

Aug. 6, 1940.

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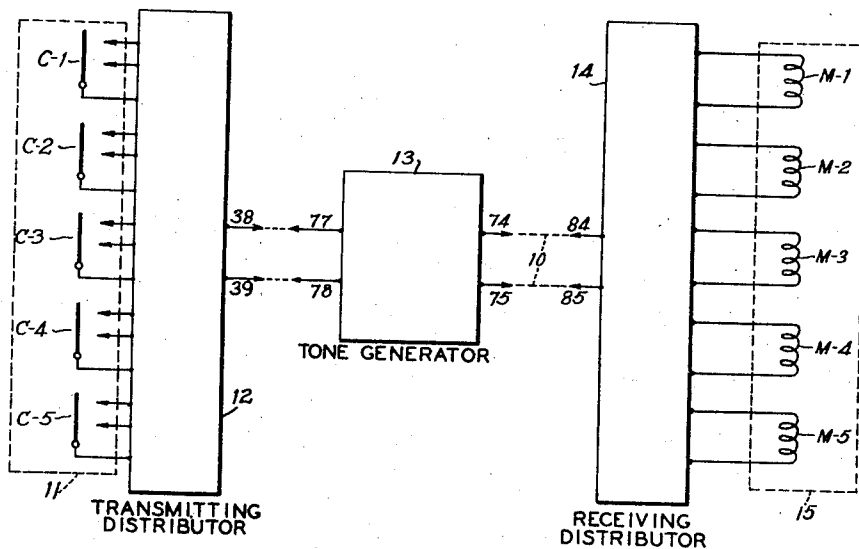
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SIGNALING SYSTEM

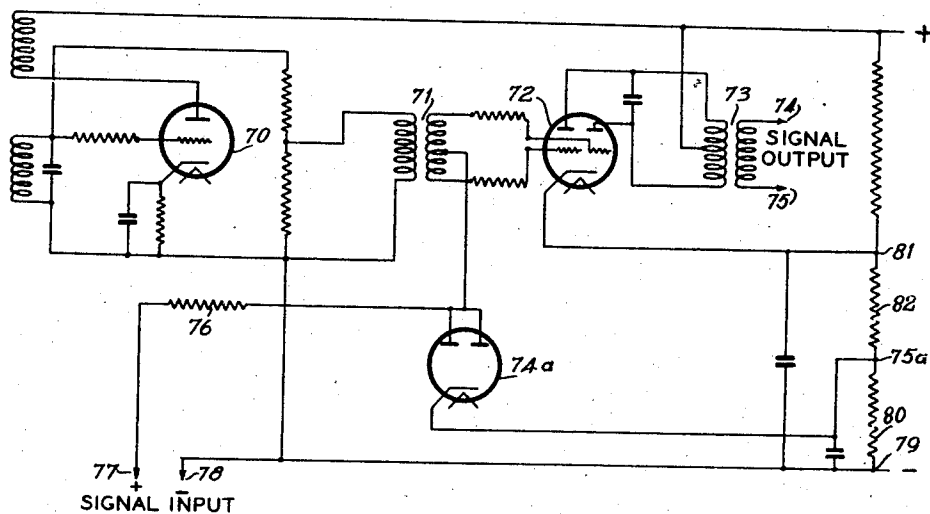
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3 Sheets-Sheet 1

Fig. 1.



T-29.2.



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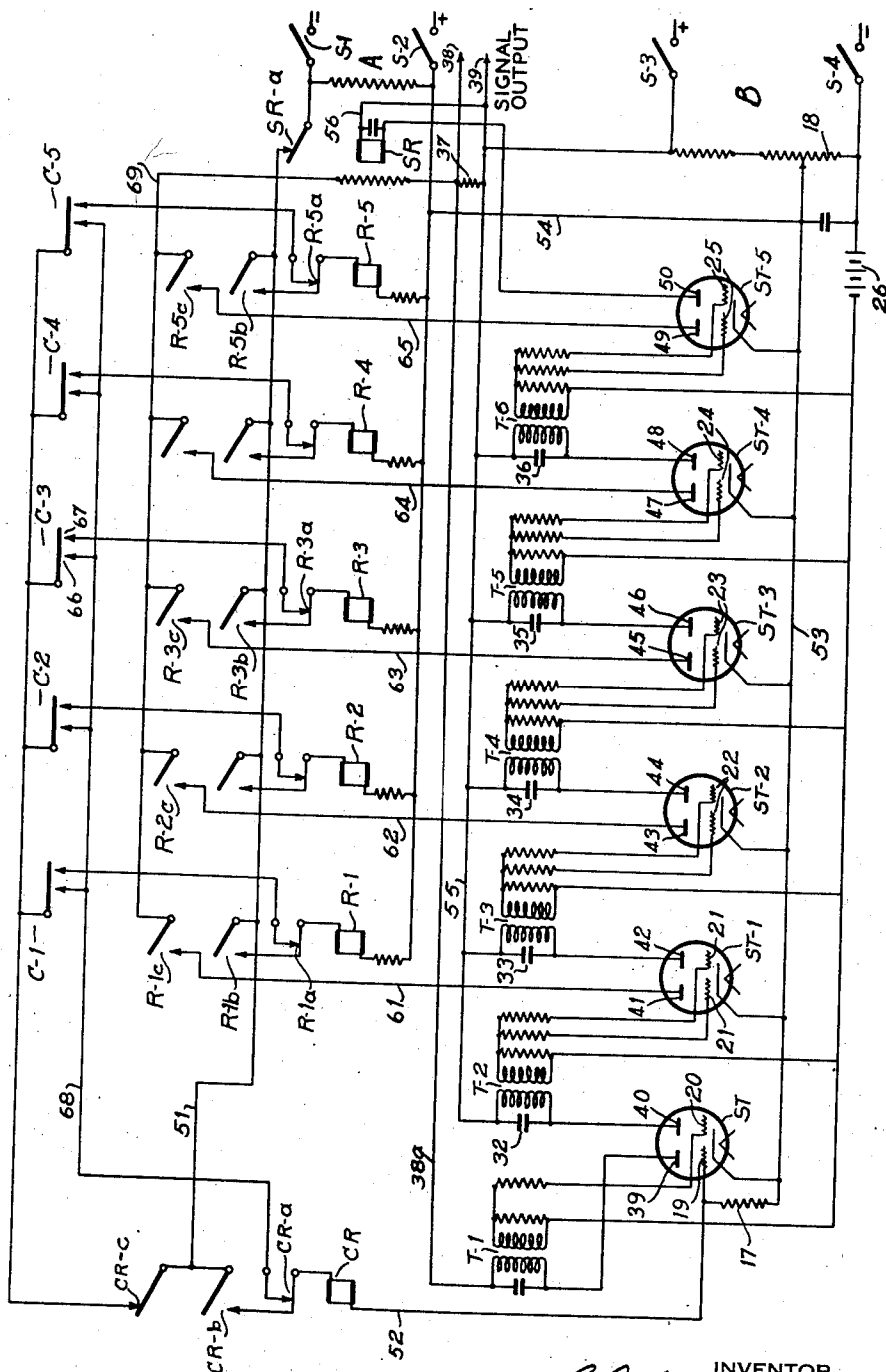
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SIGNALING SYSTEM

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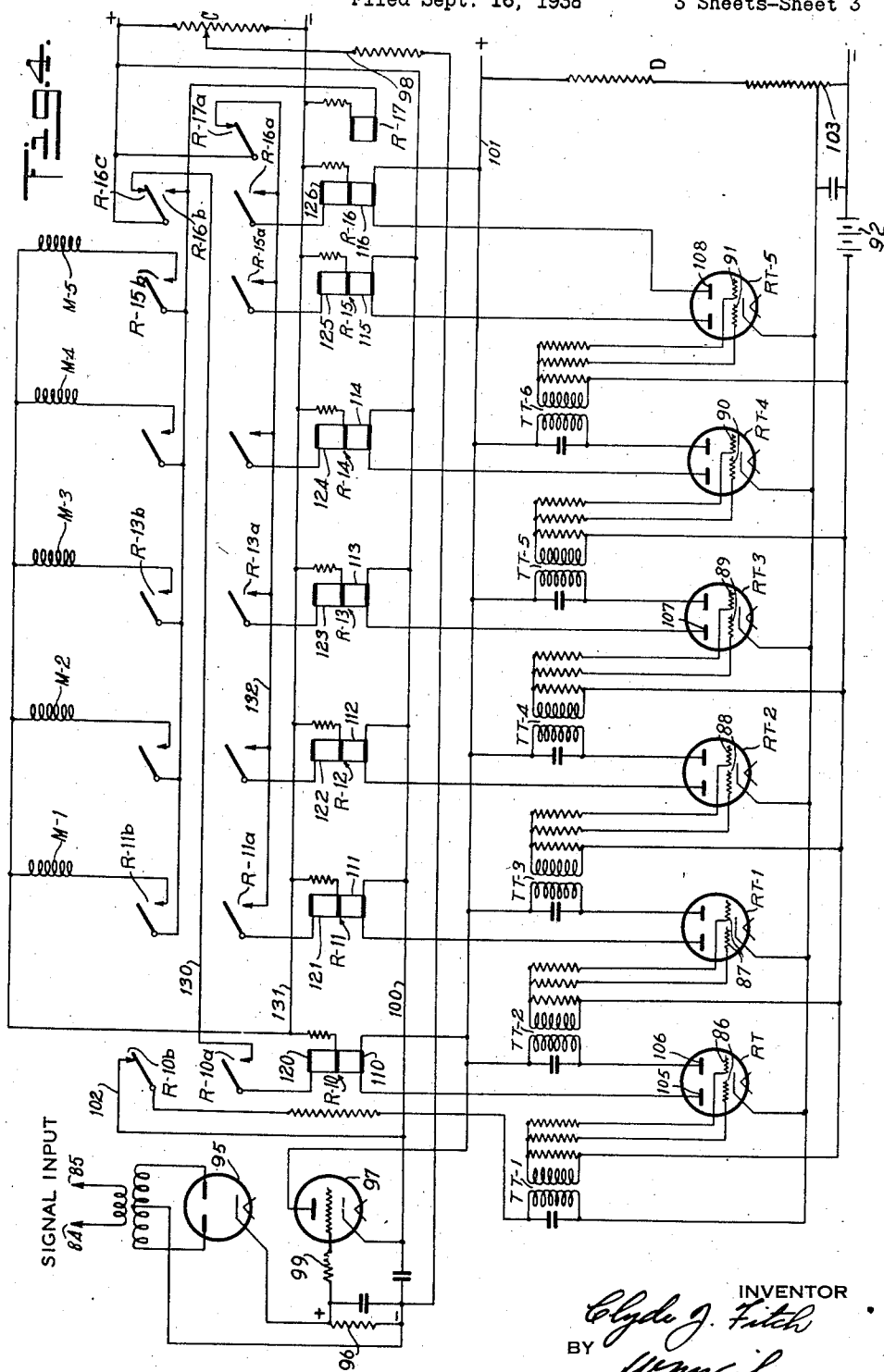
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SIGNALING SYSTEM

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3 Sheets-Sheet 3



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2,210,576

SIGNALING SYSTEM

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6 Claims. (Cl. 178—53.1)

The present invention relates to signaling systems and more particularly to signaling systems utilizing signal distributing means in the form of an electronic distributing means adapted to be controlled in accordance with the provisions of the well known principles of the mechanical start-stop signal distributors.

In the instant application the electronic distributing means comprises a plurality of electron discharge devices arranged electrically so that the anode circuits in the preceding devices exercise control over the grid circuits of the succeeding devices. Normally, the electron discharge devices are maintained non-conductive until a control circuit of the electronic distributing means is conditioned in a predetermined manner, thus rendering the electron discharge devices conductive automatically in succession until the last device of the series is rendered conductive whereupon the normal control conditions are restored to render the said series of devices non-conductive, thereby preparing and conditioning the electronic distributing means for further signal conditions. Provision is made in the present invention to condition signaling channels associated with the electronic distributing means so that at the particular time interval the said electron discharge devices are rendered conductive, the signaling channels are adapted to be rendered effective for predetermined control purposes.

One of the objects of the present invention resides in the provision of control means for a plurality of electrically associated electric discharge devices adapted to be rendered conductive successively at exclusive intervals which, when conditioned in a predetermined manner, is effective to control the initiation of the progressive operation of the electric discharge devices.

Another object of the present invention resides in the provision of means whereby the electronic distributing means is adapted to be operated aperiodically, that is, adapting the electronic distributing means to be operated so as to simulate the action of the well known mechanical start-stop signal distributing devices.

An object of the present invention resides in the provision of means comprising signal transmitting and receiving means associated with electronic start-stop distributing means at remotely situated stations to control the said distributing means for transmitting and receiving signals.

Another object of the present invention resides in the provision of means controlled by the signal transmitting means whereby upon operation thereof the electronic distributing means at the

transmitting and receiving stations are rendered operative.

Another object of the present invention is the provision of combinational code transmitting and receiving control means associated with the electronic distributing means to control and be controlled by the respective electronic distributing means at the transmitting and receiving stations.

Still another object of the present invention resides in the provision of means to impress continuously upon the transmission medium during non-signaling intervals a system conditioning signal thereby maintaining the electronic receiving distributing means inoperative until cessation of the conditioning signal occurs.

Still another object of the present invention resides in the provision of means to render inoperative automatically the electronic distributing means at both stations upon completion of the signal transmission cycle.

Further objects of the instant invention reside in any novel feature of construction or operation or novel combination of parts present in the embodiment of the invention described and shown in the accompanying drawings whether within or without the scope of the appended claims and irrespective of other specific statements as to the scope of the invention contained herein.

In the drawings:

Fig. 1 shows diagrammatically the circuit arrangement for the present signaling system.

Fig. 2 shows one form of circuit arrangement of a suitable tone signal generating system.

Fig. 3 shows a circuit arrangement of the transmitting electronic distributing means and specific associated control devices.

Fig. 4 shows the circuit arrangement with the receiving electronic distributing means and the associated specific control circuits.

Before describing in detail the electrical arrangement of the present electronic distributing means and an exemplary type of specific control circuit arrangement which may be employed in association therewith, a brief and general description of the signaling system will now be given.

General description

Referring now to Fig. 1, a diagrammatic arrangement is shown embodying the electronic distributing means indicated generally at 12 and 14 at the transmitting and receiving stations respectively. A plurality of signaling channels are shown associated with the transmitting distributor and are shown as adapted to be controlled by control elements such as the contact means

C-1 to C-5. The said contact means are provided to condition the signaling channels and electronic distributing means to initiate independent or dependent signals which are based upon a time division basis, that is, particular time values are imparted to the signals during predetermined timed intervals to differentiate between the successively initiated signals.

The signaling channels obviously may be associated with a common control device having interrelated control elements to control the conditioning of the independent signaling channels, or individual devices may be provided having unrelated control elements wherein independent control means are provided to condition simultaneously or aperiodically the signaling channels to control the initiation of the control signals. Thus, for example, the signaling channel control means, namely, the contact means C-1 to C-5 may be operated independently to condition the associated signaling channels and the electronic distributing means or may be controlled in predetermined or permutative combinations to condition the said associated signaling channels and electronic distributing means.

In order to simplify the description to follow, let it be assumed that the contact means C-1 to C-5 are controlled in accordance with well known permutation codes, that is, let it be assumed that the contact arrangement designated C-1 to C-5 are controlled by well known types of keyboard control devices such as, for example, the type disclosed in U. S. Patent 1,214,515 dated February 6, 1917, or if preferred it may be of the type shown in copending application Serial No. 113,798, filed December 2, 1936. Such forms of control devices are well known in the art and, since the control devices per se form no part of the present invention, further details and description are deemed unnecessary and thus are generally indicated in the said figure by the reference character 11.

The transmitting electronic distributing means generally indicated at 12 is shown in detail in Fig. 3 and comprises a series of electric discharge devices ST, ST-1, ST-2, etc. The individual devices ST-1 to ST-5 normally are maintained non-conductive until a predetermined signal condition is adapted to condition the control device ST to render the remaining electric discharge devices conductive progressively in succession. Upon operation of the last device in the series, control means are provided to restore the series of devices to the normal non-conductive condition until rendered operative at a later time upon further conditioning of the control device ST.

It should be mentioned in respect to the present application of the electronic distributing means to be outlined hereinbelow that further well known signaling conditions are simulated, namely, that the circuit arrangement is adapted during the periods that character signal conditions are not transmitted to impress upon the transmission medium a continuous signal or electrical condition. This signaling condition which may be applied to the transmission medium conforms to the marking signal (current condition on the transmission medium) directly impressed upon the transmission lines during the non-signaling periods in the present day printing telegraph signaling systems. Thus, it will be shown that upon conditioning the control device ST the continuous control or marking signal impressed upon the transmission medium is discontinued, creating a zero current condition

or spacing signal as it is referred to in telegraph practice. Then, during the following operation of the discharge devices ST-1 to ST-5 various signals similar to the marking and spacing signal conditions are impressed upon the transmission medium in accordance with the conditioning of the associated signaling channels.

In Fig. 1 a tone generator generally designated by the reference character 13 and shown in detail in Fig. 2 is shown interposed between the transmitting electronic distributing means and the transmission medium 10. It will be understood as the description progresses that for certain signaling applications the tone generator may be dispensed with and, instead of keying the tone generator by the initiated signals, provision may be made to impress the said initiated signals directly upon the transmission medium. Associated with the transmission medium at the receiving station is a receiving electron distributing means generally indicated in Fig. 1 by the reference character 14 and shown in detail in Fig. 4. The receiving electronic distributor is shown to comprise a series of electric discharge devices RT, RT-1, RT-2, etc. The discharge device RT is employed as a control device for the remaining devices in the series, namely, RT-1 to RT-5, and is adapted to be operated similarly as the control device ST associated with the transmitting distributing means to control the sequential operation of the series of devices RT-1 to RT-5. It will be seen that the operation of the said series of electric discharge devices at the transmitting and receiving stations are similar in action. Specific control circuits are shown associated with the receiving electronic distributing means to control the associated signaling channels which is shown to include the control means M-1 to M-5. The said control means M-1 to M-5 may comprise individual control means for individually associated and unrelated devices or, as stated in connection with the transmitting station, the said control means may form part of a common control device and be interrelated to control the common control device in accordance with the signals impressed upon the transmission medium. To continue with the example set forth in connection with the transmitting station, the control means M-1 to M-5 may comprise the individual control magnets adapted to be energized or controlled in accordance with well known permutation codes to control a signal recording device a well known form of which is disclosed in U. S. Patent No. 1,128,422, dated February 16, 1915, or may be of the type shown in the copending U. S. application Serial No. 113,799, filed December 2, 1936. In Fig. 1 the signal recording means is referred to generally by the reference character 15; and as this mechanism per se forms no part of the present invention, it is deemed unnecessary to describe it in further detail.

Transmitting circuit arrangement

Referring now to Fig. 3, the electronic signal distributing means at the transmitting station is shown to comprise a series of electric discharge devices ST, ST-1, ST-2, etc. The individual discharge devices are shown to comprise a well known form of double triode type of electron discharge means. It is seen that one of the anode circuits of the preceding tube is electrically coupled and adapted to control the input circuit of the next discharge device in the series. The grids 21-25 of the devices ST-1 to ST-5 respectively are normally adapted to be biased by

the battery 26 and the grid biases are adapted to be of such values as to render the devices ST—1 to ST—5 non-conductive. The grid 20 of the device ST is also adapted to be biased by the said battery 26 to the same degree so that no current is permitted to flow in the associated anode circuit. It is to be noted that a variable resistor 18 is provided so that slight variations in the values of the grid bias for all the individual grid elements of the tubes, except the control grid 19, may be effected. By varying the grid bias of the said devices, the timed interval required for the generation of the impulses by the said devices can be varied depending upon the degree of bias supplied. Thus, by varying the common control resistor 18 the time interval required for generating the entire group of impulses by the individual devices can be increased or decreased equally so that the complete cycle period required for the generation of the individual impulses can be arranged or set to be of any predetermined values.

The impulses generated by the individual discharge devices ST, ST—1, ST—2, etc., are impressed upon the next succeeding devices by means of the associated transformers T—2, T—3, etc. In the primary circuits of the said transformers T—2 to T—6 individual impulse delay means are incorporated in the circuits to delay the initiation of the following impulse which is to be impressed upon the next discharge device in the series by means of the associated transformer. The time delay means comprises the individual primary windings of the said transformers and the associated individual condensers 32—36.

Now assume that the switches S—1 to S—4 associated with the power supplies designated A and B are closed. It is seen that a circuit is immediately established permitting current to pass from the positive terminal of the power supply B through resistor 37 and conductor 38a through the primary winding of the transformer T—1, anode 39 and the cathode of the device ST, to the negative terminal of the power supply B through the bias control resistor 18, creating a potential difference across the signal output terminals 38 and 39 or, stated in other words, impressing a continuous signal or electrical condition upon the output terminals 38 and 39. This signal condition referred to corresponds to the continuous marking signal condition impressed upon the transmission line in well known printing systems. Current is permitted to flow in the said circuit associated with the anode 39, since the corresponding control grid element 19 is connected directly through the resistor 17 to the cathode of the device ST, thus maintaining the grid bias value thereof at zero and permitting current to pass from the said anode 39 to the cathode of the said device under the conditions described.

It was mentioned that the grid element 20 in the device ST and the grids 21—25 of the devices ST—1 to ST—5 were maintained at a normal negative bias so as to render the associated output circuits non-conductive. Thus far, it is seen that all the output circuits associated with the individual anodes of the said devices with the exception of the circuit associated with the anode 39 of the device ST are not energized under the present conditions. It should be mentioned that the direction of the current flow through the primary winding of transformer T—1 is such as to aid the negative bias potential impressed on grid element 20, so that at the moment the said circuit is established, the bias condition impressed on the grid 20 remains such so as to maintain the circuit associated with anode 40 deenergized.

Now assume for the moment that a negative potential is impressed upon the grid circuit 19 of the device ST which, for example, occurs when the contacts CR—b associated with relay CR are closed, thus permitting the following circuit to be established: from the negative terminal of the power supply A to conductor 51, contacts CR—b (assumed to be closed), conductor 52, resistor 17, conductors 53 and 54 to the positive terminal of the power supply A. Upon establishing the described circuit from the power supply A through the said contacts CR—b the direction of the current flow through the said resistor 17 is such as to impress a negative potential on the grid 19 of the device ST with respect to its cathode, which potential is sufficient to bias the device ST preventing further current flow in the circuit connected to the associated anode element 39. Suppressing the flow of current in the circuit associated with the said anode 39, it is seen that the signal condition impressed upon the terminals 38 and 39 is discontinued. Hereinafter the continuous signal condition impressed upon the terminals 38 and 39 and characterized as similar to the continuous marking signal of the present printing telegraph systems will be referred to as the "system conditioning signal." When the current flow is discontinued through the resistor 37, no difference of potential is impressed upon the terminals 38 and 39 or, in other words, the conditioning signal no longer is impressed thereupon. This condition will be referred to as the "starting signal" and corresponds to the zero current condition or spacing signal of the telegraph systems referred to.

It was just mentioned that the normal current flow through resistor 37 flows through the primary winding of the transformer T—1 in the anode 39 and cathode of the device ST. However, when this current flow is suppressed or cut off, due to the potential drop impressed upon the resistor 17 upon closure of the contacts CR—b, the sudden interruption of the current flow through the said primary winding of the transformer T—1 causes the magnetic field thereof to collapse and generate an impulse which is impressed upon the control grid 20 of the device ST through the secondary winding of the said transformer T—1. It was mentioned that normally the grid element 20 is at a negative bias, thus preventing current to pass from the associated anode 40 to the cathode of the device ST. The impulse generated, due to the collapse of the magnetic field of the transformer T—1 and impressed upon the grid 20, is adapted to be in a positive direction, thus overcoming the bias impressed upon this grid by the battery 26 and thereby permitting current to flow momentarily in the circuit connected to the associated anode 40. The circuit referred to associated with the anode 40 can be traced as follows: from the positive terminal of the power supply B to the common conductor 55, primary winding of the transformer T—2 and the shunted condenser 32 to the anode 40 and cathode of the device ST to the common conductor 53 and negative terminal of the said power supply. Since the impulse generated by the collapse of the magnetic field in the transformer T—1 and impressed upon the control grid 20 is of short duration, the current flow in the circuit connected to the anode 40 is similarly of short duration, and the time value thereof is equivalent to the timed interval during

which the impulse is impressed upon the grid 20. The impulse generated by the transformer T-2 is retarded in phase 180° from the original impulse generated by the transformer T-1 due to the impulse time delay means comprising the aperiodically tuned transformer circuit. The impulse generated by the transformer T-2 is initiated at a time duration later than the impulse generated by the transformer T-1 but the time of initiation or generation is equal to the time duration of the impulse initiated by the transformer T-1. The delayed time of initiation and the time duration during which the signal is generated by transformer T-2 is controlled by the values of the inductance, resistance and capacitance in the aperiodically tuned transformer circuit. The polarity of the windings of the transformer T-2 is such that the impulse generated thereby, upon cessation of the current flow through the primary winding thereof, which is impressed upon the grids 21 of the device ST-1 is impressed on the said grids in a positive direction, thus overcoming the negative bias impressed upon the said grids 21 by the battery 26, thereby permitting current to flow in the circuit associated with the anode 42 of the device ST-1.

It is seen that the circuit associated with the anode 42 is similar to the tuned circuit arrangement associated with the anode 40. Thus, upon impressing the said impulses upon the grids 21 of the device ST-1, thereby rendering the said device conductive, current momentarily is permitted to flow in the following circuit: From the positive terminal of the power supply B to the conductor 55 to the tuned circuit arrangement comprising condenser 33 and primary winding of the transformer T-3, anode 42 and associated cathode of the device ST-1 to the negative terminal in the said power supply. Cessation of current flow in this last described circuit is effective to generate and initiate another impulse which is impressed by means of the transformer T-3 in a positive direction upon the grids 22 of the device ST-2. The impulse initiated in this circuit, however, due to the time delay action of the tuned circuit, and impressed upon the control grid elements is retarded 180° in phase with respect to the impulse impressed upon the grids 22. Impression of the positive impulse upon the grids 23 is effective to initiate still another impulse, since the device ST-3 is rendered conductive so as to energize the tuned circuit associated with transformer T-5. The impulse initiated by this last mentioned transformer is similarly retarded 180° in phase with respect to the impulse impressed upon the device ST-3 to condition the grids 24 of the device ST-4, rendering this last mentioned device conductive and energize the tuned circuit associated with the transformer T-6 to initiate, upon deenergization thereof, still another 180° phase retarded impulse which is impressed upon grids 25 of the device ST-5 rendering this last mentioned device conductive.

Thus, it is seen that the normally non-conductive devices ST-1 to ST-5 are rendered conductive progressively in succession whenever the control device ST is conditioned in a predetermined manner. The sequential operation of the devices is effected by the generation of the individual impulses which are adapted to overcome the effects of the individual grid biases impressed upon the devices to render the said devices conductive in succession. Immediately after the operation of each device, the grid bias impressed

upon the associated device is effective to regain control thereof, thus rendering the associated devices non-conductive until a further cycle is established by virtue of conditioning the control device ST in the predetermined manner just described, namely, to render one of the current conducting paths of the device ST non-conductive, for example, by impressing a grid bias of sufficient value upon the associated control grid to prevent current flow in the associated anode circuit.

The cessation of the said system conditioning electrical condition generated by the device ST and impressed upon the circuit associated with the anode 39 thereof is effective to cause generation of the first control impulse which is of sufficient value to overcome the negative grid bias of the first device in the series of devices comprising the electronic distributing means, namely, discharge device ST-1. A second impulse is generated due to the conductivity of the said first device of the series to render the next device in the series conductive. However, the initiation of the said second impulse is delayed by means of the tuned circuit arrangement interposed between the said first and second devices. The described action is effected progressively in succession rendering in turn each of the succeeding devices conductive for a short timed interval corresponding to the time duration that the impulse is impressed thereon.

It was mentioned that upon operation of the last device in the series that the electronic distributing means is automatically restored to the normal inoperative state or condition, thus preparing the distributing means for further signaling purposes. One method of effecting this desired feature will now be explained. It was assumed that during the description of the successive operation of the said electric discharge devices the contacts CR-b were closed to effect initiation of the progressive operation of the distributing means. For the following description, at the moment, let it be assumed that the normally closed contacts SR-a upon operation are effective to open the control circuit including the said contacts CR-b until a later signaling operation, similar to the one just described, is desired to be effected. It is seen that the controlling relay coil SR which is adapted to operate the contacts SR-a is connected directly to the anode 50 of the device ST-5. Therefore, upon operation of this device ST-5, which is the last one in the series, it is seen that the coil of relay SR is energized by means of the following circuit which is established momentarily from the positive terminal of the power supply B to conductors 55 and 56, coil of the relay SR, anode 50 and cathode of the device ST-5 to the negative terminal of the said power supply through the control resistor 18, thus energizing the said coil and thereby effecting operation of the relay to open the contacts SR-a. The said contacts SR-a are included in the grid bias circuit described hereinabove to impress a bias of sufficient value upon the control grid 19 of the device ST to prevent current flow in the circuit connected to the associated anode 39 thereof. It was assumed that operation of the contacts SR-a is effective to cause the opening of the contacts CR-b until these last mentioned contacts are operated at a later time. Thus, it is seen that the negative bias is removed from the control grid 19 of the device ST, thereby permitting current to flow in the associated anode circuit which as

traced hereinabove comprises the circuit from the positive terminal of the power supply B to the resistor 37, conductor 38a, primary winding of transformer T-1, anode 39 and cathode of the device ST to the negative terminal of the said power supply. Current flow in this circuit again establishes a difference of potential across the output terminals 38 and 39, thereby impressing upon the said output circuit the system conditioning electrical condition referred to hereinbefore. It is understood now that this electrical condition is maintained on the transmission medium associated with the terminals 38 and 39 until the contacts CR-b are operated at some later time. The grid bias impressed upon the control grids of the remaining devices in the distributing means are effective during the non-signaling periods to regain control, as mentioned hereinabove, of the devices, thus preventing these devices from being conductive. In this manner it is seen that the electronic distributing means is rendered operative for a predetermined timed interval and at the end of this timed interval is rendered inoperative until at any later desired period the control device ST is conditioned in the predetermined manner as described hereinabove.

Each of the said devices ST-1 to ST-5 included in the signal distributing means is electrically associated with individual signaling channels. The control circuits of these channels comprise the individual circuits 61-65 which are associated with the anodes 41, 43, 45, 47 and 49 respectively and are conditioned in succession upon operation of the devices ST-1 to ST-5 for control purposes. In order to simplify the description, a specific signaling control arrangement will be now described.

Assume that the contacts C-1 to C-5 are controlled permutatively by suitable signaling apparatus which are well known in the art and similar to those fully disclosed in the above referred to U. S. Patent No. 1,214,515 and copending application Serial No. 113,798. Such signaling apparatus is adapted to control the operation of the contacts simultaneously in various combinations representing different characterizations. Assume now that the group of contacts designated C-3 are operated momentarily to close the contacts 66 and 67. Upon closure of the contacts 66 the following circuit is established from the negative terminal of the power supply A through the normally closed contacts SR-a, common conductor 51, normally closed contacts CR-c, contacts 66 now closed, common conductor 68, normally closed contacts CR-a, coil of the relay CR, conductor 52, resistor 17, conductors 53 and 54 to the positive terminal of the said power supply, energizing the coil of the said relay effecting operation of the associated contacts. As shown in Fig. 3, the contacts CR-b and CR-a are of the "make before break" type. Therefore, a circuit is established from the negative terminal of the power supply A, through the contacts CR-b and the coil of relay CR before the contacts CR-a are opened. In this manner the relay CR is adapted to be energized and maintained operated continuously until the normally closed contacts SR-a are opened.

At the same time through the contacts 67 a circuit is established to effect energization and operation of the relay R-3 by means of the circuit from the negative terminal of power supply A to conductor 51, contacts CR-c, contacts 67, normally closed contacts R-3a, coil of relay R3

to the positive terminal of the said power supply, thus energizing and operating the said relay. The contacts R-3b and R-3a are of the "make before break" type so that a circuit from the said power supply is established through the R-3b contacts to maintain the relay R-3 energized until the normally closed contacts SR-a are opened. The contacts CR-c associated with the CR relay are adjusted so that upon energization of the relay CR there is enough time lag in the operation of these contacts to permit the circuit just described to be established, namely, to permit energization of the group of control relays R-1 to R-5. It is seen that, when the contacts CR-c are opened, the power supply is cut off from the group of control contacts C-1 to C-5, thus preventing operation of the signaling apparatus and any one of the contacts C-1 to C-5 to disturb the signal selection set-up until the end of the transmission cycle, that is, until the signals representing the selected character are transmitted by the electronic distributing means. Closure of contacts R-3c connect conductor 63 and anode 45 of the device ST-3 by means of the common conductor 69 to the output terminals 38 and 39. Therefore, it is seen upon operation of the group of contacts identified as C-3, the said output circuit of the device ST-3 is conditioned or completed for energization whenever the device ST-3 is rendered conductive.

It was mentioned hereinabove that upon closure of contacts CR-b permitting voltage to be impressed upon the circuit associated with the control grid element 19 of the device ST, this circuit which was traced, is effective to establish a bias upon the said control grid element of such value so as to prevent current to flow in the output circuit associated with the anode 39 of the said device. It is understood now that under these conditions the potential difference impressed across the output terminals 38 and 39 no longer exists and that hereinabove this condition at this time was referred to as the starting signal condition. It was also described in detail herein above that the collapse of the magnetic field in the transformer T-1 momentarily generates an impulse in a positive direction overcoming the grid bias impressed upon the grid element 20 of the device ST and that at this moment current is permitted to flow in the circuit associated with the anode 40 of the said device. Due to this current flow, the transformer T-2 is energized and by means of the described time delay means associated therewith an impulse is generated and initiated, retarded 180° in phase with respect to the impulse originated by the transformer T-1. The impulse initiated by the transformer T-2 is effective to render the device ST-1 conductive, which in turn energizes the transformer T-3 and subsequently renders the device ST-2 conductive, in turn energizing transformer T-4 rendering the device ST-3 conductive at a later timed interval and energizing the transformer T-5 and rendering the device ST-4 conductive which in turn energizes the transformer T-6 to render the last device in the series ST-5 conductive. It is seen that since the contacts R-1c and R-2c remain open at the time the device ST-1 and ST-2 are rendered conductive, no signal conditions can be initiated by the said devices when rendered conductive, thus maintaining the transmission medium, connected to the terminals 38 and 39, unenergized at these particular timed intervals in the transmission cycle. However, when the device ST-3 is rendered op-

erative due to the impulse generated and initiated by the transformer T-4, a signal at this particular timed interval is impressed upon the output terminal 38 and 39 by means of the following circuit which is established momentarily: from the positive terminal of the power supply B to the resistor 37, conductor 69, contacts R-3c, conductor 63, anode 45 and cathode of the device ST-3 to the common conductor 53 and the negative terminal of the said power supply through the control resistor 18, thus impressing a potential difference across the terminal 38 and 39 due to the current flow through the resistor 37, thereby impressing a signal condition upon the output terminals at the particular timed interval the device ST is rendered operative. The said signal condition exists as long as the impulse generated by the transformer T-4 is impressed upon the control grids 23 of the device ST-3. Upon cessation of the said generated pulse, the negative grid bias impressed upon the said grids 23 is effective to regain control of the device ST-3 thereby preventing further current flow in the signaling circuit and thereby suppressing the signal condition impressed upon the output terminals. Since the contacts R-3c are the only contacts closed for the example chosen, a signal condition is only transmitted at the timed interval the device ST-3 is rendered conductive. However, it is obvious that various combinations of signal conditions can be impressed upon the output terminals depending upon the specific combinations of control contacts operated during the signaling cycle. It was mentioned that upon operation of the last device, namely, ST-5 in the series that the relay SR is energized and operated to open the associated contacts SR-a. Operation of these last mentioned contacts is effective to open the holding circuits for the relays R-3 and CR. Deenergization of the said relays restores the normal conditions as described herein above and as shown in Fig. 3.

It is remembered that, when the normal conditions referred to are restored, the negative grid bias impressed on the control grid 19 of the device ST is removed therefrom, permitting current to flow immediately in the circuit associated with the anode 39, thereby impressing the continuous signal condition upon the output terminal 38 and 39 and which has been referred to as the system conditioning signal. The electronic distributing means is now conditioned for further signaling purposes upon operation of the associated signaling apparatus and control circuits, namely, the group of contacts C-1 to C-5 and control relays R-1 to R-5 and the associated control circuits. In this manner it is seen that the electronic signal distributing means is rendered operative automatically upon operation of the signaling apparatus and by means of the interconnecting control circuits between the electric discharge devices of the distributing means of the device ST-1 to ST-5 are rendered conductive automatically in sequence to permit any of the conditioned signaling circuits or channels, by the respective contacts C-1 to C-5, to impress corresponding signal conditions upon the output terminals 38 and 39.

It is also seen that automatically upon operation of the last device of the series that the conditioned signaling apparatus is restored to the normal unconditioned state and that the electronic signaling distributing means is rendered inoperative until subsequent operation of the signaling apparatus. During the non-signaling

periods, that is, when the electronic distributing means is inoperative, a steady electrical condition is continuously impressed upon the output terminal 38 and 39. It is also seen that upon operation of the signaling apparatus and after the desired character selection has been effected due to the circuit arrangement of the associated control means the further operation of the signaling apparatus during the signal transmission cycle is ineffective to effect or destroy the selected and stored character selection previously set up. Due to the described circuit arrangement of the control means, the signaling apparatus is not effective to set up a new character selection until the end of the signaling cycle.

Tone signal generator

For certain applications of the present signaling system, it may be desired to provide a signal generator keying arrangement adapted to be controlled by the character impulses or electrical conditions initiated by the transmitting circuit arrangement and impressed upon the terminals 38 and 39 thereof. It has been found that, whenever such is the case, the circuit arrangement shown in Fig. 2 is suitable for such purposes. The tone signal generator in the figure is shown to comprise a conventional type of electronic oscillator system comprising the electron discharge device 70 and the associated circuits which are arranged so that the oscillator system is continuously in an oscillating state. Part of the energy from the oscillating system is impressed by means of transformer 71 upon the control grid elements of the electron discharge device 72. The device 72 comprises a double triode type of discharge device and the control grid elements of which are connected in push-pull relationship to the secondary or output winding of the oscillator system transformer 71. The energy generated by the device 72 is impressed upon the associated push-pull output transformer 73, the secondary winding of which is connected to the output terminals 74 and 75. The discharge device 72 is arranged so as to be controlled by the character impulses initiated by the transmitting circuit arrangement just described and in such a manner that, when the normal line signal or electrical condition is impressed on the output terminals 38 and 39 of the transmitting circuit (the normal line signal condition is the system conditioning electrical condition referred to hereinabove), the bias potential impressed on the grids of the device 72 is such that the device 72 is conditioned to be conductive, permitting a tone signal to be impressed upon the output terminal 74 and 75. However, when the conditioning signal is removed from the line, that is, when the signal no longer is impressed upon the terminals 38 and 39 (for example, when the starting signal is transmitted) the device 72 is adapted to be controlled so as to be non-conductive by impressing grid bias potential upon the control grid elements of the device, so that there is no current flow in the output circuits thereof, thereby discontinuing the tone signal impressed upon the output terminal 74 and 75. This grid element biasing arrangement can be effected in the following manner.

A single wave rectifying device 74a is provided, the cathode element of which is connected to a point 75a on the voltage divider and the anode elements of which are connected through resistor 76 to the terminals 77 and 78. It should be mentioned at this time that the input terminals 77 and 78 are connected directly to the transmitting

circuit output terminals 38 and 39 respectively as shown in Fig. 1. Thus, it is seen that the output circuit of the device 74a is extended through resistor 76 and also resistor 37 (Fig. 3) to the point 79 on the voltage divider shown in Fig. 2. Assuming now for the moment there is no signal condition impressed on the input terminal 77 and 78, it is seen that the anode elements of the device 74a are provided with a negative potential with respect to the cathode thereof equal to the voltage drop across the resistor 80 of the said voltage divider. A mid point connection is provided from the secondary winding of the transformer 71 to the anode elements of the device 74a and due to this arrangement the grid control elements of the device 72 which are connected in push-pull fashion to the said secondary winding are provided with a negative potential with respect to the cathode thereof which is connected to a point 81 on the voltage divider. Thus, the negative bias potential impressed on the grid elements of the device 72 is equal to the sum of the voltages across the resistors 80 and 82. This voltage value is sufficient to bias the grid elements of the device 72 so as to render the said device non-conductive, thereby preventing the energy from the oscillator system impressed directly on the winding of transformer 71 to be impressed upon the output terminal 74 and 75.

Now, whenever the normal line signal, such as the system conditioning signal or the character signals, are impressed upon the terminals 38 and 39 and 77 and 78 respectively so that the polarity corresponds to that shown in Fig. 2 (and so that the voltage value thereof is equal in amplitude to the voltage drop across the resistor 80), the rectifying device 74a will be rendered conductive and the bias potential on the grid elements of the device 72 will then be equal to the voltage drop across the resistor 82. The voltage drop across resistor 80 has been nullified by the signal voltage on the input terminals 77 and 78. Resistor 82 is of such value that the voltage drop across it is adapted to provide a bias potential for the grid elements of the device 72 so that this device is rendered conductive and operates in a manner similar to the class A type of amplifier, thereby permitting the output energy of the oscillator circuit to be amplified and impressed upon the output signals 74 and 75. If the voltage of the signal conditions impressed on the input terminals 77 and 78 is of greater value than the drop across resistor 80, current is permitted to flow through the resistor 76 and the rectifying device 74a and resistors 80 and 37. However, resistor 76 is of such relatively high value that said current flow is limited to such small value that the voltage drop across the rectifying device is negligible so that this voltage drop which opposes the voltage drop across resistor 82 is so minute that for practical purposes the class A bias potential established for the tube 72 is not effected or altered sufficiently to effect the action or operation of the device 72. In other words, if the input signal voltage impressed on the terminals 77, 78 is of a value equal to the drop across resistor 80, the device 72 is provided with bias potential comparable to that of a class A amplifier and, if the input voltage is greater than the drop across the said resistor, the class A bias potential is altered only a negligible value. The advantage of this arrangement is that, if the input signals vary in amplitude, there will be reproduced tone signals of uniform amplitude in the signal output circuit

represented by the terminals 74 and 75, providing however that the minimum amplitude of the signals on the input terminals 77, 78 is never less than the voltage drop across the resistor 80.

In accordance with this circuit arrangement, it is seen that, whenever electrical conditions representing either a system conditioning signal or character signals are impressed upon the transmitting circuit output terminals 38, 39, the tone signal generator circuit arrangement is conditioned to permit the tone signals to be impressed upon the output circuit terminal 74, 75, and it is seen that, whenever the signal conditions are not impressed upon the output terminals 38 and 39 of the transmitting circuit, the tone signal generator circuit arrangement is conditioned so that no tone signals are permitted to be impressed upon the output terminals 74 and 75. With this arrangement it will be evident that the same signaling conditions will prevail at the receiving station whether or not the tone signal generator is provided and interposed between the signal distributing means and the transmission medium, that is, with the provision of the tone generator tone signals are impressed upon the transmission medium whenever the character or system signal conditions are impressed upon the output terminals 38 and 39, and, of course, it is seen that without the provision of the tone generator the character and system signal conditions are impressed directly upon the transmission medium through the terminals 38 and 39.

Receiving circuit arrangement

Referring now to Fig. 4, the electronic receiving distributing means is shown to comprise the control electron discharge device RT and a series of electron discharge devices RT-1 to RT-5. The discharge devices utilized in the receiving circuit are of the double triode type similar to those employed in the transmitting circuit arrangement. The method of generating the control impulses to control the sequential operation of the discharge devices RT-1 to RT-5 is exactly the same as the method described in connection with the transmitting circuit arrangement and shown in Fig. 3. For this reason it is deemed unnecessary to repeat at this time the detailed method of generating and initiating the individual phase retarded impulses which are impressed progressively upon the series of devices RT-1 to RT-5.

It is to be noted, however, that all of the grid elements, namely 86-91, are provided with a negative grid bias potential by means of the battery 92 which is of sufficient value to render the devices RT, RT-1 to RT-5 nonconductive (assuming, of course, that no signal conditions are impressed upon the input terminals 84 and 85 of the receiving circuit). A full wave rectifying device 95 is shown to be electrically associated with the input terminals 84 and 85 of the receiving circuit. Whenever the tone signal generator is employed, the full wave rectifying device 95 is provided in the receiving circuit in order to rectify the tone signals impressed upon the terminals 84 and 85. Upon rectification of the tone signals and as long as the tone signals are impressed upon the input terminals of the receiving circuit, a continuous voltage is impressed across the resistor 96 of the polarity shown.

It is thus seen that the input circuit of the electron discharge device 97 is electrically associated with the input circuit of the receiving sys-

tem by means of the connection thereof with the resistor 96. It should be mentioned, however, that, whenever signal conditions are not impressed upon the input terminals 84 and 85, the device 97 is adapted to be provided with a grid bias potential of sufficient value to render this device non-conductive. This biasing circuit referred to can be traced from the negative terminal of the power supply C to conductor 98, grid current limiting resistor 99, grid and cathode elements of the device 97, through the common return conductor 100, to the positive terminal of the said power supply. However, the bias potential impressed upon the said grid element is adapted to be counteracted by the voltage impressed across the resistor 96 whenever signal conditions are impressed upon the terminals 84 and 85. Assuming now that the system conditioning signal is impressed continuously upon said input terminals of the receiving circuit and that the rectified voltage impressed upon the resistor 96 is effective to overcome the grid bias potential impressed upon the control grid of the device 97 so that this said device is rendered conductive. Now, since the device 97 is adapted to permit current to flow in its output circuit, the following circuit is adapted to be energized and can be traced from the positive terminal of the power supply D to the conductor 101, anode and cathode elements of the device 97, conductor 102, normally closed contacts R-10b, primary winding of the first sequence coupling transformer TT-1 to the negative terminal of the power supply through the resistor 103. Thus, whenever the tone signals are impressed upon the terminals 84 and 85, the device 97 is conditioned to permit current to flow through the primary winding of the first sequence transformer TT-1. Current flow, however, when first established through the primary winding of transformer TT-1 at this time is not effective to overcome the bias potential impressed upon the grid elements 86 of the control device RT so that this control device and the remaining discharge device RT-1 to RT-5 in this series remain non-conductive. The reason for this is that the direction of the current flow through the primary winding of transformer TT-1 is such as to aid the negative bias potential on the grid element 20. However, when the incoming signals are no longer impressed upon the input terminals 84 and 85, which is the case when the starting or character signals are transmitted, the device 97 is instantly controlled by the grid bias potential impressed thereon so as to render the device non-conductive and due to the interruption of the current flow through the primary winding of the transformer TT-1, the magnetic field thereof is caused to collapse resulting in an impulse in a positive direction which is impressed upon the grids 86 of the device RT through the secondary winding of the transformer TT-1. The impulse generated by the said transformer is of sufficient value to overcome momentarily the bias potential impressed upon the said grids 86 so as to render the device RT conductive. It is noted that the anode element 106 of the device RT is connected to the primary winding of the transformer TT-2 so that, when the device RT is rendered conductive, the said transformer is adapted to be energized by means of the circuit from the positive terminals in the power supply D to the time delay circuit means comprising the primary winding of the transformer TT-2 and the condenser associated therewith to the anode 106 and cath-

ode of the device RT to the negative terminal of the said power supply. Upon cessation of the current flow in the primary winding of the transformer TT-2, an impulse is generated in the secondary winding thereof retarded 180° in phase with respect to the impulse generated by the transformer TT-1 to overcome the bias on the grid elements 87 of the device RT-1 to render this last mentioned device conductive. Individual phase retarded impulses are then sequentially generated and initiated by the remaining transformers of the series TT-3 to TT-6 to render the remaining associated devices RT-2 to RT-5 conductive progressively and in succession similarly as described in connection with the devices ST-1 to ST-5 with respect to the transmitting circuit arrangement. The transformers TT-1 to TT-6 have the same inductance, capacitance and resistance values as those of the transformer T-1 to T-6 of the transmitting distributing means so that the time duration of the individual impulses generated and the time duration of the cycle of operation of the electronic distributing means is the same as that of the transmitting electronic distributing means, that is to say, when the device ST-1 of the transmitter is rendered conductive to initiate signal conditions which are impressed upon the input terminals 84 and 85 of the receiving circuit, the device RT-1 is rendered conductive so as to be controlled by the said signals so initiated. The action of the devices ST-2 to ST-5 and RT-2 to RT-5 are similarly controlled so as to be rendered conductive or operative at the same exclusive intervals during the transmitting and receiving cycles.

From the description up to this point, the operation of the electronic signal distributing means per se should be understood so that further detailed description of the receiving electronic distributing means is not deemed necessary. Therefore, the specific control circuits and signal selection circuits will now be described.

When the first control impulse, caused by the collapse of the magnetic field of the transformer TT-1 is impinged on the grids 86 of the device RT, rendering this device conductive, current is also permitted to flow in the circuit connected to the associated anode 106 which may be traced as follows: from the positive terminal of the power supply D to the common conductor 101, to the pick-up coil 110 of the relay R-10, anode 105 and cathode of the device RT to the negative terminal of the said power supply, thus energizing the said pick-up coil and operating the relay R-10 to open the normally closed contacts R-10b and closing the contacts R-10a. A holding circuit for the said relay is immediately established through the associated closed contacts and can be traced from the positive terminal of the power supply C through the normally closed contacts R-16c, conductor 130, contacts R-10a, holding coil 120 of relay R-10 to the common conductor 131 to the negative terminal of the said power supply. Therefore, it is seen that immediately upon the generation of the first control impulse of the electronic distributing means, due to the collapse of the magnetic field of the transformer TT-1, relay R-10 is adapted to be operated and maintained operated by means of the holding circuit just described until the normally closed contacts R-16c are opened which occurs at the end of the transmission cycle and will be explained later herein. The control relays R-11 to R-16 are similarly provided with

pick-up coils 111 to 116 and holding coils 121 to 126 for the same purposes.

It is seen that, when the contacts R-10b are opened, due to the energization of relay R-10 the cathode element of the discharge device 97 is disconnected from the primary winding of the transformer TT-1. It is evident that this condition exists as long as the said contacts are maintained in an operative position by the relay R-10. Therefore, due to this arrangement, further signal conditions impressed upon the terminals 84 and 85 cannot be impressed upon the primary of the transformer TT-1 to effect generation and initiation of additional control impulses to effect faulty operation of the devices RT, RT-1 to RT-5 of the series.

In order to explain how the timed character signals transmitted and impressed upon the input terminals of the receiving circuit are segregated for control purposes at the receiving station, it will be assumed that the character signal described to be initiated by the transmitting circuit arrangement under control of the group of contacts C-3 is impressed upon the input terminals of the receiving circuit. It will be remembered in connection with the description of the transmitting circuit arrangement that upon operation of the group of contacts C-3 the continuous signal impressed upon the terminals 38 and 39 thereof was discontinued to effect initiation of the so-called starting signal, and that further signal conditions were not impressed upon the terminals 38 and 39 until the time interval that the device ST-3 was rendered operative. Therefore, it is understood for the particular example described in connection with a single cycle of operation of the transmitting circuit that the following electrical signal conditions were created, namely, to interrupt the continuous electrical signal condition impressed upon the terminals 38 and 39, which is referred to as the starting signal condition which was then followed by an electrical signal condition initiated during, let us say, a third timed interval of the transmission cycle when the device ST-3 was rendered operative followed by the normal line signal condition or system conditioning signal at the end of the transmission cycle.

Upon receipt of the first said signal conditions referred to as the starting signal, the device RT is rendered operative to operate the relay R-10 and cause the progressive operation of the remaining devices RT-1 to RT-5 in the series. It was explained that during the signaling cycle, that is, when the electronic distributing means at the transmitting station and the receiving station are rendered operative progressively, the cathode element of the device 97 is isolated from the primary winding of the transformer TT-1 and that due to this arrangement the grid potential impressed upon the grid element of the device 97 is effective to regain control of the device rendering it non-conductive whenever signal conditions are not impressed upon the input terminals 84 and 85 of the receiving circuit during the transmitting and receiving cycle. Now let it be assumed that the character signal initiated by the operation of the device ST-3 of the transmitter is received and impressed upon the input terminals of the receiving circuit which, as explained before, occurs at the time that the control impulses generated by the transformer TT-4 and impressed upon the grids 89 of the device RT-3 render this last-mentioned device conductive. Receipt of the said character signal condition is

effective to cause the voltage drop appearing at this moment across the resistor 96 to neutralize or counteract the grid bias potential impressed upon the control grid element of the device 97 to condition the said device so as to be conductive. Due to the conditioning of the device 97 in the described manner, at this particular timed interval current is permitted to flow in the circuit which may be traced from the positive terminal of the power supply D to the common conductor 101, anode and cathode of the device 97, common conductor 100, pick-up coil 113 of relay R-13, anode 107, and cathode of the device RT-3 to the negative terminal of the power supply, thus energizing the said pick-up coil and causing the operation of relay R-13. A holding circuit for the said relay is immediately established and extends from the positive terminal of the power supply C to the normally closed contacts R-17a, common conductor 132, contacts R-13a now closed, holding coil 123 of the said relay to the negative terminal of the said power supply, maintaining the relay R-13 operative until the normally closed contacts R-17a are opened at the end of the distributor cycle.

It is understood that at the timed intervals the device RT-1 and RT-2 are rendered operative for the specific example chosen, current flow in the output circuits of the said devices which are associated respectively with the pick-up coils 111 and 112 of the relays R-11 and R-12 is suppressed, since the device 97 at these particular timed intervals is adapted to be non-conductive, due to the fact that signal conditions are not impressed on the input terminals 84 and 85 at these particular timed intervals, thus permitting the grid bias to control the device 97 so as to be inoperative. This same condition exists at the timed intervals when the devices RT-4 and RT-5 are rendered conductive. Therefore, the associated relays R-14 and R-15 remain inoperative during this said distributor cycle.

It will now be seen that, when the last discharge device RT-5 of the series is rendered conductive, provision is made to not only restore the electronic distributing means at the receiver to the normally inoperative state but that provision is also made to permit the conditioned and selected signaling channels to be effective for control purposes.

One method of effecting these features is to provide for the energization of the relay R-16 when the last device RT-5 in the series is rendered conductive. In accordance with this provision the pick-up coil 116 of the said relay is adapted to be energized at this time by means of the circuit established from the positive terminal of the power supply D to the common conductor 101, pick-up coil 116, anode 108 and cathode of the device RT-5 to the negative terminal of the said power supply, thus energizing the said pick-up coil and effecting operation of the relay R-16. A holding circuit is immediately established for this relay and can be traced from the positive terminal of the power supply C through the normally closed contacts R-17a, contacts R-16a now closed, holding coil 126 of the relay R-16 to the negative terminal of the said power supply, thus maintaining the said relay operated until the contacts R-17a are opened. Immediately upon operation of the relay R-16, the holding circuit for the relay R-10 is adapted to be broken due to the opening of the contacts R-16c associated with the relay R-16. Deenergization of the relay R-10 causes the contacts R-10b to be

closed, thereby permitting the system conditioning signal which is initiated upon completion of the cycle of operation of the transmitting electronic distributing means to be effective to again render the device 97 to be conductive and permitting the current in the anode circuit thereof to flow through the primary of the transformer TT-1 similarly as described hereinbefore. Thus, the receiving electronic distributing means is maintained in an inoperative state until subsequent cessation of the current flow through the primary winding of the transformer TT-1, which as now understood is effective to generate the progressive operation of the electronic distributing means. The receiving distributing means is now conditioned for the reception and segregation of subsequent character signals.

At the same time that the relay R-10 is deenergized a circuit is established through the contacts R-16b to effect energization of the selected control means of the group M-1 to M-5. Since relay R-13 is the only relay operated during the operation of the receiving distributing means in the example chosen, the control means M-3 is the only one energized by means of the closed contacts R-13b. It is understood that, whenever different combinations of the control means are selected and conditioned for energization due to the operation of the associated control contacts R-11b to R-15b, the selected control means are adapted to be energized simultaneously for control purposes upon closure of the contacts R-16b.

It was mentioned hereinabove that the control means M-1 to M-5 may be associated with individual signal receiving devices or may be associated with a common signal receiving device similar to the apparatus referred to and disclosed in U. S. Patent No. 1,128,422 and the copending application Serial No. 113,799. Upon closure of the said contacts R-16b effecting energization of the selected signal control means, a circuit is established through the said contacts to the coil of relay R-17 to energize this relay. The time interval required to sufficiently energize this relay so as to be operated to open the associated contacts R-17a is such that the operation thereof is not effected until sufficient time has transpired upon closure of the contacts R-16b to effect energization of the selected control means of the group M-1 to M-5. Upon operation of the relay R-17, contacts R-17a are opened to break the holding circuit to relays R-13 and R-16, thus restoring the said control relays to the normally deenergized condition as shown in Fig. 4. Upon deenergization of the relay R-16, current supply is disconnected from the coil of relay R-17 due to the opening of contacts R-16b, thus causing relay R-17 to be deenergized thereby permitting the associated contacts R-17a to be closed and thus conditioning the control circuit arrangement just described for further signaling channel selection purposes upon receipt of the subsequent character signals.

Thus, it has been shown that by means of the electronic distributing means and upon receipt of the timed signal conditions that signaling channels are selected in accordance with the control signals, and that the selected signaling channels are conditioned for control purposes, in a manner so that upon completion of the distributing or transmission cycle the said selected channels are energized thereby effecting control over the associated control means such as the magnets M-1 to M-5 indicated in Fig. 4. It has also been

shown that immediately upon exercising this control over one said control means that the electronic distributing means and selecting signaling channels are restored to the normal inoperative condition or state as shown in the figure for further reception of the selecting signaling conditions.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A signaling system comprising a transmitting station including signal transmitting means and a receiving station including signal receiving means, normally inoperative signal distributing means at each station comprising a series of electric discharge devices, means controlled by any one of the signal transmitting means for initiating operation of the said distributing means at both stations, each said distributing means including means for rendering the said devices conductive successively at mutually exclusive intervals and including additional means for rendering each of the said devices in the series conductive for equal timed intervals, means controlled by the distributing means at the transmitting station upon operation thereof for initiating control signals, means controlled by the distributing means at the receiving station for controlling the signal receiving means in accordance with the control signals received, and means for rendering the said distributing means at the stations inoperative upon the operation of the last devices in the said series thereby restoring the distributing means to the normal inoperative state for further signaling operations.

2. A signaling system comprising a transmitting station including a plurality of signal sources and a receiving station including a corresponding plurality of signal receiving means, normally inoperative signal distributing means at each station comprising a series of electric discharge devices, means for initiating operation of the said distributing means at both stations including means controlled by any one of said signal sources for rendering the said initiating means effective and each said distributing means including means for rendering the said devices conductive successively at mutually exclusive intervals, means controlled by the distributing means and signal sources at the transmitting station for transmitting control signals, and means controlled by the distributing means at the receiving station for controlling the corresponding signal receiving means in accordance with the signals initiated by the signal sources.

3. A signaling system comprising a transmitting station including a plurality of signal sources, a receiving station including a corresponding plurality of signal receiving means, normally inoperative signal distributing means at each station comprising a series of electric discharge devices, means controlled by any one of the said signal sources for initiating a start signal condition, means at each station responsive thereto for rendering the signal distributing means that operative, each said distributing means including means for rendering the said

5 devices conductive successively at mutually exclusive intervals, means also controlled by the signal sources for controlling the initiation of control signal conditions upon operation of the distributing means at the transmitting station, and means controlled by the distributing means at the receiving station for controlling the corresponding signal receiving means in accordance with the signals initiated under control of the signal sources.

10 4. A signaling system comprising a transmitting station including a plurality of signal sources, a receiving station including a corresponding plurality of signal receiving means, signal distributing means at each station comprising a series of electric discharge devices, means at the transmitting station for transmitting a conditioning signal condition and means responsive thereto for normally maintaining the said distributing means at both stations inoperative, means controlled by the said signal sources for effecting cessation of the said signal condition and means controlled thereby for rendering the said distributing means at both stations operative, each said distributing means including means for rendering the said devices conductive successively at mutually exclusive intervals, means also controlled by the signal sources for controlling the initiation of control signal conditions upon operation of the distributing means at the transmitting station, and means controlled by the distributing means at the receiving station for controlling the corresponding signal receiving means in accordance with the signal conditions initiated under control of the signal sources.

5. The invention set forth in claim 4 including means for establishing the said conditioning signal condition upon operation of the last devices in the said series whereupon the said means responsive thereto is again effective to render the distributing means at both stations inoperative.

6. A signaling system comprising a transmitting station including a plurality of signal transmitting channels, a receiving station including a corresponding plurality of signal receiving channels, signal distributing means at each station comprising a series of electric discharge devices, means for selecting certain signal transmitting channels for controlling the initiation of the signals including means for maintaining the said selection for a predetermined timed interval, means controlled by any one of the selecting means for initiating operation of the distributing means at both stations, each said distributing means including means for rendering the said devices conductive successively at mutually exclusive intervals, means controlled by the distributing means at the transmitting station for transmitting signals in accordance with the selected channels, means controlled by the distributing means at the receiving station for selecting the corresponding signal receiving channels, means at the transmitting station for wiping out the said channel selections maintained upon operation of the last device in the said series thereat, and means at the receiving station for rendering the selected channels thereat effective for control purposes upon operation of the last device of the series thereat.

CLYDE J. FITCH

35

CERTIFICATE OF CORRECTION.

Patent No. 2,210,576.

August 6, 1940.

CLYDE J. FITCH.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 10, second column, line 74, claim 3, for the word "that" read --thereat--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of September, A. D. 1940.

(Seal)

Leslie Frazer,
Acting Commissioner of Patents.