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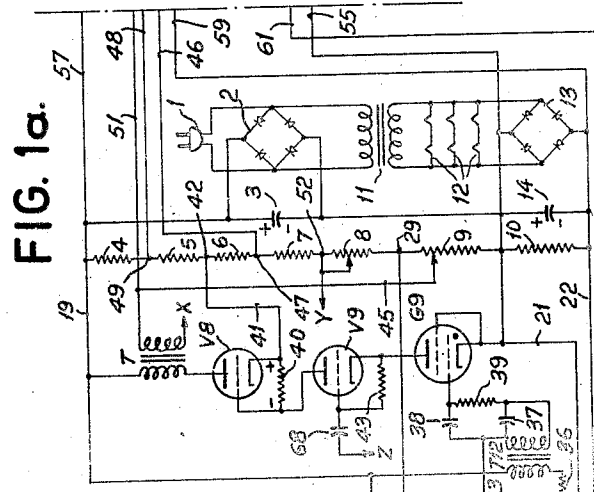
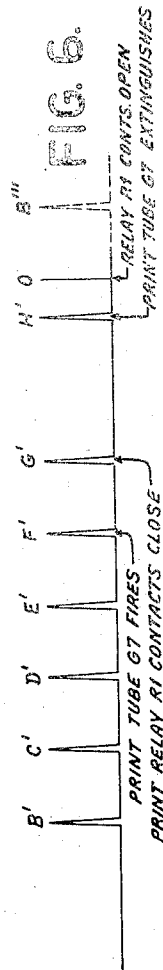
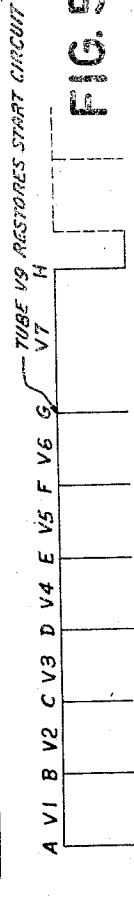
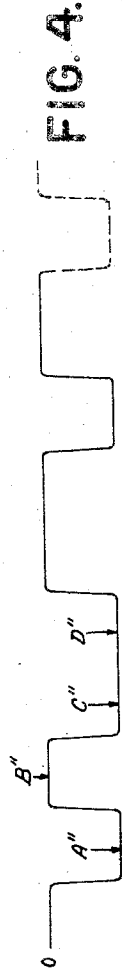
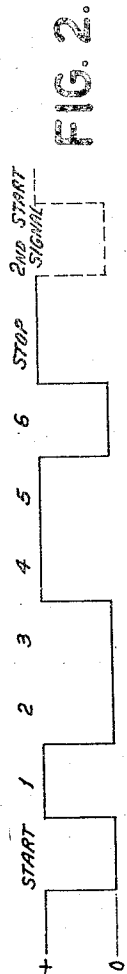
C. J. FITCH ET AL

2,456,825

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2 Sheets-Sheet 1



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This invention relates to a distributor for sequentially controlling different circuits.

One important use of the invention is for distributing telegraphic signal elements; the invention being an improvement on the distributor shown in the patent to C. J. Fitch, No. 2,210,574. Its principal advantage over the distributor disclosed in this patent is its greater reliability in operation, due to the fact that the signal elements are differentiated by sharp pulses, which can be made to come at the middle of each signal element. As compared with said patent the invention is characterized by a substitution of trigger tubes for the storage relays in the patent. The trigger tubes can be fired more rapidly than a relay can be energized, allowing shorter pulses to be used to differentiate the signal elements.

Accordingly, the main object of the invention is to provide an improved distributor particularly suited for distributing telegraphic signal elements to respective control devices.

Special features of the invention pertain to the means for starting the distributor sweep and the means for restoring the entire circuit to normal condition at the end of a sweep.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Figs. 1a and 1b are two parts of a complete wiring diagram of a telegraph receiver embodying the invention.

Figs. 2-6 are diagrams of various signal and distributor wave shapes, plotted on an equal time basis. In particular:

Fig. 2 is a diagram of a standard six-unit telegraph code signal composed of marking and spacing signal elements.

Fig. 3 is a diagram of the actual tone signal as received.

Fig. 4 is a diagram of the rectified signal which controls the distributor.

Fig. 5 is a diagram of the sweep impulses from the plates of the sequence tubes.

Fig. 6 is a diagram of the differentiating impulses derived from the sweep impulses.

For the purpose of illustration, the invention is shown embodied in a receiver of the type disclosed in Patent No. 2,210,574. Power is derived from a 110 volt A. C. line, through a plug 1, the alternating current being rectified by a full wave selenium rectifier 2, the output voltage of which is

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impressed across the plates of a condenser 3, with the polarity indicated. Across this condenser is connected a voltage divider consisting of resistors 4, 5, 6, 7, and 8, and potentiometer 9. From this voltage divider various connections are made to supply the proper voltages to the tube circuits.

The A. C. line also feeds a step down filament transformer 11, across the secondary of which the filaments of the tubes are connected in series multiple, as partially indicated at 12. The secondary of transformer 11 also has connected across it a selenium rectifier 13 which impresses a voltage across a condenser 14, of the polarity indicated, which is used as a bias supply. A resistor 10 is connected across the terminals of the condenser 14.

A complete signal, as shown in Fig. 2, comprises a start signal, six code elements, and a stop signal. A signal having any other desired number of code elements may be used, by a suitable alteration of the circuit. In this complete signal the start signal is spacing, the code elements 1, 4, and 5 are marking, the code elements 2, 3, and 6 are spacing, and the stop signal is marking. As shown in Fig. 3, the spacing signals are characterized by tone and the marking signals by absence of tone. Such a signal is more efficient for keying a C. W. radio frequency carrier on and off, as in this case the C. W. will be "off" during the stop period, or while the machine is idle.

Tone signals, as shown in Fig. 3, transmitted over any communication channel, are fed into a jack 15. The signals are impressed, through a transformer T8 and a volume control 16, upon the grid of a vacuum tube V10. The plate of the tube V10 is connected through the primary winding of a transformer T9, and through a voltage dropping resistor 18 and wire 19, to the positive end of the voltage divider 4-9. Condensers 17 filter out high frequency noise or radio frequency interference. The cathode of the tube V10 is connected through a resistance 20 and wire 21 to the negative end of the voltage divider 4-9. The plate circuit of the tube V10 is coupled by the transformers T9 and T10 to the grid of a vacuum tube V11. This grid is connected through the secondary of transformer T10 and a wire 22 to the negative end of the bias resistor 10. The cathode of tube V11 is connected through wire 21 to the negative end of the voltage divider 4-9 while its plate is connected through the primary of a transformer T11 and wire 19 to the positive end of the voltage divider 4-9. The amplified output of tube V11 passes through transformer T11 to the plate and grid of a vacuum tube V12, which is hooked up as

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a half-wave rectifier. The cathode of tube V12 is connected by a wire 28 to a point 29 on the voltage divider 4—9. This tube rectifies the tone signal and the equivalent D. C. signal appears across a condenser 24. Connected across the condenser 24 is a noise filter inductance 25 in series with condenser 26, shunted by a resistor 27. The inductance 25 and condenser 26 form a low pass filter for removing any noise or impulses of shorter duration than the signal. The rectified signal, as it appears across the resistor 27, is approximately shown in Fig. 4.

Start circuit

The negative end of resistor 27 which is shown, for the purpose of identification, as a terminal 23, is connected through a grid resistor 30 to the grid of a vacuum tube V13. The cathode of vacuum tube V13 is connected by wires 35 and 22 to the negative end of the bias resistor 10, while its anode is connected through a limiting resistor 36 and the primary coil of a transformer T12 to wire 19 and the positive end of the voltage divider 4—9. The point 29, to which the grid of tube V13 is connected through grid resistor 30, resistance 27, and wire 28, is at a potential which normally renders the tube V13 conductive, causing plate current to pass through the primary winding of transformer T12. The start signal depresses the potential on the grid of tube V13 and cuts off the plate current.

The interruption of the plate current through transformer T12 induces an E. M. F. in the secondary winding, one side of which is connected through wires 35 and 22 to the negative end of the bias resistor 10, while the other side is connected through a delay circuit comprising condensers 37 and 38 and resistor 39 to the control grid of a gas tube G9. The cathode of the latter tube is connected to the lower end of the voltage divider 4—9, while its anode is connected through a vacuum tube V9, resistance 40 and wire 41, to a point 42 between the resistors 5 and 6. The grid of the tube V9 is connected through a grid leak resistor 43 to its cathode and this tube is accordingly normally conditioned to pass current. The voltage of the impulse induced in the secondary of transformer T12, when the tube V13 is cut off by the start signal, is such that it drives the control grid of gas tube G9 positive and fires the tube. The resistor condenser combination 37—39 is selected so as to have an RC time delay constant that will delay the firing of tube G9 for a period equal to about half the duration of the start signal of Fig. 4. Thus, at time A'' (Fig. 4) tube G9 will fire.

A vacuum tube V8 has its anode connected through the primary winding of a transformer T to wire 19 and the top of voltage divider 4—9, while its cathode is connected by wire 41 to the point 42 of the voltage divider. The grid of tube V8 is connected through resistor 40 to its cathode and this tube is normally conductive. When the tube G9 fires, current flows through the resistor 40, causing a potential drop, as indicated, at resistor 40 and biasing off the tube V8. The field of transformer T collapses and an E. M. F. is induced in its secondary winding. This starts the sweep impulses, as will now be described.

One end of the secondary winding of transformer T is connected by a wire 45, through the arm of potentiometer 9, to a selected point on the resistance of this potentiometer. The other end of the secondary winding of transformer T is connected, as indicated by the letters X (see also Fig.

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1b) to the grid of the first tube V1 of a sequence of tubes V1—V7. The cathodes of these tubes are connected by a wire 46 to a point 47 on the voltage divider 4—9. The anodes of tubes V1—V6 are connected through the primary coils of related sequence transformers T1—T6 and a wire 48 to a point 49 on the voltage divider 4—9. The anode of tube V7 is connected through a resistor 50 to the wire 48. The grids of tubes V2—V6 are connected through the secondary windings of the preceding sequence transformers T1—T5 and wires 51 and 45 to the arm of potentiometer 9. The grid of tube V7 is connected through the secondary winding of transformer T6 to a point 52 on voltage divider 4—9, as indicated by Y—Y. Normally, the grids of the tubes V1—V7 are biased negatively, as shown by the connections just traced, and the tubes are non-conductive.

The sequence of tubes V1—V7, intercoupled by transformers T1—T6, operates according to a principle described more fully in the copending application of C. J. Fitch, Serial No. 465,604, filed November 14, 1942, now Patent Number 2,421,606. When a sweep is initiated the sequence tubes V1—V7 become conductive in succession, as shown in Fig 5, each tube returning to non-conductive condition as the next tube becomes conductive. The tubes V1—V6 pertain, respectively, to the 6 elements of the code. The tube V7 initiates the restoring of the circuit.

The voltage induced in the secondary of transformer T when the tube V8 is cut off is of such polarity and amplitude as to swing the potential of the grid of the tube V1 positive and render the tube conductive (see Fig. 5). Plate current starts to flow through this tube and the primary of transformer T1. At this time the secondary of transformer T1 has induced in it an E. M. F. which drives the grid of tube V2 more negative, causing no change in the conductivity of the latter. When the grid of tube V1 swings positive, grid current flows and retards the collapse of the field in the transformer T. At the time indicated by B in Fig. 5, the potential on the grid of the tube V1 drops to cathode potential and grid current ceases to flow, whereupon the field in the transformer T collapses suddenly and the tube V1 is cut off abruptly. When the current through the primary coil of transformer T1 stops, a voltage is induced in the secondary winding of this transformer which swings the potential of the grid of the tube V2 above cathode potential and this tube begins to conduct, as indicated at B in Fig. 5. Grid current flows through the secondary winding of transformer T1, delaying the collapse of the field in this transformer. At the time indicated by the letter C in Fig. 5, the potential on the grid of tube V2 passes below cathode potential and grid current ceases, causing the field in the transformer T1 to collapse suddenly, cutting off the tube V2.

In a similar way the remaining tubes V3—V6 become conductive in succession, as shown in Fig. 5.

Associated with each tube V1—V6 is a trigger tube G1—G6, preferably of the thyatron type. The cathodes of these trigger tubes are connected by a wire 55 to the negative end of the voltage divider 4—9. Their plates are connected through respective arc holding resistors 56 and wire 57 to the positive end of the voltage divider 4—9. Their control grids are connected by resistors 58 and a wire 59 to the negative end of the resistor 10. The bias on the control grids therefore normally prevents these tubes from

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firing. The shield grids of the tubes G1—G6 are connected through current limiting resistors 60, wire 61, resistor 27 and wire 28 to the point 29 on the voltage divider 4—9. When no signal is passing through resistor 27, the bias on the shield grids of the tubes G1—G6 is such as to allow these tubes to be fired if the potential on their control grids is raised to a suitable point, but if signal current is passing through resistor 27 the tubes G1—G6 are biased off so as to be uninfluenced by positive impulses applied to their control grids. The circuit proportions are such that any signal which has sufficient amplitude to start the sweep will bias the shield grids of tubes G1—G6, to prevent them from being fired by positive impulses applied to their control grids.

The control grid of each tube G1—G6 is coupled by a condenser 62 and a wire 63 to a tap on the primary coil of the related transformer T1—T6. At the successive times indicated by the letters B'—G' in Fig. 6, when current through the primary coils of transformers T1—T6 stops, positive impulses are transmitted through the condensers 62 to the control grids of the tubes G1—G6. If, at the time the control grid of any one of these tubes receives such a positive impulse the potential on the shield grid of that tube is high, due to an absence of signal current in the resistor 27, the tube will be fired. For example, at the time B' (Fig. 4) there is zero signal current in the resistor 27, and consequently the positive pulse B' (Fig. 6) fires the tube G1, its arc being held by current flowing through resistor 56. At the time C' (Fig. 4), signal current is flowing in the resistor 27 and the shield grids of all of the tubes G2—G6 are biased to a potential which renders these tubes non-responsive to positive pulses applied to their control grids. Consequently, the positive pulse (Fig. 6) transmitted from the transformer T2 to the control grid of the tube G2 at this time does not fire the tube G2. In a similar manner as the remaining signal elements come in, the tube G3 is not fired, the tubes G4 and G5 are fired, while the tube G6 is not fired. Thus, corresponding to the signal shown in Fig. 2 the tubes G1, G4 and G5 remain conductive at the end of the sweep and the other tubes remain non-conductive.

There is a separate tube G1, G2, . . . G5 for each code signal element. The potential impressed upon the control grid of each of the tubes G1—G6 varies between a low potential which will prevent the tube from being fired by a high potential applied to its shield grid, and a high potential which will allow the tube to be fired by a high potential applied to its shield grid. The low potential on the control grid is the normal bias, while the high potential is caused by a sharply peaked impulse transmitted from the related sweep transformer T1, T2, . . . T6 and occurs at a different time for each tube, coinciding with the reception of the related code signal element. This impulse unlocks the tube so that it is responsive to a high potential applied to its shield grid.

The potential impressed upon the shield grids of the tubes G1—G6 varies concurrently for all of the tubes, being high or low at any given signal time in dependence upon whether the signal element received at that time is of a marking or spacing character. Any tube having a high potential on its shield grid at the time its control grid goes to a high potential will be fired, while any tube having a low potential on its

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shield grid when its control grid goes to a high potential will not be fired.

The pulse F' (Fig. 6) is transmitted not only to the control grid of tube G5 but also, through a wire 64 and condenser 65, to the control grid of the gas tube G7. The cathode and shield grid of this tube are connected to the wire 55, while its plate is connected through a relay coil R1 to the wire 57. The control grid is connected through resistor 66 to wire 59 which leads to the negative end of the resistor 10. The normal potential on the control grid of the tube G7 therefore biases the tube off, but since the shield grid has zero bias the positive pulse F' transmitted to the control grid fires the tube, energizing the relay R1.

The contacts R1a to R1f of the relay R1 close at about the time G' (Fig. 6) due to the time required for the relay to become energized. When this occurs, circuits are extended from the plates of the tubes G1—G6 through related control magnets M1—M6 and the corresponding contacts R1a—R1f, to the wire 57. Only the control magnets connected to the plates of tubes which have been fired will be energized, in the example given the magnets M1, M4, and M5. The control magnets may be, for example, the selector magnets of the telegraph printer shown in Patent No. 2,181,940. When they are energized, the telegraph printer prints a character or executes a function, corresponding to the code combination represented by the magnets energized.

The top end of the secondary winding of transformer T6 is connected to a point on the voltage divider 4—9 which is higher than that point to which the top ends of the secondary windings of the transformers T1—T5 are connected. Consequently, the normal bias on the grid of the tube V7 is less negative than that on the grids of the tubes V1—V6. This causes a larger grid current to flow and delays the cut-off of the tube V7 longer than that of the tubes V1—V6. As indicated in Fig. 5, the tube V7 remains conductive from the time G to the time H, approximately twice as long as the other sequence tubes. When the tube V7 becomes conductive, it transmits a negative pulse, as indicated by the letters Z—Z' (see also Fig. 1a), through a condenser 68 to the grid of tube V9, rendering the same non-conductive. This opens the circuit through the tube G9 and its arc is extinguished, restoring the starting circuit to normal condition. The value of condenser 68 is such that the negative impulse impressed upon the grid of tube V9 lasts for about one signal element. During the sweep, while tube G9 remained conducting, additional signals impressed upon the grid of tube V13 caused no further effect.

When the tube V7 becomes non-conductive, at the time H in Fig. 5, it transmits a positive pulse through a condenser 69 to the control grid of the gas tube G8. The cathode and shield grid of this tube are connected to wire 55 and its anode, through resistor 70, to wire 57. The control grid is connected through a resistor 71 to wire 59, which causes the tube G8 to be normally biased off. The positive pulse transmitted through condenser 69 fires the tube G8 and a negative pulse is transmitted from its plate through a condenser 72 to the plate of tube G7, extinguishing the arc of this tube. The relay R1 is deenergized and its contacts R1a—R1f open at about point 0 in Fig. 6, deenergizing the control magnets M1, M4, and M5, which had been energized. The inductance of the coil of relay R1, together with the coupling

condenser 72 and resistor 70, form an oscillatory circuit. When relay R1 is deenergized, an oscillation is set up, the first negative wave of which is sufficient to extinguish tube G8.

Likewise, oscillatory circuits are formed by the coils of magnets M1—M6, spark suppressor condensers 73 and resistances 74 and resistances 56. When the magnets M1, M4, and M5 are deenergized, oscillatory currents are set up in the respective oscillatory circuits, the first negative wave of which extinguishes the respective gas tubes G1, G4 and G5. The distributor circuits are thereby restored to normal condition, ready to receive the next signal impulse.

The entire circuit is restored within a time duration of one signal element so that the stop signal may be as short as one signal element. In Figs. 2-6 the stop signal is $1\frac{1}{2}$ signal elements.

The variable potentiometer 9 allows the bias on the sequence tubes V1—V6 to be adjusted so that the time of the sweep can be varied to match or be in phase with the incoming signals. The variable resistor 8 is locked in adjustment at a position that will give accurate timing when resistor 9 is set at the middle of the range. Any tendency of the sweep impulses to be lengthened by an increase in the anode voltage caused by a variation in the line voltage supply is compensated for by a tendency of the impulses to be shortened because of an increase in bias and heater voltage. The proportion of the plate voltage and bias voltage and the characteristics of the sequence transformers are such that variations in line voltage supply of the order of plus or minus 10% have virtually no effect on the timing of the circuit.

The duration of the sharp differentiating impulses B'—G' (Fig. 6) may be of the order of 1% of a signal element. By adjustment of potentiometer 9 these impulses are made to unlock the distributor tubes G1—G6 for only a short time during the arrival of the center portions of the received signal elements. This allows for a maximum drift, or phase shift, of the incoming signals, and maximum signal distortion, before failure occurs.

It is evident that the distributor can be adapted to a code of any number of code elements, by changing the number of sequence tubes V1—V6, sequence transformers T1—T5, storage tubes G1—G6, and control magnets M1—M6.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, 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. In a receiver for receiving combinational code signals, a set of gaseous trigger tubes, one for each code signal element, each tube having at least a first and a second grid, means normally impressing upon the first grids of all of said tubes a biasing potential sufficiently negative to prevent said tubes from being fired by high potentials applied to their second grids, means operating in response to the received signal for applying concurrently to the second grids of all of said tubes, high or low potentials, in dependence upon the marking or spacing character of the successive code signal elements, and means for

lifting the potential on the first grids of the tubes in succession, each at the time of reception of the related signal element, whereby each tube will be fired in which the lifting of the potential on its first grid finds a high potential on its second grid, due to a marking signal element.

2. In a receiver for receiving combinational code signals, a set of gaseous trigger tubes, one for each code signal element, each tube having at least a first and a second grid, means normally impressing upon the first grids of all of said tubes a biasing potential sufficiently negative to prevent the tubes from firing when a high potential is applied to their second grids, signal receiving means having an output terminal on which the potential is high during marking signals and low during spacing signals, means connecting said terminal to all of the second grids of said tubes, a sweep circuit comprising means to transmit to the first grids of said tubes in succession, at intervals of one element, positive impulses adapted to render said tubes successively responsive to a high potential on their second grids, and means responsive to a start signal preceding each code signal for initiating an operation of said sweep circuit at such time that said positive impulses will coincide with respective code signal elements.

3. A receiver as described in claim 2, wherein said positive impulses are sharply peaked, having a width of only a small fraction of a signal element.

4. A receiver as described in claim 2, wherein said positive impulses are sharply peaked, having a width of only a small fraction of a signal element, and means are provided to adjust the interval between said impulses, to bring them to the center of the respective signal elements.

5. A receiver as described in claim 2, wherein said sweep circuit comprises a sequence of vacuum tubes intercoupled by transformers and supplied from a voltage divider fed by a line across which the voltage may vary, said sequence tubes having grids, cathodes, and anodes connected to successively higher points on said voltage divider, whereby any increase in line voltage causing a higher anode potential will be compensated by a greater bias on the grids of said sequence tubes.

6. In a distributor, a set of gaseous trigger tubes, each having at least a cathode, an anode, a first grid, and a second grid, a voltage source, means forming two circuit paths between the anode of each of said tubes and said voltage source, one of said circuit paths being normally closed and including a resistance, the other including a control magnet and a normally open contact in series, means connecting the cathodes and both grids of each of said tubes to said voltage source so that each grid has a bias voltage which will, by itself, prevent the tube from firing, means for lifting the potential on the first grid of each of said tubes in succession, means for lifting the potential on the second grids of all of said tubes concurrently with the lifting of the potential on the first grids of selected ones of said tubes, whereby those tubes in which a coincidence of high voltages on both grids occurs will be fired and their arcs held through the respective normally closed circuit paths, and means for finally closing said contacts, thereby energizing the control magnets pertaining to tubes which have been fired.

7. In a receiver for receiving combinational code signals, a set of gaseous trigger tubes, namely, a signal tube for each code signal element and a print control tube, each tube having at least an anode, a cathode, a first grid, and a second grid,

a voltage source, means including a relay coil connecting the anode of said print control tube to said voltage source, means forming two circuit paths between the anode of each of said signal tubes and said voltage source, one of said circuit paths being normally closed and including a resistance, the other including, in series, a selector magnet and a normally open contact pertaining to said relay, means connecting the cathodes and both grids of each of said signal tubes to said voltage source so that each grid has a bias voltage which will, by itself, prevent the tube from firing, means connecting the cathode and the grids of said print control tube to said voltage source so that the second grid of said print control tube has approximately a zero bias and the first grid has a negative bias which will prevent the tube from firing, means for lifting the potential on the first grid of each of said signal tubes in succession, to unlock said signal tubes at successive times coinciding with successive elements of a signal, signal receiving means, means controlled by said receiving means for lifting the potential on the second grids of all of said signal tubes concurrently during the reception of marking signal elements, whereby those signal tubes in which a coincidence of high voltages on both grids occurs will be fired and their arcs held through the respective normally closed circuit paths, and means for lifting the potential on the first grid of said print control tube, whereby the latter will be fired and said relay energized approximately concurrently with the unlocking of the last signal tube.

8. In a distributor as described in claim 6, means to open said contacts, the contact in series with each of said magnets being shunted by a spark suppressing condenser, forming an oscillatory circuit including said condenser, the coil of the related magnet, and the resistance in the related normally closed circuit, whereby, when said contacts are opened, oscillatory discharges are set up in the oscillatory circuits pertaining to any of said tubes in a conductive state, the first negative waves of which extinguish the respective tubes.

9. In a receiver for receiving combinational code signals of the type in which spacing signal elements are represented by an oscillating voltage wave and marking signals are represented by an absence of an oscillating voltage wave, a set of gaseous trigger tubes, one for each code signal element, each tube having at least a cathode, an anode, and first and second grids, a source of voltage, means connecting the cathode, anode, and grids of each of said tubes to said voltage source so that the first grid of each tube has a negative bias which will prevent the tube from being fired and so that the second grid of each tube has a positive bias, signal receiving means comprising a rectifier and a resistance in series therewith, said resistance also being in series with the connection of the second grids of said tubes to said voltage source, the current through said rectifier and resistance during spacing signal elements generating a voltage drop across said resistance of sufficient magnitude to bias the second grids of said tubes negatively and prevent said tubes from firing, a sweep circuit comprising means to transmit to the first grids of said tubes in succession, at intervals of one signal element, positive impulses adapted to render said tubes successively responsive to a high potential on their second grids, and means responsive to a spacing start signal preceding each code signal, for initiating an operation of said sweep circuit at such

time that said positive impulses will coincide with respective code signal elements.

10. A receiver as described in claim 9, wherein filtering means are placed in the circuit of said rectifier and resistance.

11. In a distributor, a sequence of vacuum tubes having at least a cathode, an anode, and a grid, intercoupled by transformers so that each tube, except the first, is made conductive in sequence by an impulse transmitted to its grid through a related transformer from the plate of the preceding tube, when the latter becomes non-conductive, a voltage source to which the cathode, anode, and grid of each tube are connected so that the first tube of the sequence is normally conductive and the other tubes are normally non-conductive, a gaseous trigger tube for starting a sequence, means connecting the electrodes of said starting tube to said voltage source so that said starting tube is normally non-conductive, means for receiving signals, means operated by said receiving means, on receiving a start signal, for firing said starting tube, means controlled by the current through said starting tube for biasing off said normally conductive first sequence tube for so long as current flows through said starting tube, thereby starting the sequence, and means controlled by the last sequence tube for extinguishing said starting tube.

12. A distributor as described in claim 11, wherein said starting tube has an anode connected to said voltage source through the plate-cathode circuit path of an extinguishing vacuum tube having a grid, the grid of said extinguishing vacuum tube being coupled to the anode of the last sequence tube so as to be biased to a cut off potential under control of said last sequence tube.

13. A distributor as described in claim 11, wherein the grid and cathode of said first sequence tube are interconnected by a resistance, said starting tube having an anode conductively coupled to the grid end of said resistance, whereby when said starting tube is fired a voltage drop is produced in said resistance which biases off said first sequence tube.

14. In an electrical circuit, a voltage source, a gaseous trigger tube having an anode and a cathode connected to said voltage source the anode connection including a resistance, an inductance and a capacitance serially connected across said resistance to form an oscillatory circuit therewith, and means to start oscillations in said oscillatory circuit, whereby said tube, if conducting, will be extinguished by the first negative wave of said oscillations.

15. In an electrical circuit, a gaseous trigger tube, a voltage source, said tube having an anode, a cathode, and a grid, connected to said voltage source so that the grid normally has a negative charge, the connection of said anode to said voltage source including a resistance, an electromagnet and a capacitance serially connected across said resistance to form an oscillatory circuit, one end of the winding of said electromagnet being connected to the anode of said tube and the adjacent end of said resistance, means to lift the potential on said grid to fire said tube, normally open contact means to connect the other end of the winding of said electromagnet to said voltage source, to energize said electromagnet when said tube is conductive, and means to open said contact means to deenergize said electromagnet and to start oscillations in said oscillatory circuit, the first negative wave of which will extinguish said tube.

16. In an electrical circuit, a voltage source, two gaseous trigger tubes, each having an anode, a cathode, and a grid connected to said voltage source so that the tubes are normally biased off, the anode connection of one of said tubes including an inductance, the anode connection of the other one of said tubes including a resistance, a condenser coupling said anodes and completing an oscillatory circuit including said inductance and said resistance, means for momentarily lifting the potential of the grid of said first tube to fire the same, and means for momentarily lifting the potential of the grid of said second tube to fire the latter, thereby extinguishing said first tube by a negative impulse transmitted through said condenser, and setting up oscillations in said oscillatory circuit, the first negative wave of which extinguishes said second tube.

17. In a distributor, a set of gaseous trigger tubes each having a plurality of electrodes including a plate, a cathode, and at least a first and a second grid, a voltage source, means connecting said electrodes to said voltage source, so that each tube is normally biased off by the potential on its first grid, means operating at differential times to raise the potential on the first grid of each of said tubes in succession, and means for changing the potential on the second grids of all of said tubes in unison, between a cut-off potential and a potential which will render the tubes responsive to the potentials on their first grids, the changes occurring at selected intervals between said differential times.

18. In a distributor, a sequence of high vacuum tubes, each of said tubes having a plurality of electrodes including a plate, a cathode, and a grid, a voltage source, means connecting said electrodes to said voltage source so that the first of said sequence tubes is normally biased on and the rest

of said sequence tubes are normally biased off, means coupling said sequence of tubes in cascade so that as each tube becomes non-conductive the next lower tube in the sequence will be made conductive, a gaseous trigger tube having electrodes including a plate, a cathode, and a control electrode connected to said voltage source so that said trigger tube is normally biased off, means to change the bias on the grid of said trigger tube to ignite the same, means conductively coupling the plate of said trigger tube to the grid of said first sequence tube so that the latter is biased off as said trigger tube is ignited and remains biased off as long as said trigger tube is conductive, and means controlled by the last of said sequence of tubes for extinguishing said trigger tube.

19. A distributor as described in claim 18, wherein the means for extinguishing said trigger tube includes a normally conductive extinguishing vacuum tube in the plate connection of said trigger tube to said voltage source, and means controlled by the last sequence tube for biasing off said extinguishing vacuum tube.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,793,329	Langmuir	Feb. 17, 1931
2,049,376	Hertwig et al.	July 28, 1936
2,099,065	Holden	Nov. 16, 1937
2,210,574	Fitch	Aug. 6, 1940
2,272,070	Reeves	Feb. 3, 1942

Certificate of Correction

December 21, 1948.

Patent No. 2,456,825.

CLYDE J. FITCH ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 8, line 21, claim 2, after the word "one" insert *signal*;
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 24th day of May, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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