Sept. 8, 1936. C. W. HANSELL 2,053,661

KEYING

Filed Nov. 28, 1933 2 Sheets-Sheet 1

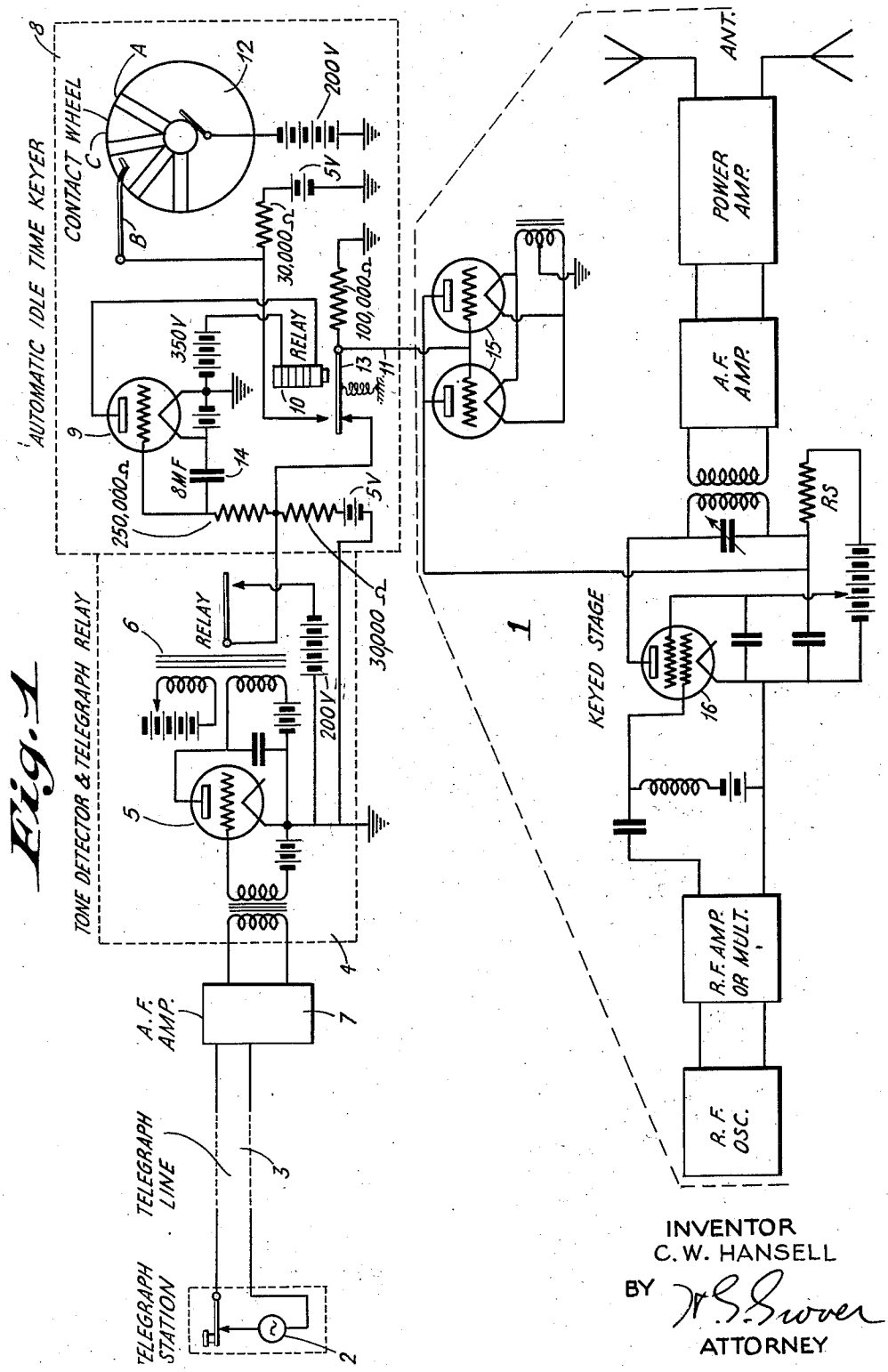


Fig. 1

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Fig. 2

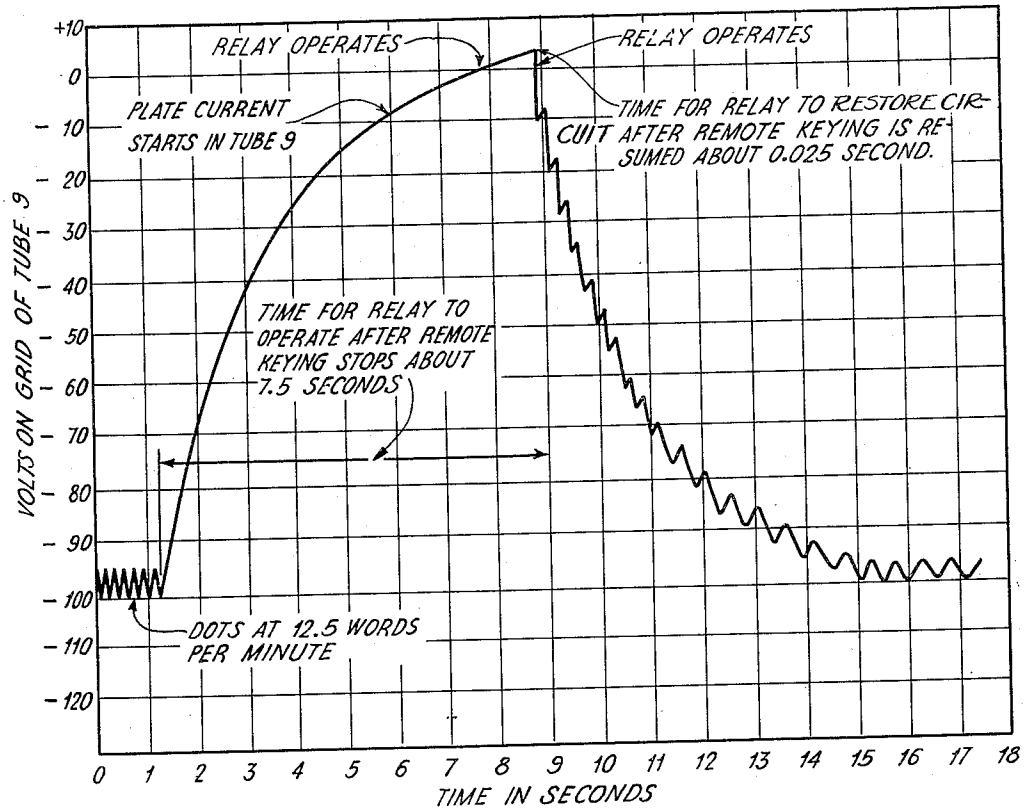


Fig. 3

DOTTED RECTANGLES SHOW NORMAL LENGTH OF DOTS AND DASHES WHILE SOLID RECTANGLES SHOW SPECIAL SHORT CHARACTERS. COMMUTATOR SHOULD RUN ABOUT 25 WORDS PER MINUTE SPEED TO KEEP SHORT DOTS SAME LENGTHS AS NORMAL DOTS AT HIGH SPEED.



INTERNATIONAL TEST SIGNAL

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UNITED STATES PATENT OFFICE

2,053,661

KEYING

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9 Claims. (Cl. 250—17)

This invention relates to radio transmitters, and has particular reference to a method of and apparatus for automatically controlling radio transmitters during idle time periods.

Hitherto, it has been found necessary in the radio field, in communicating between transmitting and receiving stations, to key the transmitter continuously during intervals between the transmission of message waves in order that the attendant at the receiver might be able to keep the set tuned to the transmitted wave, otherwise there exists the danger of losing contact between the receiving and transmitting stations. This necessity for continuous keying of the transmitter is due, to a great extent, to the absence of heterodyne oscillators in most receivers which are sufficiently constant to enable the receiving station to receive the transmitted waves over long periods of time without retuning. Another reason for keying during idle periods is to assure the receiving operator that the transmitting system is functioning properly, lest any failure in the transmitter during the idle periods be not detected until it is too late to receive a desired message.

Observations have shown that the percentage of idle time on high frequency radio transmitters often averages 50%, and that a very large proportion of power and tube costs is being expended not for the transmission of messages, but solely to maintain contact.

The present invention provides an arrangement which overcomes this great expenditure of power and effects a considerable saving in the cost of operation.

One of the objects of the present invention is to effect this economy in an automatic manner, and this is accomplished by a start-stop control at the transmitter which is responsive to the absence of message signals over the circuit for a predetermined interval of time for connecting the transmitter to a special local keying arrangement, and to the presence of message signals on the circuit for reassociating the transmitter with the distant telegraph station for the transmission of message waves.

A feature of the invention lies in the apparatus for accomplishing this object which comprises a vacuum tube relay whose operation is controlled by the charge stored up on a condenser, the relay, in turn, controlling the transfer of the radio transmitter from the message channel to the local idle time keyer. In the preferred embodiment of this invention, the keyer consists of a commutator or contact wheel having one or more contact segments in continuous association with a suitable keying voltage, the latter being utilized to influence the transmitter through a circuit which includes the segments of the commutator.

From a broad aspect, the invention comprises automatic start-stop local keying mechanism for transmitting between messages very light dots and dashes which mechanism reduces the average key down time to any desired fraction, for example, a third or a quarter of the normal key down time. Such an arrangement reduces all signal spaces to a time interval short enough to effect a considerable saving in power and tube cost, but sufficiently long to enable ready retuning at the receiving station.

The invention is described in more detail in the following specification which is accompanied by drawings, wherein Figure 1 illustrates, schematically, a complete transmitting arrangement provided with an automatic idle time keyer; Figure 2 illustrates, graphically, the relative time intervals in which the vacuum tube relay of the idle time keyer functions; and Figure 3 illustrates, by way of example only, the keying down time of the transmitter for an international test signal with and without the provision of the automatic idle time keyer.

Referring to Figure 1, there is shown a radio transmitter 1 which is connected by means of a landline or channel 3 with a distant tone keying means 2 located at a remote telegraph station. In circuit with the transmitter 1 there is provided a simple tone detector and telegraph relay circuit indicated in box 4 within which there is shown a vacuum tube 5 in whose output is a two winding relay 6, the circuit 4 functioning to detect the interrupted message tone signals transmitted over telegraph line 3 which are amplified by audio frequency amplifier 7. Relay 6 is composed of two windings, the upper one of which is biased to normally keep the armature of the relay in its upper position, as shown in the drawings, and the lower one of which responds to current variations in vacuum tube 5 to apply a negative voltage of —200 volts to the local automatic idle time keyer circuit 8. It will be appreciated, of course, that, if desired, other relay means than circuit 4 may be employed; for example, the circuit shown and described in U. S. Patent 1,887,236, granted November 8, 1932, may readily be used in place of detector relay circuit 4.

Connected to relay 6 is a local keyer 8 comprising, essentially, a vacuum tube 9 in whose output circuit is an electromagnetic relay 10, the latter controlling through its armature 13, in

an obvious manner, the transfer of the radio transmitter 1 over lead 11 from tone detector and telegraph relay 4 to the commutator and contact wheel assemblage 12, and vice versa. Vacuum tube 9 is normally arranged not to pass current while signals are being transmitted by the keying means 2 at the telegraph station. In circuit with the grid and cathode of tube 9 is a large condenser 14 which is caused to charge up negatively during keying from the telegraph station to a value sufficient to bias the grid potential of the tube 9 an amount in excess of that required to keep the plate current of tube 9 at zero. In the absence of signals, however, the negative potential on the condenser decreases to zero or to a small positive value in order to permit passage of relatively large plate current through tube 9, thereby causing the operation of relay 10 which, in turn, functions to transfer the radio transmitter circuit 1 from the tone detector and telegraph relay circuit 4 to the contact wheel 12.

The contact wheel 12 comprises any suitable interrupter keying means, such as a vacuum tube arrangement or a continuously rotating cam arrangement or commutator, such as indicated in the drawings, for causing the transmission of very light dots and dashes, or on and off modulated signals requiring, say, one-third to one-quarter the average key down time as does normal keying. In the particular embodiment shown, there is provided an adjustable brush B on the contact wheel which may be moved away from or towards the center in order to change the relative length of the contact and space time. Since the contact segments A do not grow narrow as rapidly as do the insulation segments C, it will be evident that any movement of the brush toward or away from the center of the contact wheel will change the relative length of contact and space time.

In the operation of the idle time keyer 8, the grid of the tube 9 has impressed upon it a potential which, while the distant telegraph station operator is keying the apparatus 2, is the average of +2.5 volts obtained from the flow of current of the 5 volt source through the 30,000 ohm resistor and —200 volts, that is to say, about —100 volts. The potential on the grid will remain substantially constant at this time due to action of the 250,000 ohm resistor and the condenser 14 in slowing up the response of the grid potential to the potential variations due to keying. The grid voltage required on the tube 9 to allow sufficient plate current to flow therethrough to operate the relay 10 is about zero. When keying from the telegraph station 2 over the message channel 3 ceases, relay 6 will be in the position indicated in the drawing and the voltage on the grid of tube 9 and condenser 14 will start to rise to about +2.5 volts, thus starting the discharging of the eight microfarad condenser 14 through the 250,000 ohm resistor. After about five or more seconds, depending upon the value of the condenser 14, the condenser will have discharged by an amount sufficient to raise the grid potential to zero, thus causing relay 10 to operate and throwing the control of the transmitter 1 from the message channel 3 and telegraph station 2 to the local commutator or keyer 12. This commutator will then key the transmitter 1 to send out very light dots and dashes, or on and off modulated signals having a length much less than the average key down time, as indicated in Figure 3.

When station 2 resumes keying, the grid potential of tube 9, which has been at about +2.5 volts, will quickly fall below zero, due to the application of —200 volts on the contact of relay 6 to the 250,000 ohm resistor as this relay operates, and relay 10 will release, thus transferring the control of the transmitter again to the telegraph station 2.

Figure 2 indicates in a qualitative way the relative time intervals in the functioning of the idle time keyer 8 wherein graphs indicate the time in seconds for the potential on the grid of the tube 9 to build up to a value sufficient to operate the relay, and the time within which the potential on the grid will fall to a value too low to maintain relay 10 operated. It will be noted that about 7.5 seconds is required after the remote control keying from telegraph station 2 stops before the transmitter 1 is switched over to the local keyer 12 while only about 0.025 second is required to restore the transmitter 1 to the remote control telegraph station 2 after keying from the telegraph station starts. In actual practice, the keying of the transmitter 1 was found to revert from contact wheel 12 to the remote control station 2 so quickly that, on hand keying, there was no noticeable loss of even the first dot, so far as the ear could observe.

Since the details of the transmitter 1 are well known in the art and form no part, per se, of the present invention, the operation of this transmitter will not be described other than to say that it functions in response to the application of suitable voltages over lead 11, the two tubes 15 acting in parallel to reduce the voltage on the anode or screen grid or both of the radio frequency amplifier tube 16 when the tubes 15 pass current.

It will be understood, of course, that the invention is not limited to the precise arrangement of parts shown, since it may be modified to meet various conditions encountered in its use without departing from the spirit and scope thereof.

I claim:

1. In a communication system, a transmitter, a message channel in circuit with said transmitter, a device for enabling said transmitter to send interrupted signal characters which are repeated at intervals, and retarded actuating means in circuit with said message channel and responsive to the absence of message waves in said channel only after the lapse of a plurality of seconds for disconnecting said transmitter from active control of said channel and for operatively associating said transmitter with said device.

2. In a radio communication system, in combination, a telegraph station, a remote radio transmitter, a line extending from said station to said transmitter, an electron discharge device circuit at said transmitter for keying said transmitter in accordance with the signal characters received by said circuit over said line, another keyer at said transmitter for causing the transmission of predetermined signal characters at intervals, and automatic retarded action switching mechanism at said transmitter responsive to the failure of said electron discharge device circuit to key said transmitter for a predetermined period of time for transferring the control of said transmitter from said electron discharge device circuit to said keyer, said last keyer having means for varying the interval between transmission of signal characters.

3. In a radio communication system, in com-

bination, a telegraph station, a remote radio transmitter, a line extending from said station to said transmitter, an electron discharge device circuit at said transmitter for keying said transmitter in accordance with the signal characters received by said circuit over said line, another keyer at said transmitter for causing the transmission of signal characters at intervals, and automatic retarded action switching mechanism responsive to the absence of signals over said line for a predetermined period of time for operatively associating said transmitter with said other keyer, and to the presence of signals over said line for disconnecting said transmitter from control of said other keyer and for operatively associating said transmitter with said line for control by said telegraph station.

4. In a radio communication system, in combination, a telegraph station, a remote radio transmitter, a line extending from said station to said transmitter, an electron discharge device circuit at said transmitter for keying said transmitter in accordance with the signal characters received by said circuit over said line, a keyer at said transmitter for causing the repeated transmission of predetermined signal characters, and a retarded action vacuum tube relay at said transmitter under control of said telegraph station and responsive to the absence of signals over said line for approximately seven seconds for transferring the control of said transmitter from said line to said keyer and responsive to the presence of signals over said line for disassociating said transmitter from said keyer within 0.025 second.

5. In a radio communication system, in combination, a telegraph station, a remote radio transmitter, a line extending from said station to said transmitter, an electron discharge device circuit at said transmitter for keying said transmitter in accordance with the signal characters received by said circuit over said line, a keyer at said transmitter for causing the repeated transmission of predetermined signal characters, and a vacuum tube relay at said transmitter under control of said telegraph station for transferring the control of said transmitter from said electron discharge device circuit to said keyer, or vice versa, said keyer comprising a continuously rotating contact wheel in the form of a commutator having metallic segments which are spaced apart by insulating material, said segments being arranged to make contact with an adjustable brush assemblage for varying the percentage of key down time.

6. In a radio communication system, in combination, a telegraph station, a remote radio transmitter, a line extending from said station to said transmitter, an electron discharge device circuit at said transmitter for keying said transmitter in accordance with the signal characters received by said circuit over said line, a keyer at said transmitter for causing the repeated transmission of predetermined signal characters, and a vacuum tube relay at said transmitter under control of said telegraph station for transferring the control of said transmitter from said electron discharge device circuit to said keyer, or vice versa, said vacuum tube relay comprising a tube whose grid is normally biased to cutoff when signals are being received from said telegraph station over said line, and a condenser in circuit with said grid, said condenser being arranged to charge up in the absence of signals over said line for a predetermined interval of time for biasing said grid to cause said tube to pass current and to operate said relay.

7. In a radio communication system, in combination, a telegraph station, a remote radio transmitter, a line extending from said station to said transmitter, an electron discharge device circuit at said transmitter for keying said transmitter in accordance with the signal characters received by said circuit over said line, a keyer at said transmitter for causing the repeated transmission of predetermined signal characters, and a vacuum tube relay at said transmitter under control of said telegraph station for transferring the control of said transmitter from said electron discharge device circuit to said keyer, or vice versa, said vacuum tube relay being inoperative during the transmission of message signals and operative during the absence of message signals for a predetermined interval of time.

8. In combination, an electron discharge device having an anode, cathode, and control electrode, an electromagnetic relay in circuit with said anode and responsive to the passage of current in said device, a condenser connected between said control electrode and cathode, a source of negative potential and a source of positive potential, a path of high resistance between said source of positive potential and the junction point of said condenser and said control electrode, a connection between said source of negative potential and a point on said path for placing a negative bias on said control electrode for causing said device to cease passing current, means responsive to signal impulses for effectively interrupting said last connection whereby said device is enabled to pass current, an armature and a pair of oppositely disposed contacts for said electromagnetic relay, interrupting keying means associated with one of said contacts, the other of said contacts being connected to said path of high resistance, and a utilization circuit responsive to both said interrupting means and connected to said armature.

9. In combination, an electron discharge device having an anode, cathode, and control electrode, an electromagnetic relay in circuit with said anode and responsive to the passage of current in said device, a condenser connected between said control electrode and cathode, a source of negative potential and a source of positive potential, a path of high resistance between said source of positive potential and the junction point of said condenser and said control electrode, a connection between said source of negative potential and a point on said path for placing a negative bias of said control electrode for causing said device to cease passing current, means responsive to signal impulses for effectively interrupting said last connection whereby said device is enabled to pass current, an armature, a make contact and a break contact for said electromagnetic relay, a keyer for causing the repeated transmission of signal characters connected to said make contact, said break contact being connected to the same point on said path of high resistance to which said source of negative potential is connected, and a radio transmitter responsive to both said keyer and interrupting means associated with said armature.

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