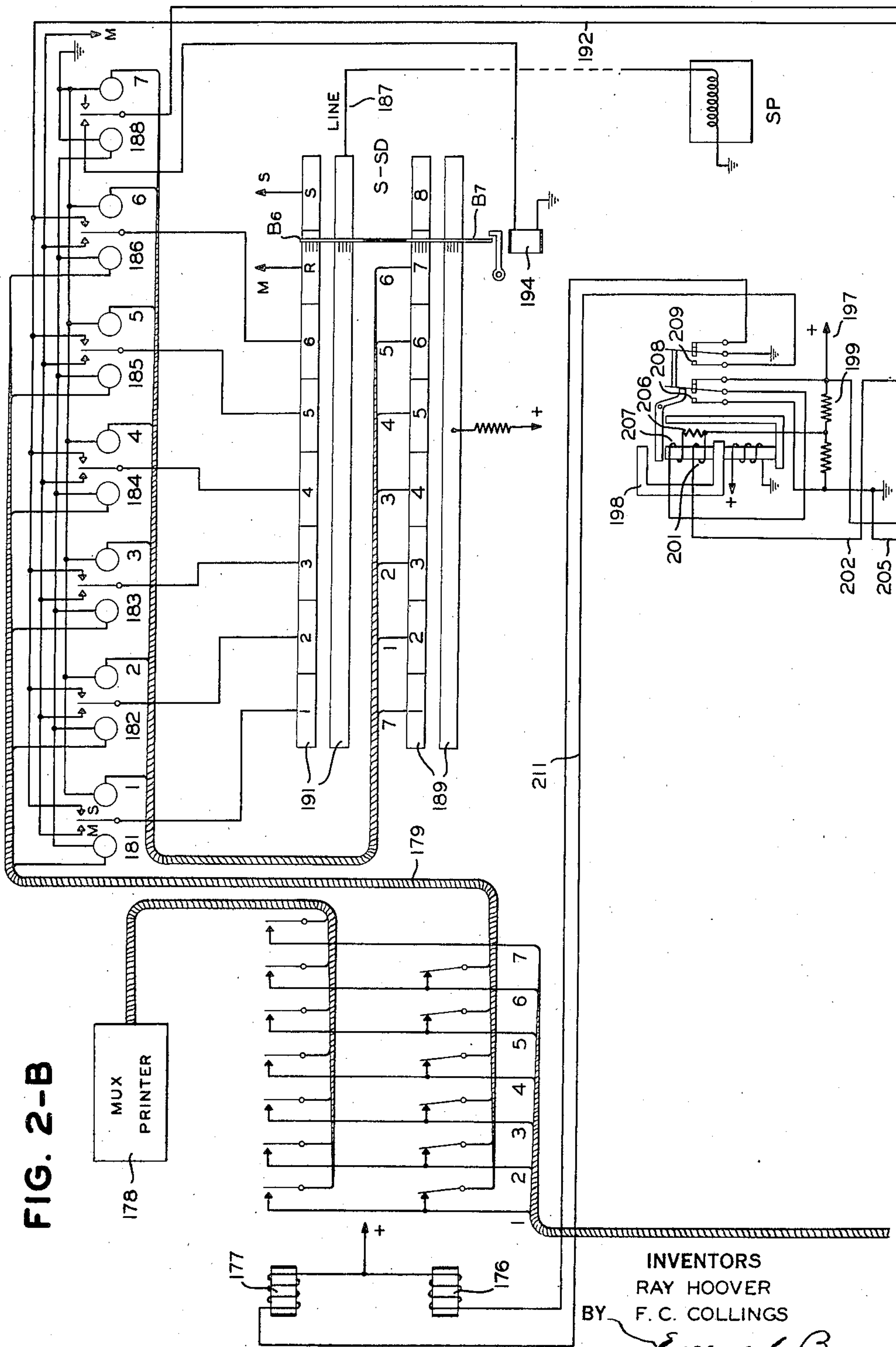
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

1,983,905

DIVIDED CHANNEL SYSTEM

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Application December 7, 1932, Serial No. 646,184

16 Claims. (Cl. 178—52)

This invention relates to a multiplex telegraph system and more particularly to a divided channel system whereby either of two or more telegraph transmitters may send over the same multiplex channel.

The invention is particularly applicable to multiplex circuits over which various minor exchange quotations are transmitted which do not occupy the full capacity of the channel but which do not admit of any delay in transmission. Heretofore individual channels are ordinarily assigned to each of such exchange services in order to give a free outlet without delay to the quotations and these channels are therefore idle a considerable proportion of the time.

One of the objects of the present invention is to provide a system whereby additional telegraph business may be carried on over such channels during the idle periods thereof, thus utilizing the full capacity of the channel.

Another object is to enable one service to be preferred over the other whereby the channel is always available for transmission of the preferred service but in which the secondary service will completely fill in the idle periods whenever the preferred service is not actually being transmitted over the line.

A still further object is to provide means for transmitting identifying signals preceding the signals comprising each type of service, whereby the preferred and secondary intelligence may be segregated at the receiving station.

Another object is to render such a system entirely automatic so that each service assumes its proper share of the channel.

A still further object is to cause the transfer from the secondary back to the preferred service to be effected only at an opportune point in the sequence of the secondary message.

Other objects and advantages of the invention will hereinafter appear.

While the invention has been referred to herein as applicable for use in exchange systems it is not restricted to such use being equally applicable to any multiplex system in which it is desired to fill in on channels which handle a preferred service, miscellaneous information or messages which can stand a certain amount of delay. The channel is therefore caused to operate a full capacity as long as there is any business to be sent by either service. Other examples of preferred service are the so-called "timed wire service", rush or X-messages, etc.

In accordance with the present invention two tape transmitters are employed for the divided channel, one corresponding to the preferred service and the other to the secondary service. One or the other of the two tape transmitters is always associated with the line, the switch-

ing from one transmitter to the other being automatically controlled by the auto control tape switch associated with the preferred transmitter. Whenever there is slack tape in the preferred tape transmitter this transmitter takes control of the channel but if the tape in the preferred transmitter becomes taut the transmitter is disconnected from the channel and the secondary tape transmitter connected therein. The secondary transmitter retains possession of the channel until slack tape again occurs in the preferred transmitter, at which time the control automatically shifts back to the preferred transmitter. If desired, however, the transfer to the preferred transmitter may be delayed until the secondary transmitter reaches a predetermined point in its transmission.

The invention will be best understood by reference to the accompanying drawings, in which:

Figures 1a and 1b are circuit diagrams illustrating the arrangement of the transmitting circuits and equipment; and

Figures 2a and 2b are corresponding circuit diagrams of the receiving equipment.

Referring first to Figures 1a and 1b, which together constitute the transmitting mechanism for one channel of a multiplex system, the preferred tape transmitter is illustrated diagrammatically at T1 and the secondary tape transmitter at T2. Tape transmitter T1 comprises the tape controlled contacts 20 (six in number in the present case) operating between the marking bus bar M and the spacing bus bar S. The individual contacts of the transmitter are designated 1, 2, 3, 4, 5 and 6. Transmitter T1 also has a tape stepping magnet 21 which serves to advance the tape through the transmitter, an auto control arm 22 having contacts 23, 24 and 25, and a differential relay 26 having opposed windings 27 and 28, the midportion of which is grounded through the winding of the tape stepping magnet 21. The relay 26 has two armatures 29 and 31, the front contact of armature 31 having a normally engaged auxiliary contact 32.

The tape transmitter T2 is similarly provided with the transmitting contacts 33, tape stepping magnet 34, tape lever 35, having a single point switch 36 and a differential relay 37 having opposed windings 38 and 39 and armatures 41 and 42.

Assuming the preferred transmitter T1 to be operating with a copious supply of tape in each transmitter, so that the loops L1 and L2 are of sufficient size to permit the auto control switches 22 and 34 to remain closed. In this case the differential relay 37 and stepping magnet 34 of the transmitter T2 are locked up from battery at 43 through the armature 42, winding

39 of relay 37 and the winding of relay 34 to ground. The tape stepping mechanism of this transmitter is thus held locked up and the transmitter thus rendered inoperative. The differential relay 26 of the transmitter T1 is unoperated at this time as will subsequently appear. Hence with the armature 29 of relay 26 open, a circuit over the conductor 44 to code relay 45 remains incomplete and the tongues of this relay remain on their back contacts. The contacts 3, 4 and 6 of the transmitter T1 are thus completed through conductors 46, back contacts of relay 45 and cable 47 to the correspondingly numbered tongues of a multi-contact relay 48. The 1, 2 and 5 contacts of the tape transmitter T1 are directly connected through the cable 47 to the corresponding number tongues of relay 48. Relay 48 is energized at this time from battery at 49, relay winding, conductor 51, contact 52 of a transfer relay 53 to ground. Consequently the tongues of the multi-contact relay 48 are connected through the cable 54 to the 1 to 6 segments of the transmitting rings 55 of a multiplex distributor TD. In addition to the transmitting rings 55 the distributor has a pair of local rings 56 and a pair of home record and transfer rings 57. Rings 55, 56 and 57 are traversed by brushes B1, B2 and B3 respectively.

In the condition of the circuit illustrated, a code combination will be set upon the contacts of the tape transmitter T1 and hence on the segments of rings 55. Consequently as brush B1 passes over segments 1 to 6 the code combination will be repeated from the solid transmitting ring through relay 58 to the outgoing duplex line 59. Immediately thereafter as brush B2 engages its segments 13, 14, 15, a circuit will be completed over conductor 61 to relay 62 which controls the operation of the tape stepping magnets 21 and 34. As relay 62 operates battery is placed on each of the conductors 63 and 64 but since the latter conductor leads to the open contact 65 and the former to the open contact 66, this battery is ineffective at this time. Battery is also placed on the conductor 67, this circuit being completed through a closed contact 68 of relay 45, conductor 69, to point 71 where the current divides, part passing through the contacts 23, 24 to the winding 28 of relay 26 and part passing through the contact 32, and winding 27 of relay 26, the current then uniting and passing through the tape stepping magnet 21.

The relay 26, due to the equal division of current through its opposed windings, remains unoperated but magnet 21 operates to advance the tape and hence to set up a new combination on the contacts of the transmitter T1. Upon each revolution of the multiplex distributor brushes a new combination is thus set up on the segments of the rings 55 and repeated to line as long as the supply of tape in the transmitter T1 is unexhausted.

Reference will now be had to the home record and transfer rings 57 of the distributor and the apparatus controlled thereby. As the brush B1 engages each of the contacts 1 to 6, a second repeating relay 72 is operated. The tongue of the relay 72 is connected to the solid ring of pair 57 and consequently as the brush B3 engages the segments 1 to 6 the code being transmitted to line is at the same time repeated to and stored in a group of relays 73 to 78, the operating circuit of these relays being completed from the tongue of the relay 72, rings 57 and brush B3, winding of the relays 73 to 78 and conductor 79 to ground. Each relay, as operated, is locked up over its tongue "a" and the back contact 81 of a relay PB to battery at 82. Each of the relays 73 to 77 also has four operating tongues b, c, d and e, relay 78 having a fifth tongue f. The relay PB has two additional contacts d' and e'. The tongues d and e of the relays 73 to 78 and the tongues d' and e' of relay PB have battery connected thereto, the d and d' contacts being connected by a cable 83 to a multiplex printer 84 and the e and e' contacts being connected by a cable 85 to a multiplex printer 86. The contacts d and e control the selecting magnets 87 of the printers and the contacts d' and e' control the printing magnets 88. These latter contacts are closed momentarily as the local brush B2 passes over segment 17 to supply the press impulse. The operation of relay PB at this time also, through the opening of contact 81, releases the locking circuit of each of the relays 73 to 78. The printers 84 and 86 provide a home record of the intelligence being transmitted over the line.

The tongues b and c of relays 73 to 78 are coded so as to complete selective circuits to the transfer relay 53 for switching from one of the transmitters to the other. The code used in the present embodiment to indicate a transfer from transmitter T1 to transmitter T2 consists of impulses 3, 4 and 6 marking and the code used for transferring from transmitter T2 to T1 employs impulses 2 and 6 marking. If the 3, 4 and 6 marking combination is transmitted over the distributor, relays 75, 76 and 78 will be operated. This prepares a switching circuit over the tongues c of relays 73 to 78 which may be traced from the normal open contact 91 of relay 92, tongues c and back contacts of relays 73 and 74, front contacts of relays 75 and 76, back contact of relay 77 and front contact of relay 78 to the conductor 93. Similarly if the 2, 6 marking combination is transmitted (indicating the transfer from transmitter T2 to T1) relays 74 and 78 operate preparing a second switching circuit over the b tongues of relay 73 and 78, this circuit being traced from contact 91 over the b tongues, through the back contact of relay 73, front contact of relay 74, back contacts of relays 75, 76 and 77 and the front contact of relay 78 to conductor 94. The circuits including conductors 93 and 94 will be completed in a manner to appear subsequently.

If it is assumed now that the loop L1 of tape approaching transmitter T1 becomes taut following a stepping operation, the tape lever 22 is raised opening contacts 24 and 25. The new combination advanced in the transmitter at this time is transmitted during the next revolution of the distributor. However as the local brush B2 engages its segments 13, 14 and 15 to operate the relay 62 following the transmission of this combination, the battery supplied over conductor 67 through the contact 68 and conductor 69 to the point 71, does not divide at this point (due to contact 24 being open) but flows solely through the contact 32 and winding 27 of relay 26 to the stepping magnet 21. The current being thus unbalanced in the windings of the relays 26 this relay operates together with the magnet 21, closing its contacts 29 and 31 and opening contact 32. The contact 31 completes a locking circuit for the relay from source of potential 95 through the winding 27.

Stepping magnet 21 is thus held energized by the locking current and the tape stepping operation (effected on the back stroke of the magnet) is not completed. The construction and operation of the tape transmitter is fully disclosed in U. S. patent to Benjamin No. 1,298,444, granted March 25, 1919.

The tongue 29 of relay 26 on closing energizes the coding relay 45, disconnecting the tongues numbered 3, 4, and 6 of the transmitter T1 from the correspondingly numbered contacts of the multi-contact relay 48 and applying marking battery directly thereto from the source 96. The remaining tongues numbered 1, 2 and 5 of the switch 48 have spacing battery applied thereto from the contacts of the transmitter T1, all of which are held on their spacing side at this time as will be apparent upon reference to the aforesaid Benjamin patent. Consequently the 3, 4 and 6 marking combination which signifies a transfer from preferred transmitter T1 to the secondary transmitter T2 is set up on the segments of rings 55 and on the next revolution of the distributor is transmitted to line, at the same time effecting the operation of relays 75, 76 and 78 and thus preparing the transfer circuit previously traced over tongues c of these relays to conductor 93.

As brush B2 now engages segments 13, 14 and 15 to operate the relay 62, battery is supplied over conductor 63, across contact 66 of relay 45, conductor 97, auto-control contact 36 of transmitter T2 and winding 38 of relay 37 in opposition to the locking battery supplied from the source 43 through winding 39.

Relay 37 is therefore released opening contacts 41 and 42 and closing the auxiliary contact 65. The opening of contact 41 releases the code relay 98 permitting the armatures thereof to move to their back contacts. This connects the numbers 2 and 6 contacts of transmitter T2 over cable 99 to the correspondingly numbered tongues of multi-contact relay 101, the numbers 1, 3, 4 and 5 contacts of the transmitter being connected directly thereto over the cable 99.

Current continues to flow through the winding of stepping magnet 34, however, to prevent its release until the transfer is completed by the operation of multi-contact relay 101 and release of relay 48. This energy is supplied from battery 43 over conductor 100, contacts 89 of relay 48 and conductor 90, the current then dividing and passing equally through windings 39 and 38, the path for the latter winding being continued from conductor 90, through contacts 65, conductors 64 and 63, contact 66, conductor 97 and auto-control contacts 36 to winding 38. The current in coils 38 and 39 then combines and passes through the stepping magnet 34. This continues until the openings of contacts 89 on completion of the transfer to transmitter T2.

As relay 62 releases (upon passing of brush B2 off of segment 15) the tape stepping magnet 34 is deenergized completing on its back stroke the setting up of a new combination on the contacts of the transmitter T2.

As brush B2 continues its movement onto segment 16, relay 92 operates closing its contact 91 and completing the transfer circuit for the relay 53 as will presently appear. This relay is of the polarized type having a polarizing winding 102, an operating winding 103, and a locking winding 104. The circuit for this re-

lay may be traced from the battery 105 through resistance 106, winding 103, conductor 107 to the contact 91 of relay 92, thence over the tongues c of relays 73 to 78 and by conductor 93 to ground 108. The direction of the current through the winding 103 is such as to attract the armature 109 to its upper pole 110, thereby moving the relay tongues to their left hand contacts and completing the locking circuit for the relay from the battery 105 through the resistances 106 and 111, winding 104 and contacts 112 to ground 108. The closing of the other tongue to its contact 113 places ground on the transfer relay 101 and removes it from relay 48. Consequently the latter relay releases disconnecting the transmitter T1 from the distributor and the former operates to connect the transmitter T2 to the distributor. The tape transmitter T2 is thus placed in condition to transmit through the distributor on the next revolution thereof, and this transmitter continues to transmit as long as no additional tape is supplied to the transmitter T1.

If during the operation of the transmitter T2 additional tape is supplied to the transmitter T1 enabling the loop L1 to enlarge sufficiently to permit the contacts 23, 24 and 25 to close, the control is returned to the transmitter T1. This transfer is not effected immediately, however, but is delayed until completion of the transmission of the particular commodity quotation then in progress from the transmitter T2.

Each commodity quotation comprises a number of lower case characters representing the alphabetical designations or titles of the commodities, followed by a number of upper case characters representing the numerical value or price of the commodity. The upper case characters are printed in the shift position of the ticker or printer and are represented in the code by a marking impulse in the zero or shift position.

With the above in mind let it now be assumed that additional tape is supplied to the transmitter T1 causing the auto-control contacts thereof to close. If at this time the transmitter T2 is in the course of transmission of a quotation, the transfer is effected only when a lower case or alphabetical character follows an upper case or a numerical character, that is, upon the transmission of the first character of a new quotation following the last character of the preceding quotation. Each alphabetical character has a spacing signal in the 6th position and consequently relay 78 will not be operated during its transmission. With relay 78 thus unoperated, as brush B2 passes over segments 13, 14 and 15 to operate relay 62 following an alphabetical character, the circuits including conductor 67 will not be completed, one branch thereof being open at contact 68 of relay 45 and the other branch being open at the contact 114 of relay 115. Battery is supplied to the tape stepping magnet 34 of transmitter T2 in the usual way, however, over conductors 63 and 64. This condition persists as long as alphabetical characters only are being transmitted by the transmitter T2. When a numerical character is transmitted, however, which includes a marking impulse in 6th position, relay 78 will be operated to close its contacts thereby completing a circuit over the conductor 116 to relay 117. This relay upon picking up applies ground at contact 118 to relay 115 closing its contact 119. As brush B2 engages contacts 13, 14 and

15, following a numerical character relay 62 again operates advancing a new character into the tape transmitter T2. Transmitter T1 still remains inoperative, however, since the unlocking circuit for relay 26 is not yet completed, this circuit being held open at the contact 121 of relay 117. However, as brush B2 now engages its segments 17, relay 78 is unlocked releasing relay 117 which removes ground from relay 115. This relay remains locked up, however, from the battery 122 over conductor 123, back contact 124 of relay 92, conductor 125, locking contact 119 of relay 115 and locking winding 126 thereof to ground. If the next character transmitted by the transmitter T2 is also a numeral, relay 117 is again operated holding its contact 121 open as relay 62 operates and again interrupting the unlocked circuit of relay 26. However, as soon as a lower case or alphabetical character is transmitted (representing the first letter of the next quotation) relay 78 remains unoperated (since the alphabetical characters all have spacing impulses in the zero position), permitting contact 121 of relay 117 to remain closed, and therefore as relay 62 is energized from segments 13, 14, 15, the unlocked circuit of relay 26 is completed from the conductors 67 and 127, contact 128 of relay 101, conductor 129, contact 121, contact 114, conductor 131, contacts 25, 24 and 23 to winding 28 and thence to ground through the tape stepping magnet 21. Winding 28 is thus energized in opposition to winding 27 (energized from the battery 95) releasing relay 26 and permitting its contacts to open.

As brush B2 leaves segment 15, releasing relay 62, the tape does not advance in the transmitter T1 since the circuit to magnet 21 is maintained closed from the battery 95 over conductor 132, contact 133 of relay 101, conductor 134 and thence both by way of contacts 32 and 24 to winding 28 of relay 26 and directly by way of winding 27 thereof to the magnet 21 and thence to ground. Relay contact 29 is opened on release of relay 26, deenergizing relay 45 and placing the numbers 3, 4 and 6 contacts of the tape transmitter T1 in connection with the multi-contact switch 48. At the same time the circuit to the winding 38 of relay 37 of transmitter T2 is interrupted at the contact 66 of relay 45, causing the current in relay 37 to be unbalanced and thereby causing it to pick up. Relay 37 locks up from battery at 43 over contact 42 and winding 39.

Contact 41 of relay 37 also closes energizing code relay 98 and applying marking battery from the source 96 over contact 135 of relay 45 and the front contacts of relay 98 to the numbers 2 and 6 tongues of relay 101. Spacing battery is applied to the numbers 1, 3, 4 and 5 contacts of this relay from the contacts of the tape transmitter T2, which are withdrawn to their spacing side at this time, through continued energization of the stepping magnet 34. All of these operations occur as the brush B2 passes over segments 13, 14 and 15. As the brush engages segments 16, relay 92 operates unlocking relay 115, thus restoring the system to normal.

With the special transfer code (2 and 6 impulses marking) thus set up on the distributor, it is transmitted to line during the next revolution of the transmitter and at which time relays 74 and 78 are operated completing the baffle circuit through the *b* contacts of relays 73 to 78. Accordingly upon the operation of relay 92 (as brush B2 again crosses segment 16)

a transfer circuit is established from battery 105 over conductor 94, tongues *b* and their contacts of relays 73 to 78, contact 91 of relay 92, conductor 107 and operating winding 103 of relay 53, the circuit then continuing through resistance 136 to ground. The polarity of the current is such as to move the armature 109 of relay 53 away from its upper pole 110 closing the relay tongues to the right hand sides. The locking circuit for relay 53 is completed at this time from the battery 105 through relay contact 118, winding 104, resistances 111 and 136 to ground. The operation of relay 53 removes ground from the multi-contact relay 101 and applies it to relay 48, thereby disconnecting transmitter T2 from the distributor and connecting transmitter T1 thereto. The opening of contact 133 of relay 101 interrupts the circuit to the stepping magnet 21 of the transmitter T1 permitting this magnet to complete its back stroke, thereby advancing a new combination into the transmitter. Transmission then continues in the normal manner from transmitter T1.

There are a number of other conditions of operation which occur in practice which will now be considered.

Assuming first that during transmission from the transmitter T2, its auto-control contacts 36 open due to the decrease in the loop L2 of tape. This occurs on the back stroke of the magnet 34 as brush B2 leaves segment 15 (releasing relay 62 at this time). The character thus set up in the transmitter T2 is transmitted during the next revolution of the distributor. However, immediately thereafter as brush B2 engages segment 13 to operate relay 62, the circuit for the differential winding 38 of relay 37 is opened at contact 36. Consequently winding 39 only receives current (over conductor 64, and contact 65) thereby operating the relay which locks up from battery 43 over its contact 42. Contact 41 on closing operates code relay 98 as usual, preparing circuits for the numbers 2 and 6 tongues of relay 101. Marking battery is not directly applied to these tongues, however, since this battery is supplied from the source 96 through contact 135 of relay 45 which is open at this time.

If at this time there is a supply of tape for the transmitter T1 so that the auto-control contacts 23, 24 and 25 are closed, the relay 26 will be released when relay 62 operates, the unlocking circuit therefore being traced from battery over conductor 67, contact 128 of relay 101, conductors 129 and 141, contact 142 of relay 98, conductor 131, auto-control contacts 25, 24, 23 to winding 28 in opposition to the current supply through winding 27 from the battery 95. Upon release of relay 26 code relay 45 is also deenergized closing contact 135 and applying marking battery through the back contacts of code relay 98 to the numbers 2 and 6 tongues of relay 101. On the next revolution of the distributor the 2 and 6 marking transfer code is sent out, at the same time operating relays 74 and 78 and preparing the transfer circuit over the *b* contacts of relays 73 to 78, which circuit is subsequently completed by relay 92 as segment 17 of ring 56 is crossed by brush B2. Relay 53 is thus operated in such direction as to reverse the connections of relays 101 and 48, the tongues of the former being disconnected from the distributor and those of the latter connected thereto.

However, if at the time the transmitter T2

stops due to an exhaustion of its tape supply, transmitter T1 is also out of tape, its auto-control contacts will be open and consequently relay 26 will not release. Therefore marking battery will not be applied to the numbers 2 and 6 tongues of relay 101 and the transfer code will not be transmitted. The distributor will therefore have spacing condition on all of its segments and no intelligence will be transmitted over the channel until either one or the other of the transmitters again obtains tape. If transmitter T1 is first supplied with tape its auto-control contacts 23, 24 and 25 will close and the transfer to this transmitter will be completed. If transmitter T2 first obtains tape, contact 36 will close and the relay 37 unlock, permitting transmission to continue from this transmitter.

In order to prevent false operation of the system in case the auto-control contacts of transmitter T1 should close momentarily during the operation of transmitter T2, an extra set of contacts 136 is added to the relay 101 and connected in shunt to the auto-control contacts 23, 24 of transmitter T1. Assuming again that transmitter T2 is operating and during such transmission contacts 23, 24 and 25 of transmitter T1 closed. This will cause release of differential relay 26 (ordinarily locked up at this time from battery 95) by supplying an impulse through winding 28 for conductor 67, contact 128 of relay 101, contacts 121 and 114 of relays 117 and 116 respectively (at the proper time in the cycle of operation of transmitter T2), conductor 131 and contacts 25, 24 and 23 to winding 28 in opposition to the locking battery supplied to winding 27 from the source 95. Relay 26 is shown released and as previously explained when this occurs, differential relay 37 of transmitter T2 locks up and the transfer to the transmitter T1 is started.

Once this transfer is started it will be completed even though auto-contacts 23, 24 and 25 again close, since relay 26 is held unoperated by the equal division of current through its differential windings, this current flowing from battery 95 over conductor 132 and contacts 133 to winding 27 an equal portion being diverted through contacts 32, conductors 69 and 137 to contact 136 and thence by conductor 138 to winding 28, the circuit for windings 27 and 28 is completed through the stepping magnet 21 and is retained until the transfer has been completed by the release of the multi-contact relay 101 and the consequent opening of contacts 133 and 136.

It will be understood that should the line 59 be interrupted for any reason, the transmitters T1 and T2 may continue to operate, with consequent transmission of signals to the wind. During such time one or more transfer code combinations may be sent out but since they are not received at the distant end of the line, the receiving apparatus cannot respond thereto. Therefore, upon re-establishment of the line the receiving and transmitting switching apparatus may not be in the same phase relation. In order to restore such relations a three-position switch 143 is placed in a convenient position for operation by the traffic and repair man. The switch 143 is normally retained in a neutral or central position, as by oppositely disposed springs 144 but may be moved on to either of two contacts 145 and 146. The former contact is connected by conductor 147 to a magnet 148 having an armature 149 connected to conductor

138 and having two normally open contacts 151, 152, connected to conductors 69 and 131, respectively. Contact 146 is similarly connected by conductor 153 to a magnet 154 having contacts 155 in series with the contacts 23, 24 and 25 respectively, of the auto-control switch 22. Contacts 155 are normally closed.

Upon re-establishment of the line circuit, following an interruption, the switch 143 is first closed to its contact 145 to operate magnet 148 and thereby close contacts 149, 151 and 152, thus short-circuiting the auto-control contacts 23, 24 and 25. If transmission is taking place at this time from the transmitter T2, the closing of contacts 149, 151 and 152 will cause the transmission to be transferred to transmitter T1 in the same manner as if the auto-control contacts had been closed. Consequently a transfer code is sent over the line to restore the receiving apparatus into condition to receive from the transmitter T1, if it is not already in such condition. If at the time of closing of relay contacts 149, 151 and 152, transmitter T1 is already conditioned for operation nothing occurs since the auto-control contacts 23, 24 and 25 are closed at this time. The traffic and repair man next moves the switch arm 143 to contact 146 for a short interval, to operate relay 154 and thereby open contacts 155. This is equivalent to the opening of the auto-control contacts and causes the transmission to be transferred to transmitter T2. Therefore, regardless of which transmitter was in condition for operation at the time the line was re-established, at least one transfer code will be sent to the receiving apparatus to bring its switching mechanism into accord with that of the transmitting apparatus.

The receiving apparatus at the distant station which responds to the transfer and code signals will now be described by reference to Figs. 2a and 2b.

The signals received over the duplexed line 59 are repeated by a line relay 160 to the solid ring 161 of the receiving multiplex distributor RD. The segmented receiving ring 162 has its receiving segments connected to the windings of a group of six storage relays, 163 to 168, the opposite terminals of the windings of these relays being grounded through a common conductor 169. Each of the relays 163 to 168 has a locking contact "a" and four operating contacts, b, c, d, and e. The locking contacts "a" are connected through conductor 171, and the back contact of an unlocking relay 172 to positive battery.

The b and c contacts of relays 163 to 168 are coded similarly to the b and c contacts of relays 73 to 78 of the transmitting apparatus and their operation will be subsequently described. The d and e contacts of these relays are each provided with battery, the e contacts being cabled at 178 and extending to a multiplex printer 174 to operate the selecting magnets thereof in accordance with each code signal received. The printer impulse for the printer 174 is supplied from battery through the contacts d1 and c1 of unlocking relay 172. The d contacts of relays 163 to 168 and the d contact of relay 172 are cabled at 175 and extend to the contacts of two multi-contact relays 176 and 177, in parallel. The relay 176 corresponds to the preferred service transmitted by the transmitter T1 and the relay 177 corresponds to the secondary service transmitted by transmitter T2. The tongues of relay 177 are connected to a second

multiplex printer 178 on which the secondary service is recorded. The tongues of relay 176 extend through the cabled conductor 179 to a group of storage relays 181 to 186. The contact *d*1 of relay 173 is not extended to these relays.

The relays 181 to 186 form part of an extended channel system for controlling the transmission of the preferred signals over a simplex line 187 through a start-stop distributor, S—SD. Each of the tongues of relay 176 is connected through the left hand windings of the associated relays 181 to 186 and thence in common through the left hand winding of an additional relay 188 and to ground. The right hand windings of each relay has one terminal grounded and the opposite terminals connected to the segments of the local ring 189 of the start-stop distributor. The tongues of relays 181 to 186 are connected to segments 1 to 6 of the transmitting rings 191 of the start-stop distributor, which rings are also provided with a rest segment R connected to marking battery and a start segment S connected to spacing battery. The tongues of the relays play between marking and spacing contacts M and S, the former being connected directly to marking battery and the latter being connected by a conductor 192 to the tongue of a slow to release relay 193, having its back contact connected to spacing battery and its front contact to marking battery.

The operation of the system is as follows:

Assuming transmission to be taking place from the transmitter T1 with multi-contact relay 176 operated, each impulse as received over the particular channel shown is set up on the segments of ring 162 as the brush B4 passes over these segments, thereby operating relays 163 to 168 in accordance with the received code combinations. These relays lock-up over their "a" contacts, causing the *d* and *e* contacts thereof to operate. The *e* contacts supply battery for the selecting magnets of the multiplex printer 174 and the *d* contacts supply battery for the left hand windings of the relays 181 to 186. As the local brush B5 engages segment 17 of local rings 190, relay 172 is operated, supplying the operating impulse to the printer 174 through the *d'* contact. The printer 174 responds to all signals whether preferred or secondary. Upon the operation of any one of the relays 181 to 186, relay 188 is actuated to its left hand contact, preparing a circuit for the start magnet 194 of the start-stop distributor, this circuit being completed as brush B5 engages local segment 18. The circuit may be traced from a positive battery at the solid local ring 190, brush B5, segment 18, conductor 195, tongue and left contact of relay 188, to the start magnet 194 and thence to ground. The energizing magnet 194 releases the brushes B6 and B7 of the start-stop distributor for one revolution. As the local brush B7 passes on to local segment 1, an impulse is supplied from battery at the solid ring 189 to the right hand winding of relay 188, restoring its tongue to the right hand side and thus interrupting the circuit to the start magnet 194 at this point. As the brush B6 passes over segments 1 to 6 the code combination set up in the relays 181 to 186 is transmitted over the simplex line. As segments 2 to 7 of local rings 189 are transversed the relays 181 to 186 are successively restored to their spacing sides. This operation continues as each code combination is received. The signals transmitted over the line 187 may be received at a distant station on a simplex printer SP.

If a transfer code is now received, indicating a change from the transmitter T1 to transmitter T2 and comprising the 3, 4, 6 impulses marking the storage relays 165, 166 and 168 are operated. This prepares a baffle circuit through the *c* contacts of these relays, the circuit being completed as local brush B5 engages segment 16 to operate the transfer relay 196. This circuit may be traced from positive battery 197, at the transfer relay 198, through resistance 199, operating winding 201 of relay 198, conductor 202, winding of slow to release relay 193, contact 203 of relay 196 and conductor 204 to the baffle circuit through the *c* contacts of relays 163 to 168, this baffle circuit including the back contacts of relays 163 and 164, front contacts of relays 165 and 166, back contact of relay 167 and front contact of 168 to the conductor 205 and thence to ground. The transfer relay 198 then operates its contacts to their left side and locks up from battery 197 through resistances 199 and 206, locking winding 207, and locking contact 208 to ground. The closing of the left contact 209 of this relay places ground over conductor 211 on the winding of multi-contact relay 177 and removes ground from the winding of relay 176. Consequently, the former relay operates and the latter releases. Subsequent signals sent out by the transmitter T2 are then distributed to the multiplex printer 178.

Since this transfer code is set up on the contacts of the relays 181 to 186, means is provided to prevent transmission thereof over the simplex line 187. This means comprises the slow to release relay 193 which it will be recalled was operated in series with the transfer relay 198. As relay 193 picks up it moves its tongue to its upper or marking contact, thereby causing marking battery to be placed on both contacts of relays 181 to 186. Relay 193 is sufficiently slow to release to maintain this condition during the following revolution of the start-stop distributor. Consequently all marking or rub-out signals are sent over the simplex line and are automatically deleted by the receiving simplex printer.

The succeeding signals are distributed to the multiplex printer 178 until the next transfer code combination is received, which indicates a transfer back to transmitter T1. This code combination consists of the second and sixth impulses of marking character, causing operation of relays 164 and 168 and completing a baffle circuit through the *b* contacts of relays 163 to 168. The circuit connections of the transfer relay 198 are such that the completion of this circuit reverses the direction of current through the operating winding 201, as described in connection with the transfer relay 53 of the transmitting apparatus, thereby operating the relay to its right contacts and thus removing ground from multi-contact relays 177 and applying it to relay 176. This transfer having been effected, the signals are again repeated over the extended channel system.

While we have described a preferred embodiment of our invention it is to be understood that various changes may be made therein without departing from the essential attributes of the invention and we do not desire to be limited to the exact details shown and described.

What we claim is:

1. In a telegraph system, a plurality of automatic transmitters, permutation means for normally transmitting from one of said transmitters over a line and automatic means independ-

ent of said permutation means, associated with said latter transmitter for interrupting transmission therefrom and causing transmission to continue from another transmitter.

5 2. In a telegraph system, a plurality of automatic transmitters, means for normally transmitting from one of said transmitters, a tape controlled mechanism for said latter transmitter and means actuated by predetermined operation of said tape controlled mechanism for interrupting the transmission from said transmitter and causing transmission to continue from another transmitter.

15 3. In a telegraph system, a transmitter, means for causing intermittent transmission of signals from said transmitter over a channel, a second transmitter and means independent of transmitted signals operating automatically to effect transmission over said channel from said second transmitter during idle periods of the first transmitter.

25 4. In a telegraph system, a preferred tape transmitter and a second tape transmitter, means for transmitting signals from said preferred tape transmitter over a line, as long as the same is provided with a predetermined supply of tape and means for automatically transferring the transmission to the second transmitter when the tape supplied to the preferred transmitter is reduced below said predetermined supply.

35 5. In a telegraph system, a preferred storage transmitter, a secondary storage transmitter, means for invariably transmitting from said preferred transmitter over a line, when the supply of signals stored therein exceeds a predetermined minimum and means for transmitting from said secondary transmitter whenever said preferred transmitter is idle.

40 6. In a telegraph system, a tape transmitter, means for permitting a loop of tape to form adjacent said transmitter, means for transmitting intelligence signals from said transmitter over a line circuit and means actuated by said loop of tape for transmitting non-intelligence signals over the line.

50 7. In a telegraph system, a plurality of sources of permutation code intelligence signals, means for associating said sources of signals, one at a time, with a common line to effect transmission of signals over the line and means for transmitting non-intelligence permutation code signals over the line independently of each source of signals and preceding the change from one source of signals to another.

55 8. In a telegraph system, a plurality of automatic transmitters, permutation means for normally transmitting from one of said transmitters over a line, means independent of said permutation means, associated with said latter transmitter for interrupting transmission therefrom and causing transmission to continue from another transmitter and means for transmitting signals indicative of each transmitter preceding the operation thereof.

65 9. In a telegraph system, an automatic transmitter associated with the line to transmit code signals thereover, means for stopping said transmitter, said stopping means being ineffective to interrupt the transmission until a predetermined signal in a sequence of signals being transmitted has been reached.

10. In a telegraph system, a plurality of auto-

matic transmitters, means for normally transmitting from one of said transmitters, an auto-control mechanism for stopping and starting said transmitter, means controlled by said auto-control mechanism, on stopping of said transmitter, for causing transmission to continue from another transmitter and means independent of said auto-control mechanism for effecting transfer from one of said transmitters to the other.

10 11. In a telegraph system, a tape transmitter normally associated with a line to transmit thereover, a second transmitter, means controlled by said tape when the supply thereof is reduced to a predetermined minimum for transferring the transmission to said second transmitter and means for restoring the transmission of said first transmitter when the supply of tape increases beyond said predetermined minimum.

20 12. In a telegraph system, a plurality of tape transmitters, means for associating one of said transmitters at a time with a line to transmit thereover, means for producing a loop of tape at one of said transmitters, means controlled by said loop when it reaches a predetermined size for transferring from one transmitter to the other and means for completing said transfer, once started, irrespective of changes in the size of said loop.

30 13. In a telegraph system, a plurality of tape transmitters adapted to be associated with a line in succession to transmit intelligence signals thereover, mechanism for at least one of said transmitters controlled by the amount of tape prepared for the transmitter, a code relay associated with each of said transmitters, said mechanism acting to transfer the transmission from one of said transmitters to the other and said code relays acting, upon said transfer, to transmit a signal to the line representative of the particular transmitter being brought into operation.

45 14. In a telegraph system, means for transmitting a plurality of different telegraph services alternately during unequal time intervals, over a single channel, means for preceding each service with a non-intelligence identifying permutation code and a receiving distributor mechanism responsive to said identifying code for distributing said services selectively to different recorders.

55 15. In a telegraph system, a sending station and a receiving station, a plurality of transmitters at the sending station, corresponding destinations for signals at the receiving station, switch means for operating said transmitters in succession, corresponding switch means at the receiving station for distributing the signals from each transmitter to its proper destination and means controlled from the sending station for bringing the receiving and transmitting switch means into phase with each other.

65 16. In a telegraph system a source of signals comprising groups of code signals representative of different services, each group being preceded by an identifying code, a separate destination for each group of signals, means responsive to said identifying code for distributing the signals to their proper destination and means for deleting said identifying code before it reaches said destination.

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