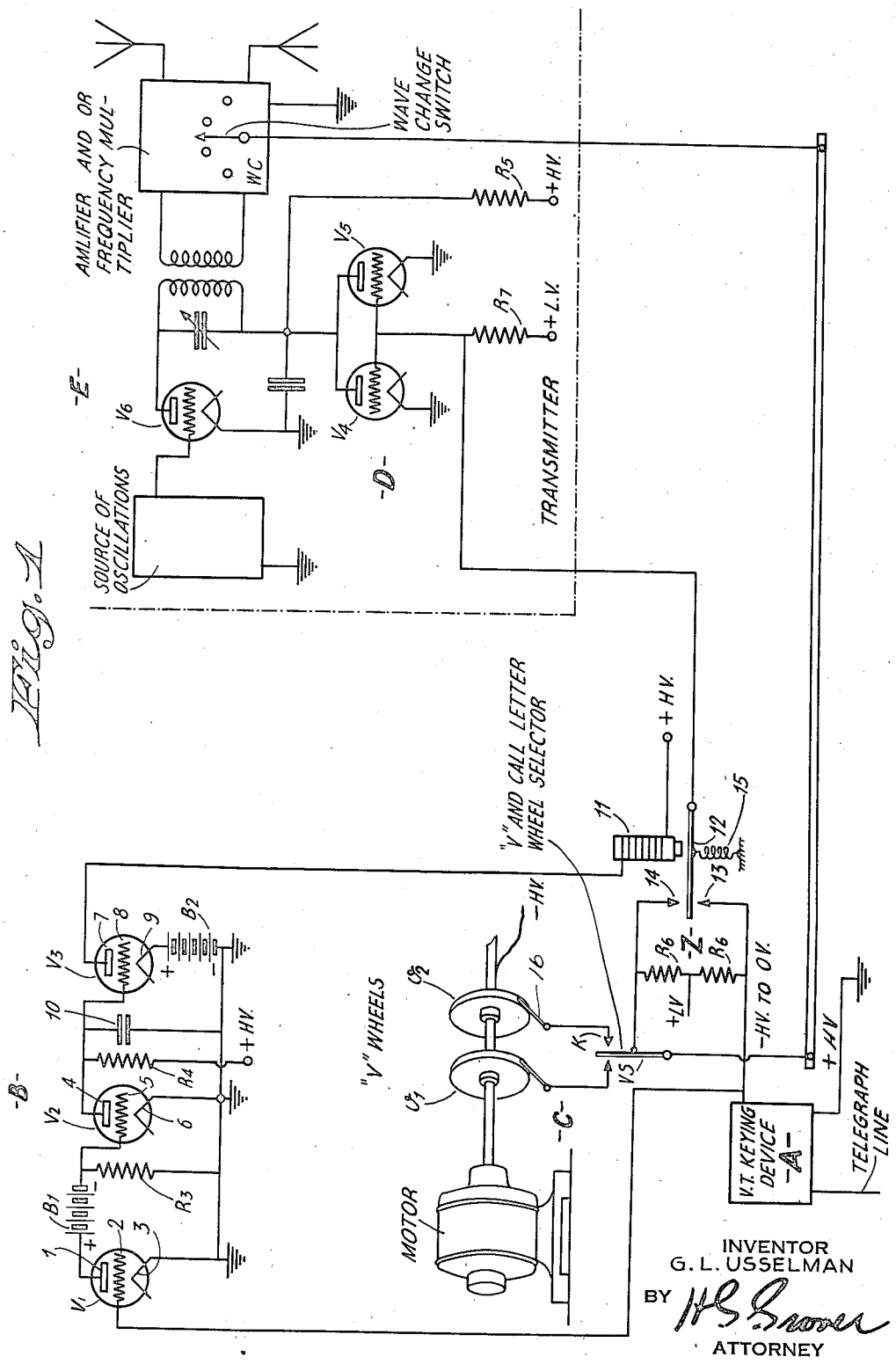
June 16, 1936. G. L. USSELMAN 2,044,519

AUTOMATIC IDLE TIME KEYING UNIT

Filed Feb. 17, 1934 5 Sheets-Sheet 1

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AUTOMATIC IDLE TIME KEYING UNIT

Filed Feb. 17, 1934 5 Sheets-Sheet 2

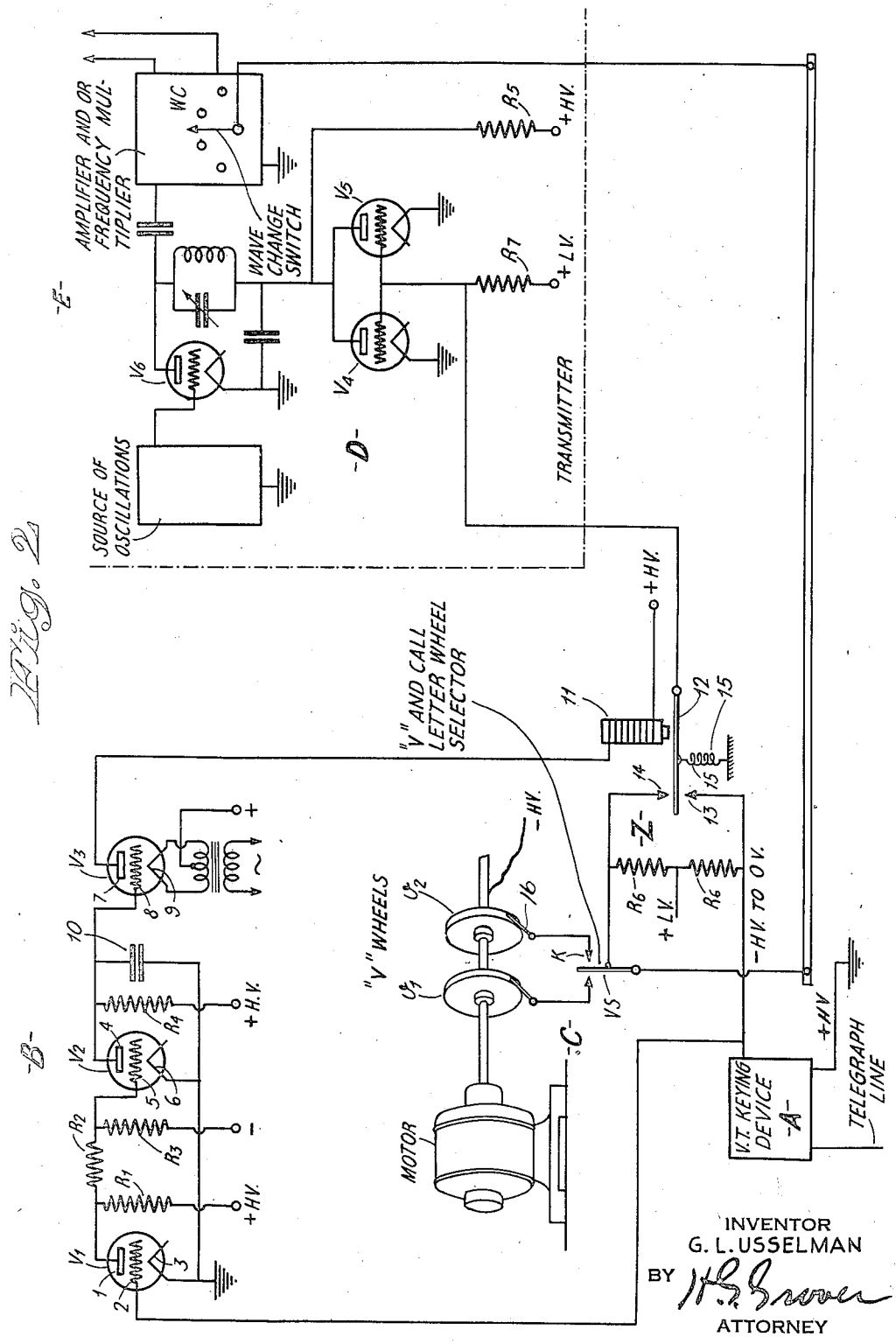


Fig. 2

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Filed Feb. 17, 1934 5 Sheets-Sheet 3

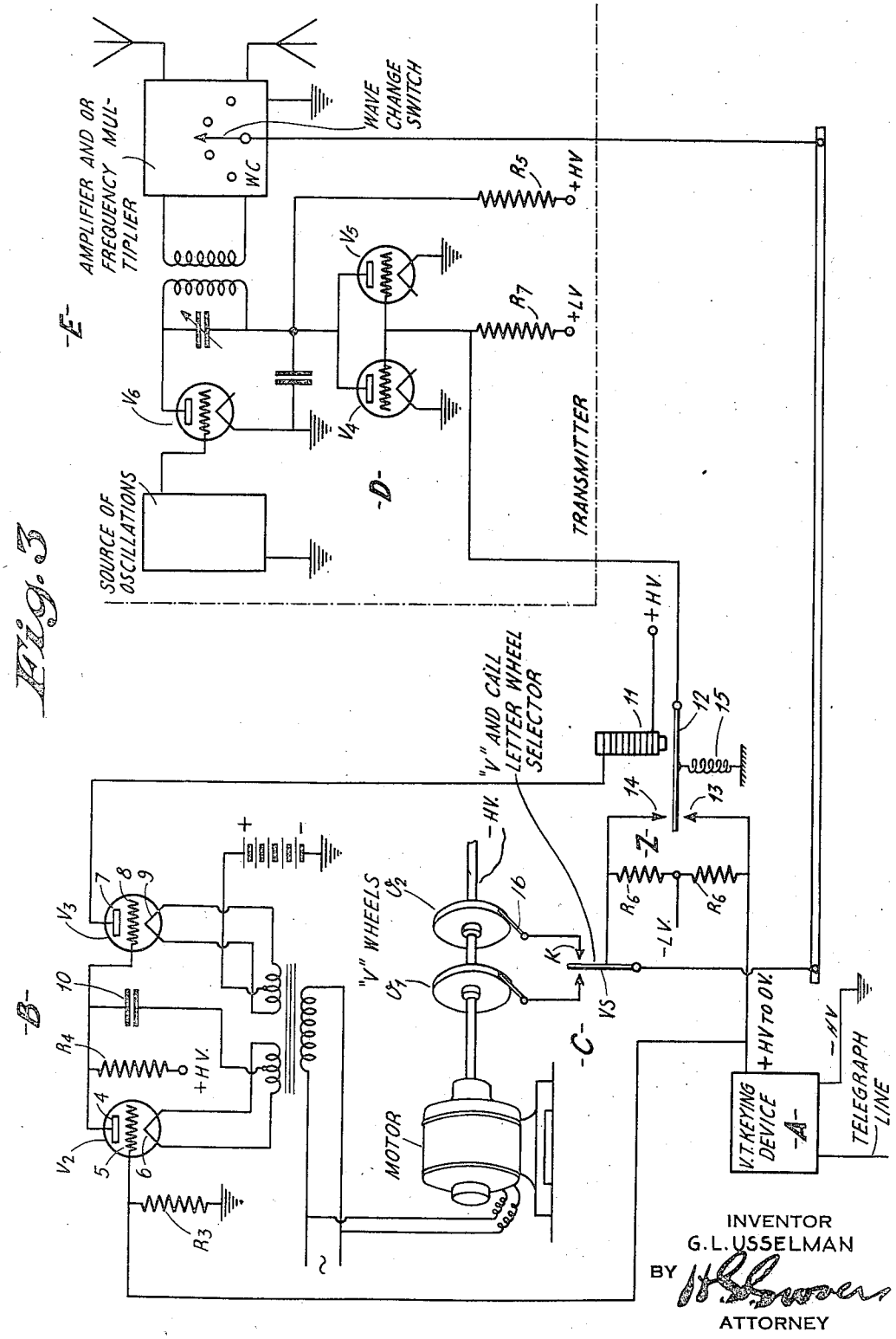


Fig. 3

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Filed Feb. 17, 1934 5 Sheets-Sheet 4

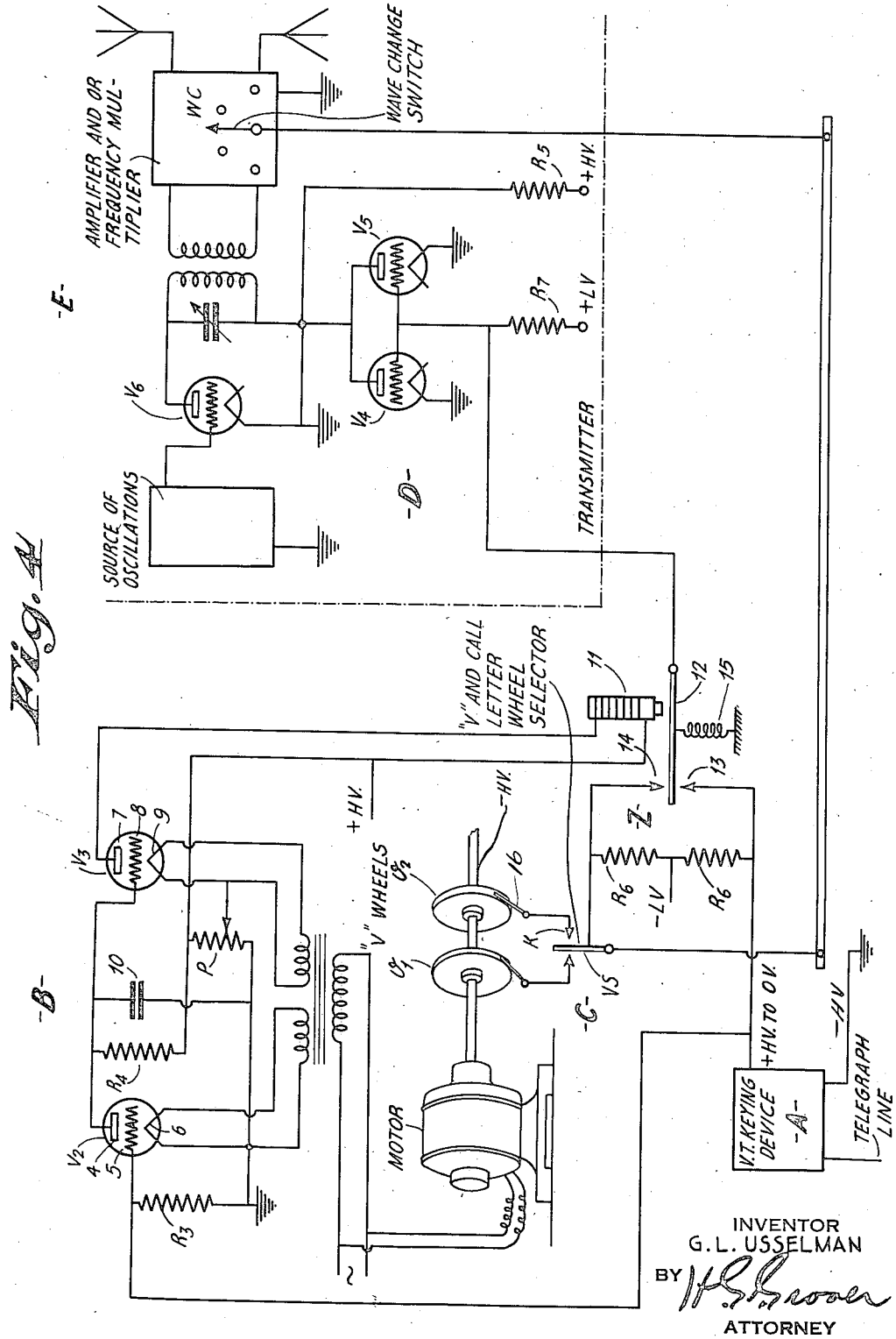


Fig. 4

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AUTOMATIC IDLE TIME KEYING UNIT

Filed Feb. 17, 1934 5 Sheets-Sheet 5

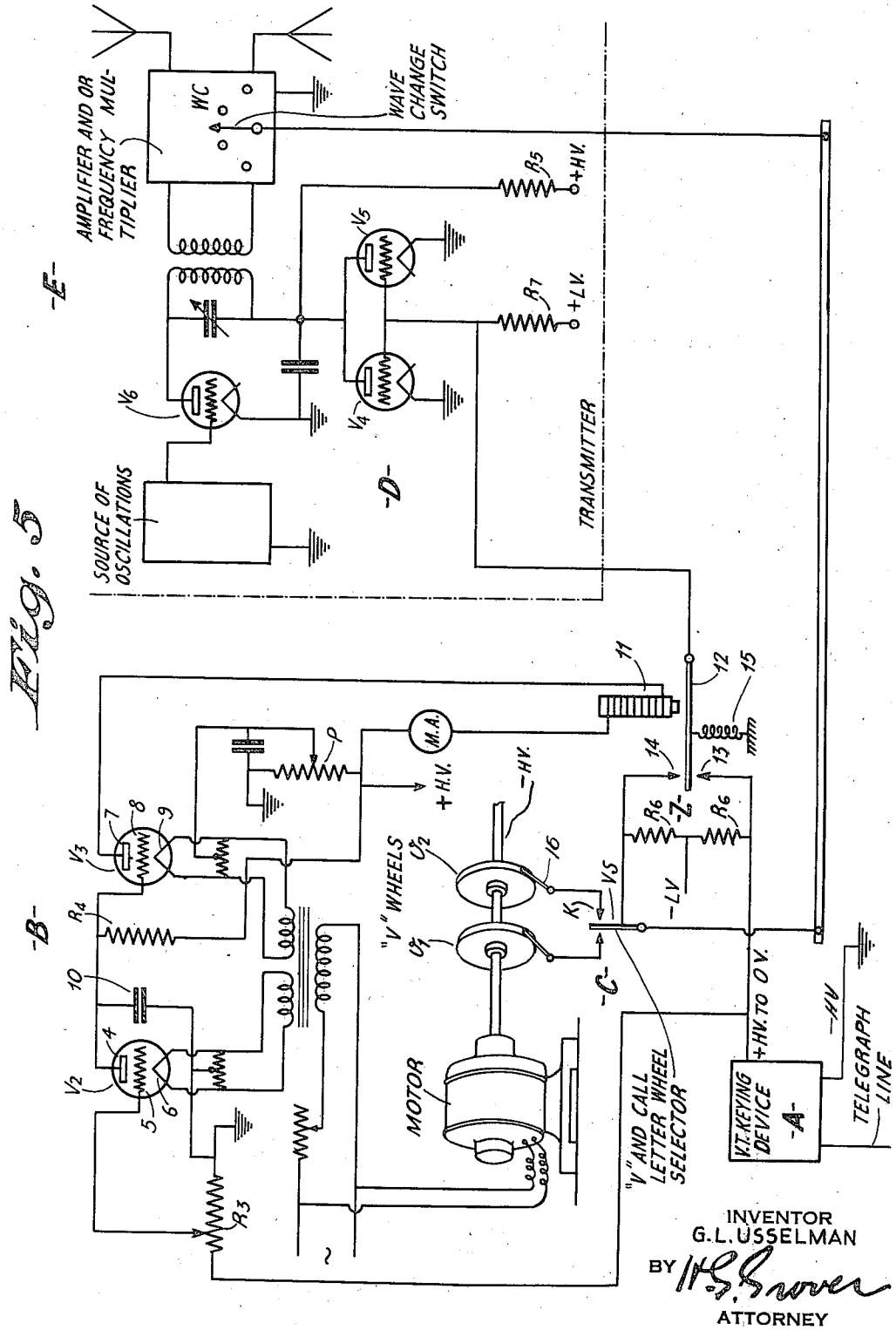


Fig. 5

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Patented June 16, 1936

2,044,519

# UNITED STATES PATENT OFFICE

2,044,519

## AUTOMATIC IDLE TIME KEYING UNIT

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Application February 17, 1934, Serial No. 711,764

15 Claims. (Cl. 250—17)

This invention relates to telegraphy signalling means and in particular to keying control switching for radio transmitters, said keying control switching means being automatic in operation.

Transmitters of this type in general comprise a line for incoming control or keying impulses or source of keying impulses, and a transmitter adapted to signal at different frequencies, including an oscillation generator, the necessary amplifiers and radiating means coupled therewith, and keying means interposed between the signal line or source and one or more stages in the transmitter. The signals from the source, or on the line from the remote point, key the transmitter to send out signals.

In transmitters of this type known in the prior art it has been the practice to send out "V's" or "*a*—*b*—*c*" between messages in order that the receiving apparatus destined to receive said messages may be kept in tune and ready for the next message. This continued operation of the transmitter in sending out these "V's" or "*a*—*b*—*c*" is wasteful of power because these idle signals used up as much power as is used by signals in a useful message. One of the objects of the present invention is to eliminate or at least reduce materially this waste of power.

Briefly, I attain the object mentioned above by the use of a novel device for automatically switching the transmitter over to a source of signals of relatively short duration. These signals require less power to transmit and serve the same purpose as the "V's" or "*a*—*b*—*c*" of normal length transmitted heretofore. The control impulses may be "V's" or any other desired characters of reduced length. These signals may have wider spaces as well as shorter dots and dashes. For example a dot or dash one-third as long and spaces that much longer may be used and the utilization of dots and dashes of reduced length and spaces of increased length will require only about one-third as much power as is required to send out the control or tuning impulses sent out heretofore at normal spacing.

The source of "V's" or other characters of reduced length and the increased spaces may be sent out by means of a wheel. The characters may be arranged on the periphery or on the face of the wheel which when rotated will in accordance with the present invention transmit the dots and dashes of reduced length and the spaces of increased length. The wheel may also include call letters or characters which identify the particular channel on which signalling is going on. The wheel will for convenience be termed a "V" wheel throughout this specification. It will be understood, however, that other means may be used to send out the signals of reduced length and spaces of increased length without departing from the spirit of the present invention. Of course each transmitter may send out signals on several channels, and the frequencies of the waves used on the various channels may be different. In my invention I provide a V wheel as described above for each channel, and the V wheels may be thrown in or out of circuit, by switching means which is operated simultaneously with and by the device used to change the frequency of the signals worked with.

Where the keying control is operative during extended no-signal periods as described above, the telegraph line may become open-circuited or inoperative for some other reason without the operator at the receiver end being aware of such inoperativeness. The open circuit would merely connect the selected V wheel to the keying tube to send out the V's or other short pulses for tuning purposes and the identifying signals.

An object of the present invention is to provide means whereby the operator at the receiving station will know whether the operator at the transmitter is still in control and when such control is relinquished. This is accomplished in accordance with the present invention by providing a simplified means whereby the transmitter may be disconnected from the channel and connected to one of the sources of "V's" or other characters of reduced length and spaces of increased length by the presence of a continued marking character on the line, and disconnected from the "V" wheel and connected to the message line in the absence of said continued marking current.

Briefly the object mentioned above is accomplished in accordance with applicant's novel invention by interposing the contacts of a relay between the "V" wheels and the keying apparatus in the transmitter and interposing a thermionic relay between the source of signal and the armature in said relay as in the prior modifications and operating said thermionic device in such a manner that as long as normal message characters separated by normal spaces or intervals are coming in over the line or from the source the transmitter will be connected with said line or source, but as soon as a signal character of continuous duration is put on the line the transmitter will be disconnected from the message or line and connected to the selected "V" wheel. This action takes place slowly so that there is no danger of the transmitter being disconnected

from the message line or source as long as messages are coming in. When messages are again started the thermionic relay is actuated to permit the contact of the relay to close the circuit between the message source or line and the transmitter. This operation takes place quickly so that the transmitter is connected to the message line or channel immediately so that no messages are mutilated.

The novel features of my invention have been set forth in detail in the claims appended hereto.

The nature of my invention and the manner in which the same may be carried out will be best understood by the detailed description thereof which follows and therefrom when read in connection with the attached drawings throughout which like reference characters indicate like parts insofar as possible and in which:

Figure 1 illustrates a circuit arrangement including the essential elements of my novel automatic idle time keying unit. In this circuit the essential elements only of the transmitter keyed by my novel circuit are shown;

Figure 2 shows modification of the arrangement of Figure 1, while;

Figures 3, 4, and 5 show a modification of the arrangement of Figure 2. In the circuits of Figures 3, 4, and 5 however, the operativeness of the transmitter to send signals or tuning impulses is determined by the presence or absence of signals or a pulse of continuous duration on the line.

Referring to all of the figures, the keying unit is indicated at A, a thermionic relay which controls the mechanical relay is indicated at B, the mechanical relay is indicated at Z, the transmitter keyed stage is indicated at E, the transmitter keying stage is indicated at D and the source of characters of reduced length and increased spaces for tuning purposes at the receiver and channel identifying symbols is indicated at C by the "V" wheels $v_1$ and $v_2$.

In Figure 1 keying unit A has its output connected to the control grid 2 of thermionic tube $V_1$ and also to contact 13 of relay Z as shown. The cathode 3 of tube $V_1$ is grounded. The anode 1 of tube $V_1$ is connected to the positive end of a source $B_1$, while the negative end of $B_1$ is connected to the grid 5 of tube $V_2$, and also to ground by way of a resistor $R_3$. The cathode 6 of tube $V_2$ is connected to ground as shown. The anode 4 of tube $V_2$ is connected to the positive terminal of a high voltage source HV by way of resistor $R_4$ and to the grid 8 of tube $V_3$ and to one terminal of a condenser 10, the other terminal of which is connected to ground. The cathode 9 of tube $V_3$ is connected to the positive terminal of a source $B_2$, the negative terminal of which is grounded. The anode 7 of the tube $V_3$ is connected to the coil 11 of the relay Z and by way of the coil 11 of the relay Z to the positive terminal of a high potential source. All of the high potential sources mentioned above may be replaced by a single source when desired. Furthermore this source may be obtained from a generator or by way of rectifiers from an alternating current source. The tongue 12 of relay Z is connected to the grid electrodes of a pair of thermionic tubes $V_4$ and $V_5$ as shown in the keying stage D of the transmitter. A spring 15 retains the tongue 12 of relay Z pulled over against contact 13 when there is no current flowing in coil 11. Contact 14 is connected to a brush on one of the "V" wheels. To simplify the description of applicant's device it will be assumed that wheel $V_2$ is connected in circuit by contact K. The other brush on "V" wheel Z is connected as shown to a source of negative potential. Contacts 13 and 14 are also connected to a source of low positive potential through resistors $R_6$ and $R_7$. The tongue 12 is connected to a low positive voltage by way of a resistor $R_7$ of high value.

The stage D, that is the keying stage of the transmitter, and the stage E of the transmitter form no part of the present invention. However, it may be said that the tubes $V_4$ and $V_5$ of stage D and the tube $V_6$ of stage E all derive their anode voltage and current by way of a resistance $R_5$ from any source of high voltage HV. If the control grids of tubes $V_4$ and $V_5$ are maintained at positive potential or a small negative potential tubes $V_4$ and $V_5$ are conductive and draw anode current. In this manner they divert current and potential from the anode electrode of the transmitter tube in E and decrease the amplitude of the oscillations produced by E. In this manner the transmitter is keyed. The thermionic tube E may be an amplifier, a frequency multiplier or a relay and may have its control electrode excited or energized by a source of oscillations as shown. The output circuit of E may be coupled to a utilization circuit directly or by way of amplifiers or frequency multipliers or both. The utilization circuit may be an aerial system or a transmission line.

In the operation of Figure 1 it will first be assumed that there is no signal being sent from the telegraph office to the vacuum tube keying unit at A, which may be located at or near the transmitter. Under these circumstances the output voltage of unit A is zero and the grid 2 of tube $V_1$ is made positive by the current through $R_6$. The tube $V_1$ is then conductive and current flows through the resistance $R_3$. Because of the drop of current in the resistance $R_3$ the grid 5 of tube $V_2$ becomes sufficiently negative to cut off the flow of anode current in $V_2$. This permits the condenser 10 to charge up slowly to a higher positive value through resistance $R_4$ which is connected to the high voltage source HV. When the charge in condenser 10 has reached a sufficiently high value the grid 8 of tube $V_3$ will be made sufficiently positive in respect to cathode 9 to cause current to flow in the anode circuit thereof. This current passing through coil 11 of relay Z produces a magnetic field which attracts the armature 12 to overcome the bias supplied by the spring 15 and to pull the armature 12 over to make contact with the contact point 14. The "V" wheel $V_2$ is now connected to the control grids of the keying tubes $V_4$ and $V_5$ in the transmitter and when said "V" wheel is rotated current impulses representative of the signal on the periphery thereof or on the face thereof are impressed on the control grid of the keying tubes $V_4$ and $V_5$ for transmission.

The "V" wheel operates as follows:

When the brush 16 passes over the conducting segment, on the rotating "V" wheel, negative voltage is impressed on the grids of tubes $V_4$ and $V_5$, which causes these tubes to be non-conductive. The anode potential of tube $V_6$ is sufficiently high to allow this tube to function as an amplifier or a relay or as a frequency multiplier so that carrier energy is impressed on the following stage and passes on through the transmitter to the antenna or transmission line. Likewise, when brush 16 passes over a non-conducting segment on the

"V" wheel, the grids of tubes $V_4$ and $V_5$ of stage D become slightly positive because of the current through resistor $R_6$. This causes tubes $V_4$ and $V_5$ to conduct current which is drawn through resistor $R_5$. This extra current causes a much greater voltage drop in $R_5$ so that the anode potential of tube $V_6$ in stage E is too low to conduct sufficient current and the carrier energy is cut off from the remaining stages of the transmitter and no signal is transmitted at this moment. The characters on the "V" wheel may be of any desired length and may as indicated above be very short while the spaces may be of greatly increased length.

Now assume that a signal or message comes in over the telegraph line. This message causes keying unit A to send out a series of negative potential pulses. The first negative pulse cuts off the current in tube $V_1$ and the grid 5 of tube $V_2$ changes to ground or cathode potential because there is no current flowing in $R_3$. This causes tube $V_2$ to become conductive so that current flows in the anode circuit thereof. Condenser 10 quickly discharges by way of the path of low resistance in tube $V_2$, which lowers the potential on the grid 8 of tube $V_3$ with respect to the cathode 9 thereof. The tube $V_3$ immediately becomes non-conductive thereby deenergizing the winding 11 of relay Z. This allows the field of the magnet to fall and permits the spring 15 to pull the tongue 12 over against contact 13 which connects the transmitter keying stage D to the vacuum tube keying device A. Keying is accomplished in the same manner described in connection with the "V" wheel. The negative impulses of high potential from the output of A, biases the control grids of $V_4$ and $V_5$ negatively so that their anode circuits are non-conductive. This causes a potential on the anode of $V_6$ to increase and transmission of oscillations takes place. When the potential from A to the control grids of $V_4$ and $V_5$ is zero or less negative the keying tubes become conductive thereby lowering the potential on the anode of $V_6$ to cut off oscillations in the transmitter. If the signals from A should stop for, say, ten seconds then condenser 10 will have time to charge up sufficiently to cause the control grid of tube $V_3$ to become positive enough to start a flow of current in the anode circuit of $V_3$. This current energizes 11 and actuates relay Z to connect the transmitter keying stage D to "V" wheel $V_2$.

The overall operation would be that as long as the telegraph office is sending the transmitter will respond, but if the telegraph office stops sending for several minutes or for a period longer than a pre-arranged time delay, the transmitter will be idle until the time delay is up and then the "V" wheel will be automatically switched on. This is where the saving in power occurs. The "V" wheel dots and dashes are shorter than normal, while the intervals between dots and dashes are longer than usual.

This requires less transmitter power than normal keying requires and yet serves to keep the receiving stations tuned to the transmitter frequency. The change from the "V" wheel to the message line control is almost instantaneous, but a comparatively long period is required to automatically switch from the message channel to the "V" wheel.

The "V" wheel may be made so that any ratio of length between dots and spaces can be obtained by moving the brush near to or further from the center. The number of dots or spaces per time interval may be controlled by controlling the speed of rotation of the wheel.

In the modification of Figure 2 I have eliminated the necessity of the separate sources $B_1$ $B_2$. To accomplish this I interpose a resistance $R_2$ between the anode of $V_1$ and the control grid of $V_2$. Positive potential for the anode of $V_1$ is supplied by way of a resistance $R_1$ from any source of high potential. Biasing potential for the control grid of $V_2$ may be supplied by way of a resistance $R_3$ connected to a negative point on a source. The current for the cathode of $V_3$ may be supplied from an alternating current source and the cathode 9 of $V_3$ may be connected to a source of positive potential. The modification of Figure 2 otherwise operates in the same manner in which the modification of Figure 1 operates as described in detail hereinbefore. For this reason it is thought unnecessary to repeat the operation of the circuits at this point. It is noted, however, that the action of $V_1$ causes through the network of resistors $R_1$, $R_2$, and $R_3$ potential changes on the grid 5 of $V_2$ as in Figure 1.

When it is desired to control the relation between the transmitter and the message channel or the "V" wheel from the message source the keying device may be made to function from an extended dash put on the message line at the source or telegraph office. When the keying control is so operated the receiving operator is conscious of the fact that the telegraph operator still has the transmitter under his control. If the automatic keying control is made to function by the extended no-signal period, as in the prior modifications, the telegraph control line may become open-circuited due to some other cause during this time and the receiving operator might not be aware that anything abnormal had taken place.

In the modifications shown in Figure 3 I have illustrated schematically the circuit of an automatic idle time keying unit which functions after an extended dash has been put on the control line. This circuit is a modification of the arrangement of Figure 2 disclosed hereinbefore. The operation of this device is the same as the operation of the prior arrangements except as indicated hereinafter.

At the end of a message or group of messages the telegraph operator sends a prolonged dash over the line to the vacuum tube keying unit A. This causes the vacuum tube keying unit A to maintain a steady negative potential in its output. The grid 5 of tube $V_2$ is in this case made sufficiently negative to block the anode current in the tube. Condenser 10 then slowly charges through resistor $R_4$ and causes the grid 8 of tube $V_3$ to become sufficiently positive with respect to the cathode 6 which is already positive to some extent to permit anode current to flow in $V_3$. This anode current passes through the coil 11 of the relay Z to cause the relay tongue 12 to make contact with contact 14 which connects the selected "V" wheel to the control grids of the tubes $V_4$ and $V_5$ of the transmitter keying unit D. As long as the dash is maintained on the telegraph control line the "V" wheel will continue to key the transmitter.

Now if a telegraph message is started the long dash is taken off the control line. No voltage appears on the output of the vacuum tube keying unit A and the grid 5 of tube $V_2$ assumes practically ground potential because of its connection to ground through resistor $R_3$. Tube $V_2$ quickly discharges condenser 10 and also draws more cur-

rent from the positive source through the resistor $R_4$, so that the potential drop in this resistor $R_4$ prevents further building up of positive potential on condenser 10 and grid 8 of tube $V_3$. This causes grid 8 to be sufficiently negative with respect to the cathode 9 of this tube to block the anode current. Consequently relay Z is deenergized and the relay tongue 12 is pulled over by spring 15 to make contact with contact 13. This in effect connects the keying stage D of the transmitter to the vacuum tube keying unit A. When the next dot or dash comes, condenser 10 starts to charge slowly through resistor $R_4$ but before it is charged is sufficiently high to cause relay Z to operate, the next space between signals causes it to quickly discharge through tube $V_2$ so that as long as signals or prolonged no-signal periods are maintained the transmitter keying stage will remain connected to the signal line or telegraph channel.

Very briefly, when the telegraph operator wishes to put on the "economy" "V's" he holds a continuous dash on the control line. After a certain adjustable time delay the automatic control device switches the transmitter keying control to the "V" wheel. When the operator wishes to start a message he may start immediately and the automatic control device very quickly switches the transmitter keying control to the telegraph control system.

In a modification the automatic keying control device described above may be used on the extended dash while the extended no-signal period may be used through another and somewhat similar control system to stop and start the transmitter.

The apparatus may be simplified in practice. For example, I may utilize the arrangement shown in Figure 4. Here the cathodes of the tubes $V_2$ and $V_3$ may be both heated by alternating current supplied from any alternating current source. Furthermore, the secondary windings of these heating circuits need not be centertapped but may be grounded at one side as shown. Cathode 6 may be maintained at the desired potential by connecting one side of the heating circuit thereof to the terminal of resistance $R_3$ which is grounded. The desired positive potential for the cathode 9 of tube $V_3$ may be obtained by connecting one side of the heating circuit for cathode 9 to the tap on a potentiometer P connected as shown between the positive terminal of the direct current source and ground which is also connected to the negative terminal of the source of direct current. Here, as in Figure 3, the charge on the condenser 10 is determined by the amount of current flowing in the anode circuit of tube $V_2$ and in turn determines the bias of the control grid 8 of tube $V_3$. The conductivity of tube $V_3$ determines whether or not the winding 11 of relay Z is energized. The keying of the transmitter by the "V" wheel or by messages from A is accomplished here in the same manner in which it is accomplished in Figure 3 and it is thought unnecessary to describe in detail the operation of the arrangement in Figure 3. The "V" wheels $V_1$ and $V_2$ here as in the prior modifications may be rotated in any manner as for example by means of a motor. The motor in turn may be energized in any manner and may be energized as shown by alternating current from the same source used to energize the cathodes of the tubes $V_2$ and $V_3$.

In arrangement of Figure 5 the output of the vacuum tube keying device A is connected to contact 13 and to one terminal of $R_3$, the other terminal of which is grounded. The electrical center of the heating circuit of $V_2$ is connected to ground while the electrical center of the cathode heating circuit of $V_3$ is connected to a point on a potentiometer P connected between a high potential source and ground. The lower potential N of potentiometer P may be shunted by a capacity as shown and in the operation of the arrangement shown in Figure 5 as in the prior modifications the conductivity of $V_3$ is determined by the charge of condenser 10 which is in turn determined by the conductivity of $V_2$.

The transmitters of each modification are usually provided with wave changing devices in one or more stages to permit signalling on a plurality of different frequencies or channels. Each channel is preferably identified by its own call letters or symbols. In my invention I provide a "V" wheel for each channel. Each "V" wheel may carry channel identifying letters or symbols in addition to the "V's" or tuning signals. The desired channel may be selected by a wave change switch WC. The particular "V" wheel that carries the identifying letters for the selected channel may be thrown in circuit by a switch VS which may be connected to the control for the wave change switch WC as shown.

Having thus described my invention and the operation thereof, what I claim is:

1. A signalling system comprising a transmitter of the thermionic type including a source of signals, keying means interposed between said source of signals and said transmitter, and means for sending out controlling signals of reduced length between messages, comprising, a control signal producing device, a relay, and thermionic means coupled to said source of signals on the one hand and to said relay on the other hand, said thermionic means being responsive to the presence or absence of signals in said source to disconnect said source from said transmitter between messages and to connect said control signal producing device to said transmitter.

2. A signalling system comprising, a transmitter including a thermionic keying tube, a source of signals, a source of control impulses, a relay including contacts for connecting said keying tube to said source of signals or said source of control impulses, and a thermionic device interposed between said source of signals and actuating means in said relay, said thermionic device responding to a constant signal from said signal source to actuate said relay to connect said source of control impulses to said keying tube.

3. A signalling system comprising, a transmitter including a thermionic keying tube, a source of signals, a source of impulses of short duration separated by intervals of long duration, means for connecting said keying tube to said source of signals or said source of short impulses including, a thermionic relay device interposed between said source of signals and said keying tube, said thermionic device responding to a constant signal from said signal source to actuate said relay to connect said source of short impulses to said keying tube.

4. A signalling system comprising, a transmitter of the thermionic type, a source of signals, keying means interposed between said source of signals and said transmitter, and means for sending out controlling signals of reduced length separated by spaces of increased length between messages, comprising, a control signal producing device, a mechanical relay including a movable contact connected to said keying means, and fixed

contacts connected to said source of signals and to said control signal producing device, and thermionic means coupled to said source of signals on the one hand and to said mechanical relay on the other hand, said thermionic means being responsive to the presence or absence of signals in said source to move said movable contact against one or the other of said fixed contacts.

5. In a signalling system, a transmitter of the thermionic type, a source of signals, a thermionic keying tube connected with said transmitter, a magnetic relay having a movable contact and a pair of fixed contacts, a connection between said keying tube and one of said contacts, a source of control signals connected with another of said contacts, a connection between the remaining one of said contacts and said source of signals, a thermionic tube having output electrodes connected with the energizing winding in said relay, said tube having input electrodes, and a coupling between the input electrodes of said thermionic tube and said signal source.

6. A signalling system comprising, a transmitter of the thermionic type, a source of signals, keying means interposed between said source of signals and said transmitter, and means for sending out controlling signals of reduced length between messages comprising a controlling signal producing device, a mechanical relay, and thermionic means coupled to said source of signals on the one hand and to said mechanical relay on the other hand to disconnect said source of signals from said transmitter between messages and to connect said controlling signal producing device to said transmitter, said operations taking place slowly and means for quickly disconnecting said transmitter from said control signal device and connecting the same to said source of signals.

7. In a signalling system, a transmitter of the thermionic type including a keying tube, a source of signals, a wheel having conducting segments connected to a source of potential and separated by non-conducting segments, a relay having a movable member connected to said keying tube and a pair of contacts, a connection between a brush on said wheel and one of said contacts, a connection between the other of said contacts and said source of signals, a thermionic tube having an output connected with an energizing winding in said relay, said tube having an input circuit, and a coupling between the input circuit of said thermionic tube and said signal source.

8. A signalling system comprising, a transmitter of the thermionic type, a source of signals, a keying tube interposed between said source of signals and said transmitter, and means for sending out controlling signals of reduced length and increased spaces between messages comprising a controlling signal producing device, a mechanical relay having an armature connected to said keying tube, said relay having a pair of contacts and a winding, a connection between said source of signals and one of said contacts, a connection between said controlling signal producing device and the other of said contacts, thermionic means coupled to said source of signals on the one hand and to said winding on the other hand to disconnect said source of signals from said transmitter when signals from said source are interrupted and to connect said control signal source to said transmitter said operations taking place slowly and for quickly disconnecting said transmitter from said control signal source and connecting the same to said source of signals when signals are resumed.

9. A signalling device comprising, in combination carrier wave producing and keying means, wave length changing means connected therewith, a source of messages, a plurality of sources of short impulses and wave length identifying symbols, a device for selecting one of said last named sources, common control means for said wave length changing means and said source selecting device, and a relay for connecting either said source of messages or said selected short impulse and wave length identifying symbol source to the keying means in said transmitter.

10. A signalling system comprising, a wave relaying circuit of the thermionic type, wave changing means connected to the relaying circuit, a source of signals, a thermionic keying tube connected with said relaying circuit, a relay having a plurality of contacts, a connection between one of said contacts and said keying tube, a plurality of sources of control signals and wave length identifying symbols, a switch for selecting one of said sources and connecting the same to another of said contacts, a connection between a third one of said contacts and said source of signals, thermionic means connected with an energizing winding in said relay, a coupling between the input circuit of said thermionic means and said signal source, and a common control for said switch and said wave changing means.

11. A signalling system comprising, carrier wave relaying means and wave length changing means, a source of signals, keying means interposed between said source of signals and said carrier wave relayings means, means for sending out controlling signals of reduced length separated by spaces of increased length between messages and wave identifying symbols, comprising, a plurality of control signal producing devices, there being a device for each wave length, means for selecting a particular one of said devices, a mechanical relay including a movable contact connected to said keying means, and fixed contacts connected to said source of signals and to the selected one of said devices, thermionic means coupled to said source of signals on the one hand and to said mechanical relay on the other hand, said thermionic means being responsive to the presence or absence of signals in said source to move said movable contact against one or the other of said fixed contacts, and a common control for said wave length changing means and said device selecting means.

12. In a signalling system, a wave relaying circuit, wave changing means connected to said relaying circuit, a source of signals, a thermionic keying tube having a plurality of electrodes, a connection between a pair of said electrodes in said keying tube and said relaying circuit, a magnetic relay having an energizing winding and a plurality of contacts, a connection between one of said contacts and one of the electrodes in said thermionic keying tube, a plurality of sources of control signals and wave length identifying symbols, a switch for selecting one of said last named sources and connecting the same to another of said contacts, a connection between a third of said contacts and said first named source of signals, a thermionic tube having input and output electrodes, resistive means connecting the input electrodes of said thermionic tube to said source of signals, an additional thermionic tube having input and output electrodes, resistive and capacitive elements coupling the input electrodes of said additional thermionic tube to the output electrodes of said

preceding thermionic tube, and a circuit connecting the output electrodes of said additional tube in series with said energizing winding of said relay.

13. In a signalling system, a wave relaying circuit, a source of signals, a keying tube having a plurality of electrodes, a connection between a pair of the electrodes in said keying tube and said relaying circuit, a magnetic relay, having an energizing winding, a movable contact and a pair of fixed contacts, a connection between said movable contact and one of the electrodes in said keying tube, a source of control impulses, means connecting the source of control impulses to one of said fixed contacts, a connection between the other of said fixed contacts and said source of signals, a control tube having input and output electrodes including a cathode, an impedanace connecting the input electrodes of said control tube to said source of signals, an impedance connected between said fixed contacts, a connection between a point on said impedance and the cathode of said control tube, an additional tube having input and output electrodes, an impedance and a capacity coupling the input electrodes of said additional tube to the output electrodes of said control tube, and a circuit connecting the output electrodes of said additional tube with said energizing winding of said relay.

14. A signalling system as recited in claim 13 wherein all of said impedances are resistive in character.

15. A system as recited in claim 13 in which the input and output electrodes of said additional tube includes a cathode and in which the cathodes of said control tube and said additional tube are heated by alternating current.

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