Sept. 9, 1941. A. R. BONORDEN 2,255,595

SIGNALING SYSTEM

Filed Feb. 25, 1939 4 Sheets-Sheet 1

FIG. 1

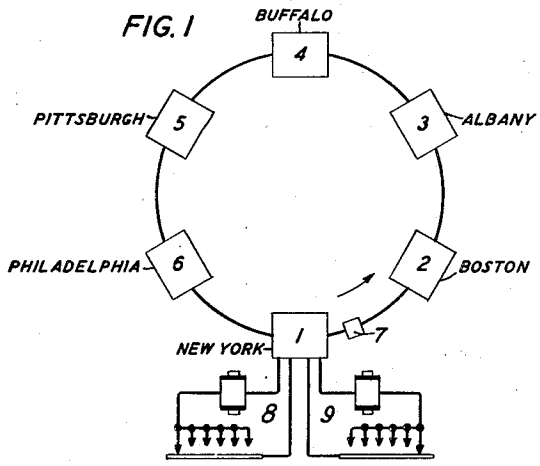
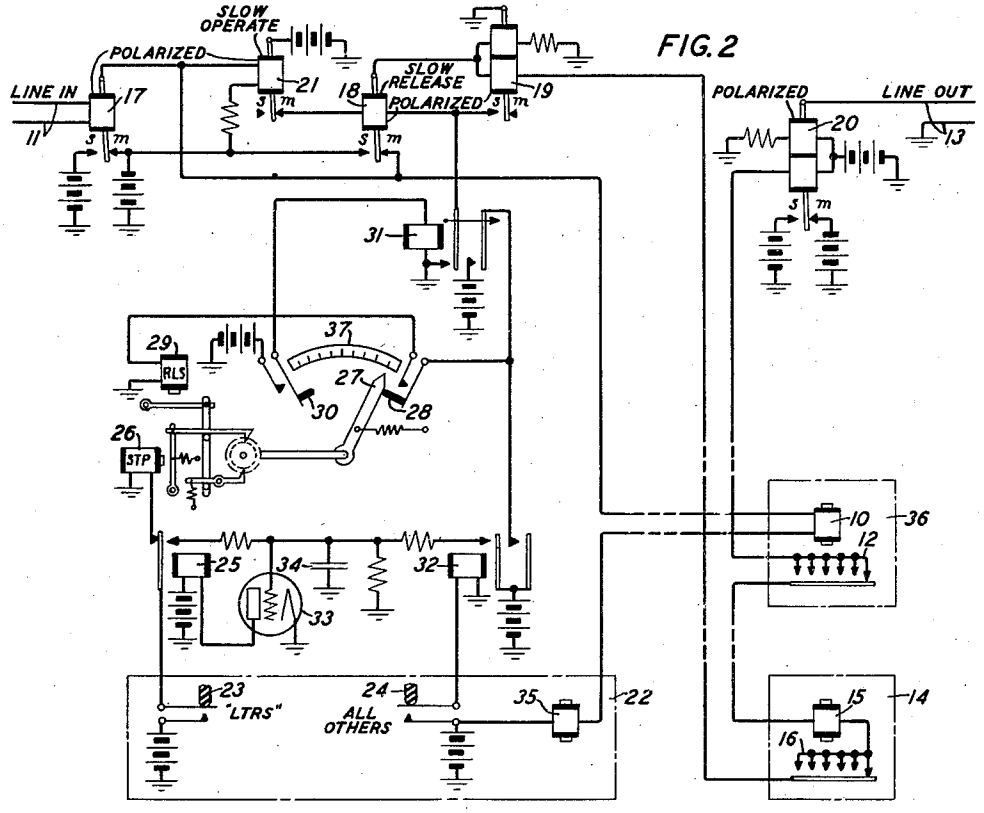


FIG. 2



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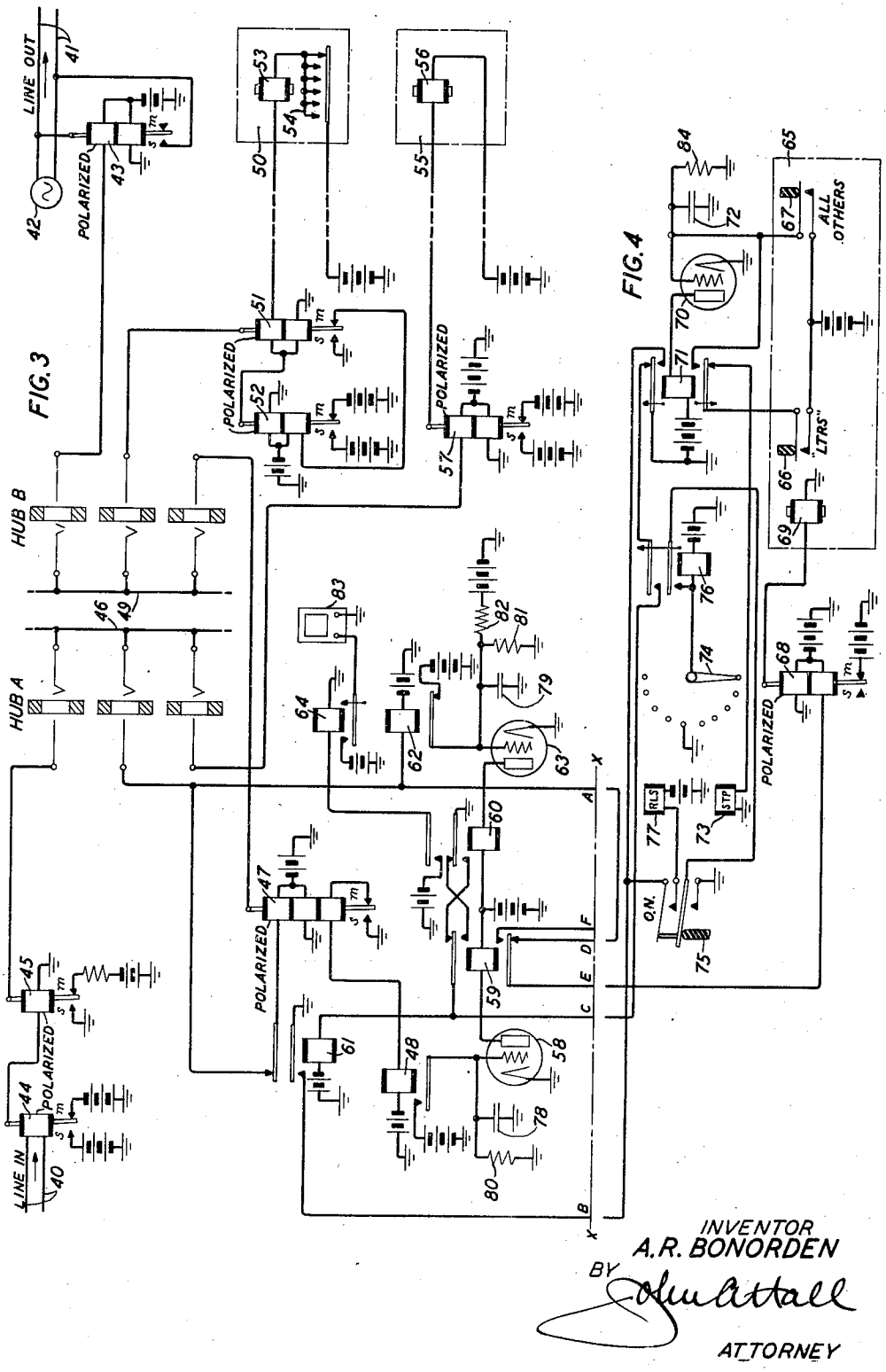
SIGNALING SYSTEM

Filed Feb. 25, 1939 4 Sheets-Sheet 2



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Sept. 9, 1941 A. R. BONORDEN 2,255,595

SIGNALING SYSTEM

Filed Feb. 25, 1939 4 Sheets-Sheet 3

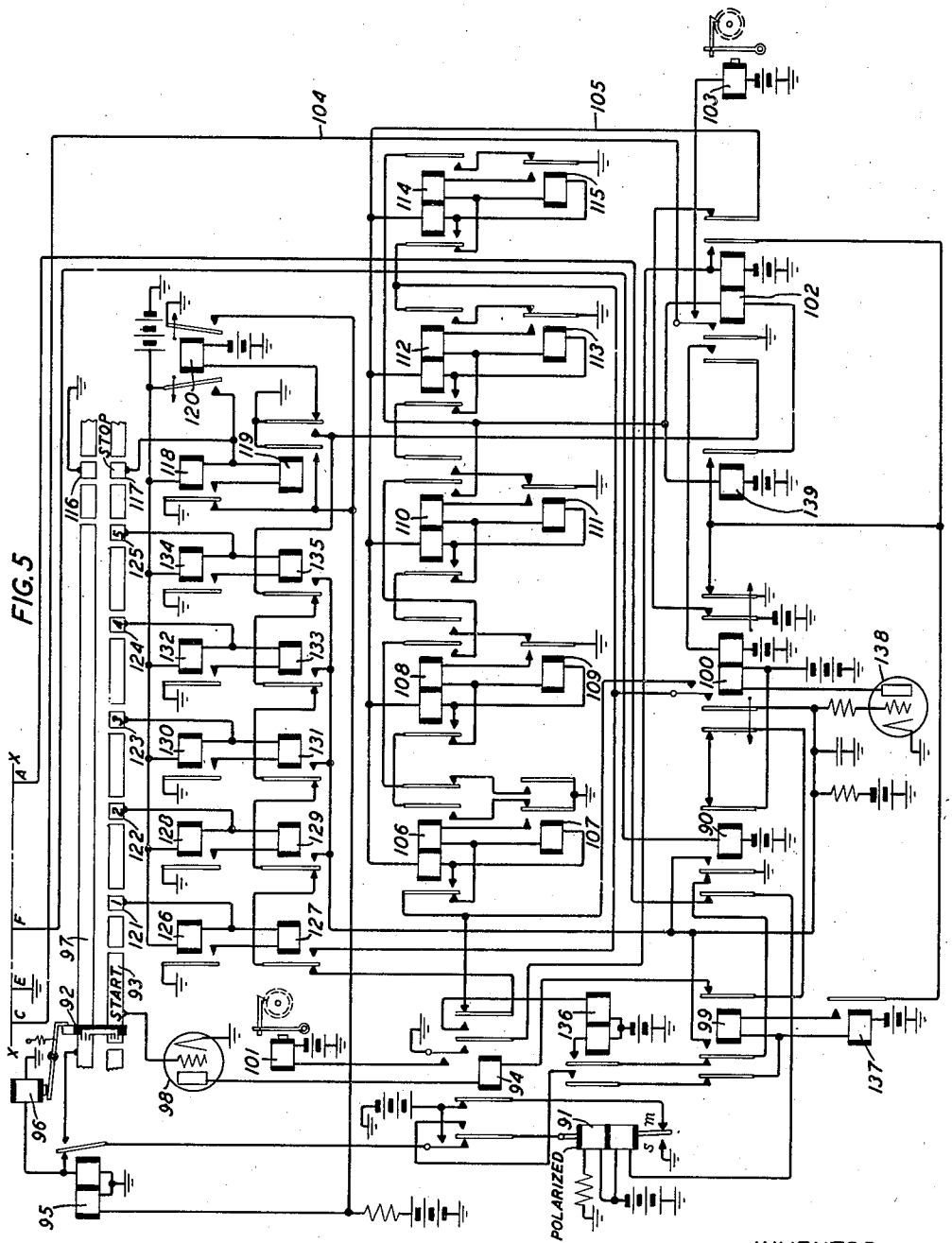

FIG. 5

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SIGNALING SYSTEM

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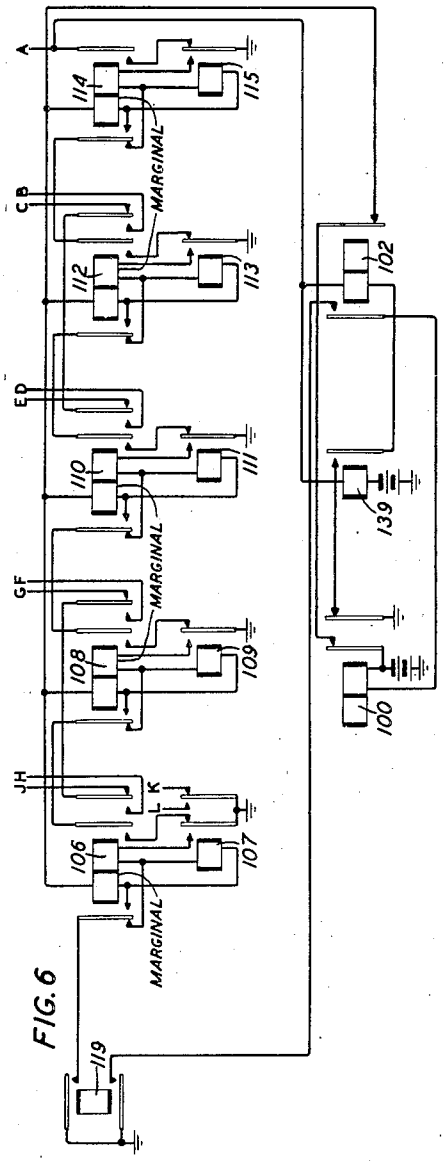

FIG. 6

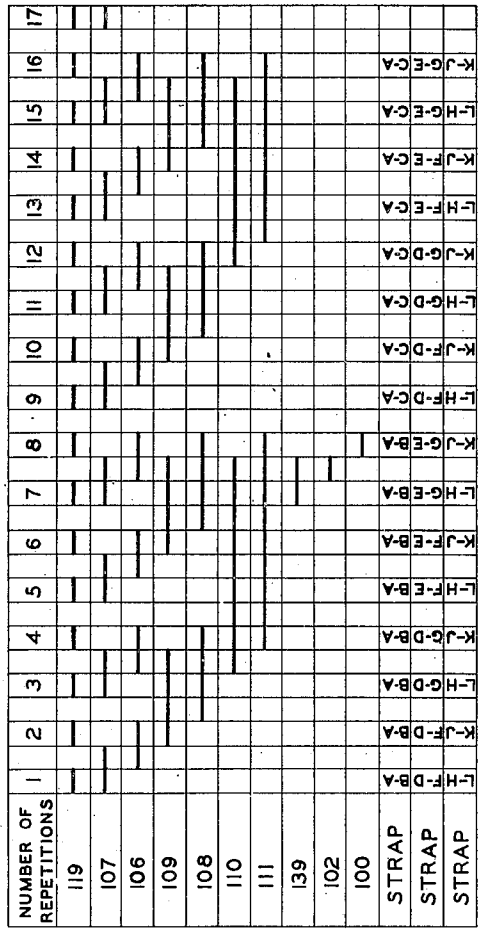

FIG. 7

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Patented Sept. 9, 1941 2,255,595

UNITED STATES PATENT OFFICE

2,255,595

SIGNALING SYSTEM

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Application February 25, 1939, Serial No. 258,547

18 Claims. (Cl. 178—69)

This invention relates to telegraph systems and particularly to systems wherein a common transmission channel is provided for a plurality of stations, any one of which may broadcast messages into said channel for simultaneous reception by all of said stations. The invention is an improvement on the system disclosed in Patent 2,111,685 granted March 22, 1938, to C. R. Walker.

In ring type circuits having even a measurable propagation time signals transmitted at one point in the ring will traverse the ring and return to such point and since they are not synchronous at the incoming and outgoing terminals of the station forming such point, must be separated. Hence, during transmission the normally closed connection between the incoming and outgoing terminals of the circuit must be opened. This has been done in various ways all devised to either manually and according to schedule, or automatically, close the ring only after the last impulse has completely traversed the ring so as not to set up a traveling or stray impulse which will traverse the ring indefinitely. However, even though such means are efficient and effective, a hit or accidental opening of the circuit for even an extremely short time interval will start a traveling stray impulse around the closed ring and which will be objectionable as it will operate the receiving apparatus at all the stations in some manner and make the circuit appear busy.

An object of the invention is to suppress any such traveling hit or useless signal while not interfering with the transmission of normal signals. Accordingly, a feature of the invention is a means to differentiate between a periodically recurring useless signal and normal transmission and means responsive thereto to suppress such useless signal. In one embodiment of the invention there is a means responsive to signals of this nature which acts to step a device forward step by step until a predetermined point is reached whereupon the switch causes the ring circuit to be opened for a length of time somewhat greater than the propagation time of the ring. As a switch is being stepped forward to this point it will be returned to its starting point if character signals are received and the ring will not be opened and hence the means for opening the ring and suppressing the use of a signal only becomes effective after a predetermined period and in its action may be halted at any time previous thereto.

In accordance with another feature of the invention the number of forward steps to be taken by the step-by-step device may be readily altered so that a useless traveling signal may be suppressed in the shortest possible time consistent with the characteristics of the circuit and consistent with a desired use of the circuit.

In accordance with a further feature of the invention the step-by-step device may be constituted of an arrangement of relays well known as "counting" relays.

Another feature of the invention is a means differently responsive to spacing signals of different length whereby various traffic conditions may be properly treated. For instance, the code for "letters" comprises a spacing signal as a start pulse followed by five marking pulses constituting the code proper and a stop pulse which is also marking. Therefore the code for "letters" appears as a single and isolated spacing pulse which might easily be mistaken for a hit or unwanted and useless traveling impuse. But traffic conditions sometimes require that the code for "letters" be transmitted a number of times in succession and so unless provision were made to prevent it, the automatic means of this invention might cause the opening of the ring at the wrong time.

Accordingly, a feature of the invention is means to delay the opening of the ring in response to the repeated reception of a spacing signal of the exact length of such a signal as used in the code for "letters" for a number of times in excess of any traffic requirement. Since a hit or unwanted useless traveling impulse may be of the exact length of such a signal it must be suppressed if it continues beyond a given time.

As another instance, the code for the letter "V" constitutes a spacing signal as a starting signal, a spacing signal as a first code pulse followed by four code marking pulses and another marking pulse as a stop pulse so that this code may appear as a prolonged but isolated spacing pulse. Since no traffic condition requires that this code be sent many times in succession, arrangements are made to suppress it after it has been repeated a second time. Being a legitimate code it must not be suppressed on a single repetition but again since it may be simulated by a hit or unwanted useless traveling impulse it must be suppressed if it persists.

As a further instance such a hit may be of such short duration that it does not simulate any known code and therefore it must be suppressed as soon as possible. Arrangements are therefore made to open the ring circuit and suppress such a hit on the first repetition thereof.

Another feature of the invention is a quick-

acting slow-releasing means for holding the circuit open after such means has been properly energized for a period somewhat longer than the propagation time of the ring.

The drawings comprise four sheets, the first sheet including Figs. 1 and 2, the second sheet including Figs. 3 and 4, the third sheet including Fig. 5, and the last sheet including Figs. 6 and 7.

Fig. 1 is a schematic diagram showing the general outline of a ring type circuit;

Fig. 2 is a circuit diagram showing one form of the invention in which a moving arm is caused to move forward step by step for a predetermined number of steps in order to cause circuit changes which will result in the suppression of a traveling useless impulse;

Figs. 3 and 4, together, form a circuit diagram showing a station circuit in a ring type system in which a step-by-step switch is employed for causing circuit changes to suppress a useless impulse. The type of telegraph circuit herein shown is known as a "hub" circuit, generally described in the Kinkead et al. Patent No. 2,056,277;

Figs. 3 and 5, together, form another circuit diagram showing the use of counting relays as a step-by-step device for suppressing a useless traveling signal;

Fig. 6 is a circuit diagram showing how counting relays may be connected in various ways; and

Fig. 7 is a chart giving instructions for such various connections and showing the relative time of operation of the various relays.

Fig. 1 shows in schematic form a ring type circuit. Here the rectangles 1, 2, 3, 4, 5 and 6 represent station circuits in as many cities as, for instance, New York, Boston, Albany, Buffalo, Pittsburgh and Philadelphia. The small rectangle 7 represents other apparatus of an electrical time consuming nature, such as a repeater. Extending from the station circuit 1 there are shown in the usual manner, two subscribers' stations 8 and 9 each having receiving apparatus represented by a magnet and sending apparatus represented by transmitting contacts, though it is not necessary to use this exact combination at any local subscriber's station as will appear hereinafter. In a system of this nature transmission from one of the subscriber's stations entering the station circuit will proceed in the direction indicated by the arrow through stations 2, 3, 4, 5 and 6 and will in time return to the station circuit 1. Ring circuits of this type have a definite and measurable propagation time depending partly on the length of the circuit and partly on the amount of apparatus included therein. In some cases it is desired to have the receiving apparatus connected to the incoming terminals, then the transmission sent from a station has to traverse the entire ring before it affects such receiving apparatus. In doing so, however, it forms a check on the continuity on the whole circuit.

In Fig. 2 this feature is illustrated by showing the receiving magnet 10 connected to the incoming terminals 11 so that transmission from the transmitting contacts 12 going out over the outgoing terminals 13 will have to traverse the entire ring before the apparatus connected to the incoming terminals is affected. In the case of another station 14, illustrated in Fig. 2, the receiving apparatus 15 and the transmitting contacts 16 are connected in series and both are effectively connected to the outgoing terminals 13. The receiving apparatus in this case will print local copy but will form no check on the continuity of the ring. In case it is desired, a duplicate apparatus may be installed at any subscriber's station so that he will have both local copy and copy coming in after being transmitted around the ring.

Fig. 2 in general shows a circuit diagram illustrating a station circuit with appropriate connections to two local stations on subscriber's premises. Impulses coming in over the line 11 will affect the polarized relay 17 and this will transmit like impulses over its armature through the right-hand marking contact of slow-releasing relay 18, the lower winding of relay 19, out over the transmitting contacts 16 of local subscriber's station 14, the transmitting contacts 12 of local subscriber's station 36, the lower winding of relay 20 to battery and ground. Relay 20 will, therefore, respond in the same way as relay 17 and repeat the impulses from the incoming terminals 11 to the outgoing terminals 13.

Relay 21 is connected to this circuit but is slow to operate and will not respond to impulses representing ordinary traffic conditions. As will appear hereinafter this relay will respond to a long break or an open circuit in line 11 which simulates a prolonged spacing signal. Thus impulses being transmitted over the ring will pass through the station circuit of Fig. 2 without affecting anything other than relay 17 and the receiving magnets such as 10, 15 and 35.

When the transmitting contacts 12 or the transmitting contacts 16 are being operated relay 19 will respond and by moving its armature to its left-hand or spacing contact will cause the operation of slow-releasing relay 18. This relay effectively opens the ring circuit so that the impulses transmitted from the transmitting contacts 12 or 16 will not get back in to affect the incoming line 11 except and until they have traversed the entire ring. In this case, the receiving magnets 10 and 35 will respond to transmission around the ring but receiving magnet 15 which is not connected to the incoming line will respond only to the outgoing transmission. Relay 18 is made slow to release and is timed to be slightly slower than the propagation time of the entire ring so that it will maintain an open circuit in the ring until the last spacing impulse sent by the transmitting contacts 12 or 16 has been transmitted entirely around the ring. When the transmission has ceased, therefore, relay 19 will move to its right-hand or marking contact thereby allowing the slow-releasing relay 18 to also move its armature to its right-hand or marking contact, thus closing the ring circuit. It is evident that extraneous hits or short spacing impulses of a useless nature impressed upon the circuit at any point will continue to be transmitted around the circuit indefinitely except that any inherent bias in repetition may either cause the space signal to diminish to zero length leaving the circuit in a marking condition after an indefinite length of time or may increase its length until the entire circuit is in a spacing condition. It is a purpose of this invention to provide means to prevent this condition and to clear out such a hit in a few seconds.

The receiving magnet 35 is enclosed within a broken-line rectangle 22 representing teletypewriter receiving apparatus. In this machine, only one of which need be included in the ring circuit, there are two contact actuating lugs or pull bars 23 and 24 which are operated in a well-known manner. The lug 23 moves downwardly

and closes its associated contact only when the signal for "letters" has been received by the magnet 35, while the lug 24 moves downwardly and closes its associated contact whenever any other character or signal is received by the magnet 35. Since the code for "letters" is closely simulated by a single spacing impulse the contacts closed by the lug 23 will be closed whenever a hit or open circuit of short duration is transmitted over the ring circuit and enters this circuit station through the incoming terminals 11.

If the ring circuit is completely closed, that is, if no relay corresponding to relay 18 is operated to its spacing contact and no transmitting contacts, such as 12, are being operated, and a short momentary open circuit or hit occurs, this would, without the means herein provided, be transmitted about the ring indefinitely and consequently all the teletypewriters in the circuit would be operated periodically as though a "letters" code were being sent. In this case, with the relay 25 deenergized, a circuit will be closed periodically from battery through the contacts controlled by lug 23, the armature and back contact of relay 25 through stepping magnet 26 to ground whereby the stepping magnet will cause the arm 27 to advance step by step. After advancing one step the contacts controlled by lug 28 will be operated so as to place the release relay 29 in a circuit ready for operation at some later time. If this hit or single spacing continues to traverse the ring the arm 27 will finally strike lug 30 and close a contact to operate relay 31. It should be noted that the number of steps which arm 27 is caused to take before striking the lug 30 may be varied in any well-known manner, such for instance, as by having the contacts carrying the lug 30 mounted on an adjustable support carried on the scale 37.

Relay 31 by its inner armature causes the operation of slow-release relay 18 which opens the ring to prevent the traveling impulse when it next returns from being relayed from the incoming line 11 to the outgoing line 13. Through its outer armature relay 31 closes a circuit from battery through the contacts controlled by lug 28 through the release magnet 29 which allows the arm 27 to return to normal, thus opening both pairs of contacts controlled by lugs 28 and 30. Relay 31 is deenergized but being slow to release holds the circuit of relay 18 closed for a short time and relay 18 in turn, being also slow to release, holds the ring circuit open for a period slightly greater than the propagation time of the ring so that the traveling impulse is effectively stopped.

In order to prevent the opening of the ring circuit through chance sending of the "letters" signal or through the actual transmission of a series of "letters" signals the lug 24 operated by all other characters will cause the operation of relay 32. Relay 32 renders the grid of vacuum tube 33 positive so that relay 25 becomes energized and thus opens the circuit for the stepping magnet 26. If during regular and legitimate transmission the "letters" signal occurs the movement of lug 23 will not step the arm 27 but will substitute a battery connection to the grid of tube 33 for that supplied by the inner armature of relay 32. A condenser 34 is connected to the grid circuit of vacuum tube 33 to render the vacuum tube circuit slow in releasing, and this may be timed in accordance with the propagation time of the ring circuit.

Any time that the arm 27 has been moved from its normal position to an intermediate position and regular transmission operates the lug 24, the consequent operation of relay 32 will cause the release magnet 29 to be energized to return the arm 27 to normal.

In case a break signal which takes the form of a prolonged spacing signal enters the station circuit by way of the incoming line 11, relay 17 will be driven to its spacing contact and, after a period the slow-operating relay 21 will move its armature to its spacing contact so as to prevent the sustained operation of slow-release relay 18 by the operator at the keyboard 16 or 12. The spacing signal set up by relay 17 will, therefore, appear as a break signal to the operator at station 14. An operator at station 36 will receive the break directly from relay 17.

Figs. 3 and 4 taken together as shown on the second sheet of the drawings constitute a station circuit having incoming carrier channel terminals 40 and outgoing carrier channel terminals 41. Connected to the outgoing terminal 41 is a source of signaling current 42 which is converted into spacing and marking signals by the operation of sending relay 43. Signals of this same nature will operate the receiving relay 44 in the well-known manner. Incoming signals, therefore operate the receiving relay 44 and this in turn operates a relay 45 which places a ground connection for spacing signals and a negative battery for a marking signal on the incoming hub circuit 46. These spacing and marking conditions affect the relay 47 through its upper winding and this relay in turn places a ground connection for spacing signals and a negative battery connection through its lower winding and the winding of relay 48 for marking signals on the outgoing hub 49. The upper winding of sending relay 43 being connected to the hub 49 will, therefore, repeat into the outgoing terminals 41 those signals which come in over the incoming terminals 40 and affect the receiving relay 44.

Also connected to the hub 49 is a station circuit for operating the local subscriber's station 50. Spacing and marking conditions on the hub 49 are transmitted through the armature of polarized relay 51 and thence through the lower winding of sending relay 52 which, in turn, transmits corresponding spacing and marking signals over its armature through the upper winding of relay 51, thence over the receiving magnet 53 and the transmitting contacts 54 of the local subscriber's station 50 to battery.

Another local subscriber's station 55 is shown, this one having only teletypewriter receiving apparatus. No provision is made for transmission from this station so that various types of commercial arrangements are therefore illustrated. The receiving magnet 56 of this station 55 is operated by sending relay 57 whose upper winding is connected to the hub 46. Therefore, it will appear that the local subscriber's station 55 will respond directly to impulses coming in over the incoming terminals 40 whereas the receiving apparatus of the local subscriber's station 50 will get so-called local copy when this station originates signals and will not respond to such signals after they have traversed the entire ring. Station 50 will, of course, respond to all signals originated at other stations in the ring circuit.

When the subscriber at station 50 transmits, then the receiving relay 51 will operate and will cause the operation of sending relay 43 to transmit out over the ring. At the same time this transmission will proceed through the hub 49 to

the armature of relay 47 where it will affect the relay 48. This relay will establish a positive potential on the grid of tube 58 which will cause the operation of relay 59 and this relay in turn will establish a circuit from ground, the upper armature and back contact of relay 60, the front contact and upper armature of relay 59 to the winding of relay 61. Relay 61 through its upper armature opens the circuit for relay 47 so that the ring is effectively opened at this point and signals coming in over the incoming terminals 40 are not repeated to the outgoing terminals 41. Therefore, when the subscriber at station 50 is transmitting, his magnet 53 will immediately respond to his transmission but will not respond to the same transmission after it has traversed the entire ring and come in over the incoming terminals 40. It should be noted that by means of condenser 78 and resistance 80 the vacuum tube 58 is adjusted to hold relay 59 energized for a period after the release of relay 48 somewhat longer than the propagation time of the ring circuit. Under normal conditions when the subscriber at station 50 has ceased to operate his transmitting contacts 54 vacuum tube 58 will therefore hold relay 59 operated for a period somewhat longer than the propagation time of the ring so that relay 61 will effectively hold the ring circuit opened for such a period after transmission has ceased.

Local subscriber's station 55 being effectively connected to the incoming hub 46 will respond only to the transmission from station 50 after it has entirely traversed the ring.

Space signals appearing on hub 46 from the incoming terminal 40 cause relay 62 to operate. This opens a minus battery connection to the grid of tube 63 but due to the connection of condenser 79 and potentiometer resistances 81 and 82 the grid does not immediately become sufficiently positive to cause relay 60 to operate. The timing of this operation depends on the value of condenser 79 and resistances 81 and 82 and may, for instance, be made as long as twice the propagation time of the ring circuit. If this condition occurs while the subscriber at station 50 is operating his transmitting contacts 54, relays 59 and 61 will be operated so that now when relay 60 operates from tube 63 it will cause relay 61 to release, again connecting hub 46 to the upper winding of relay 47. When station 50 next goes to marking, relay 47 will move to the spacing contact in effect continuing the spacing signal on hub 46 into hub 49 and thence out onto the outgoing terminals 41. Since relay 48 released when station 50 went marking and relay 47 is now held on its spacing contact, tube 58 eventually opens its plate circuit causing relay 59 to release and again operating relay 61 effectively opening the connection between hub 46 and the winding of relay 47. Since the operator at station 50 recognizes the break and in accordance with traffic instructions ceases to operate his transmitting contacts 54, a steady mark signal is impressed on the outgoing terminals 41 which eventually arrives at the station which initiated the break. The attendant at that station thereupon releases his break key and the space signal entering incoming terminals 40 changes to mark, releasing relay 62, which immediately opens the plate circuit of tube 63 allowing relay 60 to release and in turn release relay 61 again closing hub 46 to the winding of relay 47. The station which originally "broke" station 50 may therefore send, and his signals will appear at stations 50 and 55 and be repeated by relay 47 and hub 49 to the outgoing terminals 41.

Thus it will appear that tube 58 may be considered a fast-operating slow-releasing relay and tube 63 may be considered a slow-operating fast-releasing relay.

In the same manner that relay 60 will respond to a "break" it will respond to any prolonged spacing condition on incoming terminals 40. Should trouble occur so that relay 60 is maintained energized for some time relay 64 which may be timed to respond in, let us say, ten seconds will operate an alarm 83. This will notify an attendant that trouble has developed.

In Fig. 4 there is shown a broken-line rectangle 65 indicating the receiving part of a teletypewriter machine. Here, as in Fig. 2, there are two lugs 66 and 67; 66 operates only on the "letters" signals and 67 operates on all other signals. This machine is operated from the incoming hub 46 through the back contact and lower armature of relay 59 and the polarized relay 68 which in turn operates the receiving magnet 69. If a hit or useless traveling impulse periodically operates the magnet 69 the lug 66 will periodically close a circuit from battery through the lower armature and back contact of relay 71 and the stepping magnet 73. This will cause the switch arm 74 to advance step by step. After the arm 74 has moved off normal, the lug 75 will cause the off-normal switch to close. The immediate effect of this is to place ground on the inner armature of relay 76 and to connect the release magnet 77 to the front contact of the upper armature of relay 71. Therefore, if the traveling hit or "letters" signal is followed by some other recognized signal, which will operate the lug 67, the grid of the vacuum tube 70 is rendered positive with the consequence that relay 71 is operated and ground on its upper armature causes the operation of release magnet 77 to return the switch arm 74 to normal. If, however, this hit or traveling useless impulse continues to be received and continues to periodically operate the lug 66 the switch arm 74 will advance step by step until it strikes a ground connection which may be placed on any contact so as to appropriately time this operation. Thereupon the relay 76 is operated and locks through its inner upper armature to ground on the off-normal contacts. Relay 76 also closes a circuit from ground, the upper armature and back contact of relay 71, the outer upper armature of relay 76 to the winding of relay 61 which effectively opens the ring circuit to stop transmission of this traveling impulse further than this particular station circuit. Relay 61 in turn places a ground on the release magnet 77 to return the switch arm 74 to normal but relay 76 being slow to release maintains relay 61 operated long enough to suppress the hit.

When the switch arm 74 returns to normal and the off-normal switch is operated to the position shown by lug 75, relay 76 is released and this in turn results in the release of relay 61 so that the ring circuit is again effectively closed at the back contact and upper armature of relay 61.

Tube 70 is equivalent to a fast-operating slow-releasing relay due to the use of the timing circuit including condenser 72 and resistance 84. During regular transmission tube 70 will therefore keep relay 71 energized and even a series of "letters" signals will maintain this tube activated through the lower armature and front contact of

relay 71. Thus this circuit will act to clear out an unwanted traveling space signal but will not interfere with legitimate transmission of even a series of "letters" signals which might otherwise appear to be a traveling hit.

Fig. 5 may be substituted for Fig. 4 by changing the connections at the broken line marked XX. With this arrangement spacing and marking signals transmitted by the relay 45 into hub 46 will be transmitted over the back contact and outer left-hand armature of relay 90 to the lower winding of polarized relay 91, which latter relay will follow the impulses, even in the case of a short pulse, that is, one of such duration that the brush 92 will still be on the start segment 93 when it ends. At the end of such a hit the arrangement of Fig. 5 will effectively open the ring circuit and clear it out in the following manner. When relay 91 goes to its left-hand or spacing contact, ground will be connected through the armature and spacing contact of relay 91, the outer left-hand armature and back contact of relay 94, the armature and front contact of relay 95 where it will result in short-circuiting the right-hand winding of this relay and the winding of latching magnet 96. Relay 95 and latching magnet 96 will release and the brush 92 will begin to travel according to the well-known practice in the art of stop-start distributors. Since this hit is of short duration the relay 91 will be moved to its marking contact before the brush 92 has left the start segment 93 whereupon a circuit will be established from battery, the back contact and inner left-hand armature of relay 94, the right-hand contact and armature of relay 91, the outer left-hand armature and back contact of relay 94, the armature and back contact of relay 95, ring 97, brush 92, start segment 93 to the grid of tube 98. This plus battery placed on the grid of trigger tube 98 causes the energization of relay 94 whose circuit may be traced through the back contact and right-hand armature of relay 99, the outer left-hand armature and back contact of release relay 100, the back contact and right-hand armature of relay 90 to battery. Relay 94 now makes a direct connection of plus battery through the alternate contacts of the outer left-hand armature of relay 94 to the armature of relay 95 and thence over the circuit previously traced to the distributor ring 97. At the same time, relay 94 removes the armature of relay 91 from connection to the armature of relay 95 so that this relay will have no more influence over the distributor ring 97.

Relay 94 through its inner right-hand armature energizes the peg count register 100 so that a count may be made of the number of such hits as they occur. At the same time relay 94 closes a ground connection to the right-hand winding of relay 102 which becomes energized and locks through its front contact and inner right-hand armature to ground on the back contact and outer right-hand armature of relay 100. Relay 102 in operating operates a peg count register 103 and at the same time closes ground to conductor 104 leading to relay 61. Relay 61, therefore, operates and effectively opens the ring circuit. This condition will be maintained, as will appear, for a period somewhat greater than the propagation time of the ring circuit. Relay 102 also removes a battery connection from conductor 105 thereby releasing any one of relays 106 to 115 which may be operated.

As the brush 92 passes over the segments 121 to 125 any pair of relays, such as 126 and 127 or 134 and 135, which may be in an operated condition are now caused to release. As the brushes pass over the stop segment 117 a circuit is established from ground segment 116, brush 92, segment 117 through winding of relay 118 to battery. Relay 118 operates and prepares a circuit for the operation of relay 119. This circuit becomes effective when the brush 92 leaves the segments 116 and 117 so that the relays 119 and 118 are operated in series with each other.

During the time that relay 118 is operated and relay 119 is non-operated the shunt around the left-hand winding of relay 95 is open and this relay operates and locks through its right-hand winding to battery through the alternate contacts of the outer left-hand armature of relay 94. The latch magnet 96 also operates in parallel with the left-hand winding of relay 95 and prepares to stop the brushes when they arrive at their original position.

With relay 119 operated the circuit of slow-release relay 120 is opened with a result which will be presently noted. Relay 119 also closes a circuit from ground, the outer right-hand armature and front contact of relay 119 and thence in series through the armatures and back contacts of relays 135, 133, 131, 129 and 127 from whence it is extended by the outer right-hand armature and front contact of relay 94 to the right-hand winding of relay 136. Relay 119 also again shunts the left-hand winding of relay 95. When relay 120 finally releases it places a short circuit about the winding of relay 118 which releases and thereby opens the circuit of relay 119 so that this relay in turn releases and again causes the energization of relay 120.

Relay 136 in operating locks to the back contact of relay 99 and therethrough to ground at the back contact of relay 90. Relay 136 also extends the armature of relay 91 through the back contact and outer left-hand armature of relay 99 to the winding of relay 137.

When the spacing signal caused by the hit has traveled around the ring circuit and again appears on the hub 46 it causes relay 91 to operate and this now causes the operation of relay 137. Relay 137 in operating now places a ground on the other terminal of relay 99 so that during the time relay 91 has its armatures on its spacing contact relay 99 is short-circuited. At the end of the spacing signal, relay 91 moves to its marking contact and relay 99 is caused to operate in series with relay 137. Relay 99 operated (1) opens the locking path of relay 136 which releases, (2) makes the grid of tube 138 less negative causing relay 100 to operate, and (3) opens the plate circuit of tube 98 which allows relay 94 to release. Tube 98 is known as a trigger tube and it only takes a short energization of the grid in order to start sufficient current flowing to cause the energization of relay 94 and this in turn will continue to flow after the energizing impulse has ceased. Therefore, it is not until the circuit of relay 94 is opened at the back contact and right-hand armature of relay 99 that the tube 98 will cease to function.

With relay 94 released the control of relay 95 and latch magnet 96 is restored to the armature of relay 91 and the peg count register 101 is released. Relay 102 is now also released since the original energizing circuit of its right-hand winding is opened by the relay 94 and the locking circuit is opened at the back contact of the release relay 100. Relay 102 in releasing releases peg count register 103 and at the same time allows relay 61 to become deenergized so as to again ef-

fectively close through the ring circuit. Thus the ring circuit has been opened and closed again after a single repetition of a hit.

Release relay 100 in operating causes relays 137 and 99 to release allowing the grid of tube 138 to become sufficiently negative in a few seconds to cause relay 100 to release restoring the circuit to its former condition.

Should a spacing signal be transmitted around the ring which corresponds to the code for the letter "V" this will mean that relay 91 goes to spacing and remains in this condition until after the brush 92 has passed over the segment 121. In this case trigger tube 98 is not caused to operate but a ground connection from the spacing contact of relay 91 is connected through segment 121 to the winding of relay 126 and thence to battery. Relay 126 operates and prepares a circuit for relay 127. As soon as the brush 92 leaves segment 121 relay 127 comes up in series with relay 126. The other pairs of counting relays are not affected except that any pair which was previously operated will be caused to release at this time. The pair of relays 118 and 119 are operated as hereinbefore described. In this instance, however, since relay 127 has moved its armature relay 136 will not be operated but instead a ground will be placed through the left-hand armature and back contact of relay 114 through the winding of relay 115 thence through the left-hand winding of relay 114, the outer right-hand armature and back contact of relay 102, the back contact and inner right-hand armature of relay 100 to battery. Relay 115 alone will operate in this circuit due to the resistance of the winding of relay 115. However, relay 115 closes a circuit for the right-hand winding of relay 114 which becomes effective when relay 119 releases. At this time with current flowing through both the windings of relay 114 this latter relay becomes energized.

On the receipt of a second "V" signal relay 119 again connects a ground pulse to the left-hand armature of relay 114 whereupon relay 115 is shunted and releases. Thereupon a circuit is established from ground at the armature and back contact of relay 115, the front contact and right-hand armature of relay 114 through the winding of relay 139. When relay 119 releases and therefore removes ground from the left-hand armature of relay 114 this relay now being held through its left-hand armature releases. Thereupon relay 139 remains energized in a circuit through its winding, the left-hand winding of relay 102, the armature and front contact of relay 139 to ground at the back contact and outer right-hand armature of relay 100. With relay 102 operated relay 61 operates and effectively opens the ring circuit so that on the third receipt of the code signal for the letter "V" this code will be received by relay 91, but will not be repeated into the outgoing hub 49. Brush 92 rotates a third time and when relay 119 becomes operated a ground will be extended from the outer right-hand armature and front contact of relay 119 through the outer left-hand armature and front contact of relay 102 to the right-hand winding of release relay 100 which therefore becomes operated. With relay 100 operated relays 102 and 139 are released, in turn causing relays 61, 100 and the register 103 to release. When relay 119 releases, relay 100 will also release thus restoring the circuit to normal.

In the event that a "letters" signal is received this means that relay 91 will go to its spacing contact for a period long enough to allow brush 92 to move off the start segment leaving the trigger tube 98 unaffected but relay 91 will again be on its marking contact when segment 121 is reached. Also the relay 91 will be on its marking contact as the brush 92 passes over the segments 122, 123, 124 and 125 so that all of the counting relays 126 to 135, inclusive, if in an operated condition, will be released. Hence when relay 119 operates it connects one ground pulse through the outer right-hand armature and back contact of relay 94 to the counting relays 106 and 107.

The arrangement of counting relays, such as relays 106 to 115, inclusive, is well known and the manner of interconnecting them to get various counts is also well known. With the number here provided a maximum of sixteen "letters" signals may be counted and then relay 139 will be operated. The connections shown provide for counting seven "letters" signals.

When relay 119 again operates, relay 107 will operate for a fourth time causing relay 139 to operate, and when relay 119 then releases relay 105 will operate allowing relay 102 to operate in series with relay 139 as previously described and the ring circuit will be opened as before. Relay 102 operated also releases all operated counting relays. At the next rotation of the distributor on receiving the eighth "letter's" signal, the operation of relay 119 will cause relay 100 to operate through its right-hand winding in turn releasing relays 139 and 102 and restoring the circuit to normal.

Thus it will be seen that this circuit will effectively open the ring circuit after one reception of a short hit, after a second repetition of a "V" signal and after a predetermined number of repetitions of a "letter's" signal.

On all signals other than "V" and "letters" the operation of relay 119 causes relay 100 to operate from the plate of tube 138. Relay 100 operated restores all counting relays and causes the release of relay 61. During the period the release relay 100 is operated or holding, subsequent signals of any type will hold the release relay 100 operated, hence an indeterminate number of "V" and "letters" signals may be passed if the first follows closely after some other character.

In Fig. 6 certain relays of Fig. 5 are shown in order to show how the counting relays may be arranged for variable operation. With the aid of the directions noted in the chart, Fig. 7, the relay 139 may be made to operate on any desired number of repetitions of the incoming "letters" signal. As stated above, the particular connection shown in Fig. 5 is that in which terminals A and B are strapped together, terminals E and G are strapped together and terminals H and L are strapped together so that relay 139 will operate after seven repetitions of the "letters" signal. In the chart the heavy lines indicate just when the various relays are operated and the relays 139, 102 and 100 are shown as operated when the strapping indicated in the column headed by the numeral 7 of the line "Number of repetitions" is used. Any alternative strapping will cause relays 139, 102 and 100 to operate at corresponding times.

What is claimed is:

1. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal for differentiating between normal signals and recurring stray

signals, and means responsive to actuation of said means by stray signals for suppressing said stray signals only after said stray signals have passed through said station circuit a predetermined number of times.

2. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal for differentiating between normal signals and recurring stray signals, and means controlled by said first-named means for opening said normal connection between said terminals only after said stray signals have passed through said station circuit a predetermined number of times.

3. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal, means in said receiving apparatus for differentiating between signals of different types, and means responsive to the reception of signals of a particular type only after a predetermined number of successive repetitions thereof for opening said normal connection between said terminals.

4. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal, said receiving apparatus having decoding means for differentiating between signals of one type and signals of other types, a stepping device, means responsive to signals of the said one type and to stray disturbances simulating signals of the said one type for operating said stepping device, and means operated by said device when it reaches a predetermined position for opening said normal connection between said terminals.

5. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal responsive to stray signals only after being repeated a predetermined number of times for opening said normal connection between said terminals, and means for maintaining said open connection for a predetermined length of time thereafter.

6. In a signaling system, a station circuit having incoming and outgoing terminals normally connected in a tandem ring circuit for through transmission, means connected to said incoming terminal responsive to stray signals only after being repeated a predetermined number of times for opening said normal connection between said terminals, and a slow-releasing instrumentality for maintaining said open connection for a period greater than the propagation time of said tandem ring circuit including said station circuit.

7. A signaling system comprising a transmission circuit in a closed ring including a plurality of serially connected station circuits and including other devices and apparatus, all combining to establish an over-all definite and measurable propagation time, each said station circuit having incoming and outgoing terminals normally connected for through transmission, means for differentiating between normal signals and stray signals traversing said station circuit, and slow-releasing means responsive to said differentiating means for opening said terminals and maintaining such open connection for a period greater than the propagation time of said closed ring.

8. A signaling system comprising a transmission circuit in a closed ring including a plurality of serially connected station circuits and including other devices and apparatus all combining to establish an over-all definite and measurable propagation time, each said station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal, transmitting apparatus associated with said outgoing terminal, and means responsive to signals from said transmitting apparatus for opening said normal connection between said terminals and at least one of said station circuits having additional means comprising means for differentiating between normal signals and stray signals, and means responsive thereto for opening said normal connection between said terminals and maintaining such open connection for a period greater than the propagation time of said closed ring when stray signals have successively traversed said station circuit a predetermined number of times.

9. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal for differentiating between normal signals and recurring stray signals, means responsive to operation of said means for suppressing said stray signals only after said stray signals have passed through said station circuit a number of times, and adjustable means for predetermining said number of times.

10. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal for differentiating between normal signals and recurring stray signals, means responsive to operation of said first-named means for suppressing said stray signals only after said stray signals have passed through said station circuit a predetermined number of times, and means for rendering said last means unresponsive to stray signals.

11. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal for differentiating between normal signals and recurring stray signals, means responsive to the operation of said first-named means by stray signals for suppressing said stray signals after said stray signals have passed through said station circuit a predetermined number of times, and means responsive to normal signals followed thereafter by stray signals passing through said station within a predetermined time for rendering said last means inoperative.

12. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, devices connected to said incoming terminal for differentiating between normal signals and recurring stray signals, means responsive to operation of said devices by stray signals for suppressing said stray signals only after said stray signals have passed through said station circuit a predetermined number of times, and a delayed action instrumentality for preventing the operation of said last means, said instrumentality being responsive to normal signals and to stray signals closely following normal signals.

13. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission,

means connected to said incoming terminals responsive to a particular signal, variably adjustable means for counting the number of times said signal passes successively through said station circuit without other intervening signals, and means responsive thereto only when the count has reached a predetermined point for preventing further passage of said stray signal.

14. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means connected to said incoming terminal responsive to a particular signal, variably adjustable means for counting the number of times a said signal passes through said station circuit, and means responsive thereto only when the count has reached a predetermined point for suppressing said signal, and means responsive to one of other signals for returning said counting means to its starting point.

15. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means responsive only to the repeated reception of a single signal for opening said through transmission channel, means responsive to the length of said signal for operating said last means upon differing numbers of repetitions of said signal.

16. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means for opening said normal connection, means responsive to the repeated reception of a single impulse for counting the number of repetitions of said impulse, means variably responsive thereto for operating said first means, and means responsive to the character of said single impulse for controlling the variable response of said last means.

17. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, means for opening said normal connection, means responsive to the repeated reception of a single impulse for counting the number of repetitions of said impulse, means variably responsive thereto for operating said first means, means responsive to the character of said single impulse for controlling the variable response of said last means, and means responsive to the reception of normal signals for preventing the operation of said first means.

18. In a permutation code transmission system for transmitting a plurality of units in permutated groups having an equal number of units per group, each unit consisting of one or another of more than one possible condition, a station circuit having incoming and outgoing terminals, means connecting said terminals to relay a permutated group from the incoming to the outgoing terminals, means responsive to a given number of repetitions of some one group to interrupt the relaying, and means responsive to the reception of another group to cancel the effect of any number of repetitions less than said given number.

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