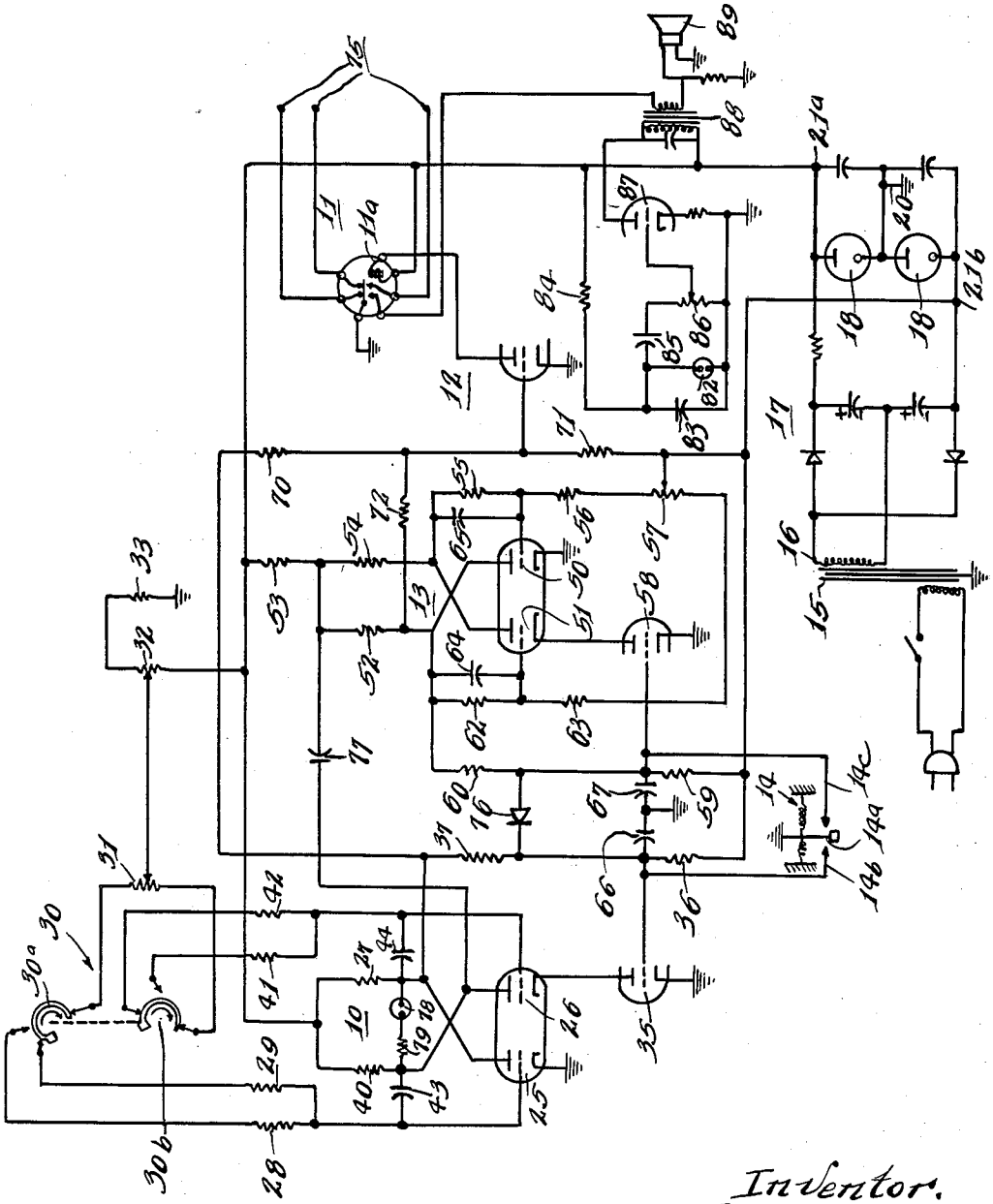
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TELEGRAPHIC KEYER

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Inventor.
James B. Ricks.
By Hofgren, Brady, Wegner.
Allen & Stellman.
Attorneys.

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TELEGRAPHIC KEYER

James B. Ricks, Lake Forest, Ill., assignor to The Hallicrafters Co., a corporation of Delaware

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This invention is concerned with a keyer, as for a radio transmitter, and more particularly with an electronic keyer actuated by a mechanical key.

In code transmission, use is made of short periods of transmission, preferably of different length and referred to as dots and dashes or marks, separated by periods of non-transmission, referred to as spaces. In accordance with best practice, the dot and space should have the same time period and a dash should be formed by bridging the space between two dots, thus the dash is three times as long as a single dot.

A principal object of this invention is the provision of an improved automatic keyer which will provide uniform dots, dashes and spaces at a constant speed, and which is not dependent upon the skill or accuracy of the operator in forming the individual marks.

One feature of the invention is the provision in a keyer of a free-running multivibrator having a pulse output, first selectively operable control means for actuating the free-running multivibrator, a bi-stable pulse actuated multivibrator having a pulse output, second selectively operable control means for conditioning the bi-stable multivibrator for operation and for actuating the free-running multivibrator, means for deriving a trigger pulse from the free-running multivibrator and applying it to the bi-stable multivibrator and means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of the first and second control means.

Another feature is that the second or bi-stable multivibrator acts as a frequency divider to cooperate with the free-running multivibrator in the provision of dashes having a fixed time relation with the dots formed by the free-running multivibrator.

A further feature is that each of the multivibrators is normally maintained in an inoperative condition and is rendered operative upon actuation by the control means of a control device connected therewith. Yet another feature is the provision of a feedback circuit between the multivibrators and the associated control device to effect completion of an initiated character regardless of the condition of the selectively operable control means.

Still a further feature is the provision of a control for varying a bias condition of each section of the free-running multivibrator to control the speed of formation of the characters. And another feature is the provision of a variable control element to vary a time constant in the circuit of the free-running multivibrator to control the mark-to-space ratio.

Further features and advantages of the invention will readily be apparent from the following specification and from the single figure of the drawing, which is a schematic diagram of an embodiment of the invention.

Code transmission is widely used for certain types of communication and various automatic electromechanical keyers have been developed, primarily for high speed commercial circuits which employ automatic translating equipment at the receiver. They are not designed or readily usable for amateur communication, for example. The keyer of the present invention is intended for manual operation, providing dots and dashes of a desired and consistent mark-to-space ratio and at a desired rate consistent with the skill of the transmitting operator and the ability of the receiving operator.

During the course of the following description of the embodiment of the invention illustrated in the drawing, the various circuit elements will be given specific values or type designations. It is to be understood that this specific disclosure is made for the purpose of describing an operative embodiment of the invention and that many changes will be apparent to those skilled in the art.

The keyer operation is based on the action of a free-running multivibrator **10** which provides a series of positive pulses that are utilized to actuate a keying relay **11**, through the operation of a relay control tube **12**. The pulses from the free-running multivibrator alone form a series of dots, separated by spaces having a time duration preferably equal to that of the dots. A bi-stable pulse actuated multivibrator **13** is actuated by pulses derived from free-running multivibrator **10** and provides a pulse output to the relay control tube which effectively bridges the space between succeeding dot pulses, for the formation of a dash.

Each of the multivibrators is biased in a manner rendering it inoperative, and operation is effected through the manipulation of a control means, as the two-position key **14**.

The construction and operation of the keyer will now be described in more detail. The apparatus is energized from a suitable A.C. source through power transformer **15**, having a high voltage secondary winding **16** connected with a voltage doubler power supply **17**. Regulators **18** and **19**, as type OA2 and OB2 gas regulator tubes, respectively, are connected across the power supply **17** and a junction between them returned to a reference potential or ground **20**. A positive potential of the order of +150 volts appears at terminal **21***a* of the power supply and a negative potential of the order of −105 volts at terminal **21***b*.

Free-running multivibrator **10** includes a first section **25** and a second section **26**, each one-half of a dual triode 12AU7. The cathode of first section **25** is returned directly to ground and the anode is connected through resistor **27**, 100,000 ohms, with the 150 volt positive source. The control grid is connected through one or the other of resistors **28**, 2.2 megohms or **29**, 5.6 megohms, section **30***a* of switch **30**, and a portion of potentiometer **31**, 1 megohm, with the movable arm of potentiometer **32**, 100,000 ohms, which is connected in series with resistor **33**, 10,000 ohms, across the 150 volt source.

The cathode of second multivibrator section **26** is connected with the anode of control tube **35**, one-half of a 12AU7, the cathode of which is returned to ground. The control grid of control tube **35** is connected with a voltage divider including resistors **36**, 2.2 megohms, **37**, 680,000 ohms, and **27**, between the +150 volt and −105 volt supplies. This establishes a potential at the control grid of control tube **35** of the order of −10 volts, biasing the control tube below cutoff and rendering multivibrator **10** inoperative.

The anode of the second section **26** of multivibrator is connected through resistor **40**, 100,000 ohms, with the 150 volt supply. The control grid is connected through one or the other of resistors **41**, 2.2 megohms and **42**, 5.6 megohms, as selected by section **30***b* of switch **30**, with the end of potentiometer resistor **31** opposite the connection of the control grid of multivibrator section **25**. Coupling capacitors **43** and **44**, each 0.02 μf, are connected from the anode of section **26** to the control grid of multivibrator section **25**, and from the anode of multivibrator section **25** to the control grid of section **26**, respectively, completing the multivibrator circuit.

The bi-stable, pulse actuated multivibrator **13** comprises two sections **50** and **51**, each one-half of a 12AU7. The cathode of section **50** is returned directly to ground and

the anode is connected through resistor **52**, 100,000 ohms, and resistor **53**, 22,000 ohms, with the positive 150 volt supply. The control grid is connected with a voltage divider including resistor **53**, resistor **54**, 100,000 ohms, resistor **55**, 470,000 ohms, resistor **56**, 470,000 ohms, and a portion of potentiometer **57**, 500,00 ohms, between the positive 150 volt supply and the negative 105 volt supply, the movable tap of potentiometer **57** being connected to the negative supply. As will appear below, the potentiometer **57** is so adjusted that the control grid of section **50** has essentially zero bias potential applied thereto and section **50** is normally conducting.

The cathode of the section **51** of multivibrator **13** is connected with the anode of control tube **58**, one-half of a 12AU7, the cathode of which is returned to ground and the control grid of which is provided with a negative cutoff potential by a voltage divider including resistor **59**, 2.2 megohms, resistor **60**, 680,000 ohms, and resistors **52** and **53**, connected between the negative 105 volt and positive 150 volt supplies. The anode of section **51** of multivibrator **13** is connected through resistors **54** and **53** with the positive 150 volt supply. The control grid of section **51** is connected with a voltage divider which includes resistors **53**, **52**, **62**, 470,000 ohms, **63**, 470,000 ohms, and a portion of potentiometer **57**. This divider applies a negative potential to the control grid of multivibrator section **51**, sufficient to render it nonconducting, even when control tube **58** is not cut off. The feedback circuit for multivibrator **13** includes a capacitor **64**, 0.001 μf., connected between the anode of section **50** of the multivibrator and control grid of section **51**, shunting resistor **62**, and capacitor **65**, 0.001 μf., connected between the anode section **51** and the control grid of section **50**, shunting resistor **55**.

Key **14** includes a key lever **14***a* spring biased to a position intermediate a pair of contacts **14***b* and **14***c*, connected with the control grids of control tubes **35** and **58**, respectively. The key **14***a*, which is returned to ground, and may be actuated manually to make contact with one or the other of contacts **14***b* and **14***c*. The key switch contacts are shunted by capacitors **66** and **67**, each 0.02 μf.

Dots are formed by the keyer upon actuation of key lever **14***a* to the left, grounding contact **14***b* and thus the control grid of control tube **35**. This renders free-running multivibrator section **26** conductive and initiates operation of the free-running multivibrator **10**. So long as the key lever **14***a* is held to the left, multivibrator **10** will continue to operate with first one section and then the other conducting. When the operation is initiated and section **26** for it rendered conducting, the anode potential drops sharply and this sharp drop is coupled through capacitor **43** to the control grid of section **25**, cutting it off. The plate voltage of section **25** rises rapidly providing a positive pulse which is coupled through resistor **70**, 2.2 megohms, to the control grid of relay control tube **12**.

Relay control tube **12** is normally cut off as its control grid is returned to a negative potential of the order of −15 volts provided by a voltage divider including resistor **71**, 2.2 megohms, and a circuit including resistors **70** and **27** in one branch and resistors **72**, 1 megohm, **52**, and **53** in the other branch, connected between the negative and positive terminals of the power supply. The positive pulse derived from section **25** of free-running multivibrator **10** renders relay control tube **12** conducting, energizing relay coil **11***a* and reversing the connections of the contacts associated therewith. It will be noted that certain of the contacts are normally grounded while others are normally isolated from ground. The ground connection condition reversal upon actuation may be utilized by suitable connection of a transmitter keying circuit to output terminals **75**.

Dashes are formed by actuating key lever **14***a* to the right, grounding contact **14***c* connected with the control grid of control tube **58**. This in itself merely conditions section **51** of bi-stable multivibrator **13** for conduction but does not render it conductive as there is a negative potential of the order of −12 volts on its control grid. A diode **76**, 1N1763, is connected between the control grids of control devices **58** and **35** and phased to conduct when the control grid of control tube **58** is at a more positive potential than that of tube **35**. Accordingly, when the grid of tube **58** is grounded, the control grid of control tube **35** is also grounded initiating operation of free-running multivibrator **10**. The negative pulse appearing at the anode of section **26** of multivibrator **10** upon initiation of its operation, is coupled through a differentiating circuit including capacitor **77**, 0.001 μf. and resistor **53**, to the anodes of the two sections **50** and **51** of bi-stable multivibrator **13**. Conducting section **50** has an extremely low anode voltage because of the high resistance in the anode circuit, and the negative pulse from the differentiator circuit serves to cut it off, whereupon section **51** begins to conduct. This condition remains for a full cycle of operation of free-running multivibrator **10** until section **26** is again rendered conducting whereupon a further trigger pulse is coupled to bi-stable multivibrator, this time rendering section **51** cut off and permitting section **50** to conduct. The positive pulse appearing at the anode of section **50** of bi-stable multivibrator **13** when this section is rendered nonconducting, is coupled through resistor **72** to the control grid of relay control tube **12**, and serves to bridge the gap between successive positive pulses provided by section **25** of free-running multivibrator **10**, keeping the relay control tube **12** conducting and providing a dash equal in time to two dots and the space between them.

Each of the multivibrators is provided with a feedback circuit connected with the associated control tube to insure the completion of a character once it is initiated, regardless of the operator's handling of key lever **14***a*. In the free-running multivibrator **10**, there is a connection between the anode of the first section **25** through resistor **37** with the control grid of control tube **35**. When formation of a dot is initiated by grounding the control grid of the control tube **35**, multivibrator section **25** is rendered nonconducting and the plate voltage jumps to B+ potential. This positive potential changes the condition of the voltage divider to which the control grid of control tube **35** is connected, keeping it conducting until multivibrator **10** completes a cycle of operation. Similarly, in bi-stable multivibrator **13**, there is a connection through resistor **60** between the anode of section **50** and the control grid of control tube **58**. When a dash is initiated and section **50** of multivibrator **13** is rendered nonconducting, the increase in potential at the anode changes the condition in the biasing network for control tube **58** keeping it, and through diode **76**, control tube **35**, conducting until the character is completed.

Two controls are provided for the speed of free-running multivibrator **10**. Switch **30**, comprising switch sections **30***a* and **30***b*, provide for a selection of resistors in the grid circuits of the two sections **25** and **26** of the free-running multivibrator. A high speed range is provided with resistors **28** and **41** in the circuit, and a low speed range with resistors **29** and **42** in the circuit. A further control over the speed is provided by potentiometer **32** which simultaneously varies the bias conditions in the grid circuit of the two sections of the multivibrator.

Variable resistor **31** controls the portion of the resistance **31** which is in each of the two grid circuits. If the other components of the circuit are properly matched and potentiometer **31** set at its mid-point, the two circuits are substantially identical and the mark-to-space ratio of the free-running multivibrator is unity. Adjustment of potentiometer **31** increases or decreases the mark time as related to the space time.

Potentiometer **57** in the circuit of the control grid

of the two sections of the bi-stable multivibrator is utilized to provide a balance in the bi-stable multivibrator to compensate for variations in tube characteristics.

A visible indication of the operation of the keyer is provided by a neon lamp 78, NE51, connected in series with resistor 79, 100,000 ohms, between the anodes of sections 25 and 26 of free-running multivibrator 10. When the keyer is in operation and functioning properly, neon bulb 78 flashes continuously, once for each dot and twice for each dash. With a perfectly formed character, the rhythm of flashes in uninterrupted.

An audible monitoring signal is provided by an audio relaxation oscillator utilizing a neon bulb 82, NE2, shunted by capacitor 83, 0.001 μf. connected in series with resistor 84, 2.7 megohm, across the 150 volt positive portion of the supply. The oscillator operates continuously and its output in coupled through capacitor 85, 0.001 μf., to a volume control potentiometer 86, 2 megohms, connected in the grid circuit of an audio amplifier 87, one-half of a 12AU7. The output of the audio amplifier is coupled through transformer 88 and a contact associated with keying relay 11 to loud speaker 89. Whenever a character is formed and relay 11 actuated, the circuit to the loudspeaker is completed, provided an audible indication of the keyer operation.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. In a keyer: a free-running multivibrator, having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator, having a pulse output; second selectively operable control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said trigger pulse to said bi-stable multivibrator; and means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of said first and second control means.

2. In a keyer: a free-running multivibrator, having a pulse output; first selectively operable dot producing control means for actuating said free-running multivibrator; a frequency dividing, bi-stable, pulse actuated multivibrator having a pulse output; second selectively operable dash producing control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said pulse to said bi-stable multivibrator; and means combining the pulse outputs of both multivibrators to provide a series of dot and dash keying control pulses in accordance with the actuation of said first and second control means.

3. In a keyer: a free-running multivibrator, having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator, having a pulse output; second selectively operable control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said trigger pulse to said bi-stable multivibrator; means operatively connected with each of said multivibrators for effecting completion of initiated pulses; and means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of said first and second control means.

4. In a keyer: a free-running multivibrator having a normally conducting section and a normally nonconducting section, and having a pulse output; a first control device connected with said normally nonconducting section and biased to maintain such section in the nonconducting condition; first selectively operable control means connected with said first control device, operable to change the bias thereon to render said free-running multivibrator operative; a bi-stable, pulse actuated multivibrator having a normally conducting section and a normally nonconducting section, and having a pulse output; a second control device connected with the normally nonconducting section of said bi-stable multivibrator for maintaining it nonconductive; second selectively operable control means connected with said second control device, operable to change the bias thereon to condition said bi-stable multivibrator for operation; means for deriving a trigger pulse from a free-running multivibrator and applying it to a bi-stable multivibrator; and means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the operation of said first and second control means.

5. In a keyer: a free-running multivibrator having a normally conducting section and a normally nonconducting section, and having a pulse output; a first control device connected with said normally nonconducting section and biased to maintain such section in the nonconducting condition; first selectively operable control means connected with said first control device, operable to change the bias thereon to render said free-running multivibrator operative; a bi-stable, pulse actuated multivibrator having a normally conducting section and a normally nonconducting section, and having a pulse output; a second control device connected with the normally nonconducting section of said bi-stable multivibrator for maintaining it nonconductive; second selectively operable control means connected with said second control device, operable to change the bias thereon to condition said bi-stable multivibrator for operation; a diode connected between said control devices to couple a bias change of the second control device to the first control device; means for deriving a trigger pulse from said free-running multivibrator and applying it to said bi-stable multivibrator; feedback circuits associated with each of said multivibrators for effecting completion of initiated pulses; and means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the operation of said first and second control means.

6. In a keyer: a free-running multivibrator having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator, having a pulse output; second selectively operable control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said trigger pulse to said bi-stable multivibrator; means for varying a bias condition of each of the sections of said free-running multivibrator for controlling the speed of the pulses; and means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of said first and second control means.

7. In a keyer: a free-running multivibrator having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator, having a pulse output, second selectively operable control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said trigger pulse to said bi-stable multivibrator; means for varying a time constant in said free-running multivibrator for controlling the mark-to-space ratio of said pulses; means combining the pulse outputs of both multivibrators to provide a series of keying control pulses

in accordance with the actuation of said first and second control means.

8. In a keyer: a free-running multivibrator having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator, having a pulse output; second selectively operable control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said trigger pulse to said bi-stable multivibrator; means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of said first and second control means; and a visual indicator connected with said free-running multivibrator and responsive to the pulses generated thereby.

9. In a keyer: a free-running multivibrator having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator, having a pulse output; second selectively operable control means for conditioning said bi-stable multivibrator for operation and for actuating said free-running multivibrator; means for deriving a trigger pulse from said free-running multivibrator and applying said trigger pulse to said bi-stable multivibrator; means combining the pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of said first and second control means; and an audible monitor connected with said multivibrators and responsive to the pulse outputs thereof.

10. In a keyer: a free-running multivibrator having a pulse output; first selectively operable control means for actuating said free-running multivibrator; a bi-stable, pulse actuated multivibrator having a pulse output; means for deriving a trigger pulse from said free-running multivibrator of fixed time duration and having a predetermined time relationship to the pulse output of said free-running multivibrator and for applying said trigger pulse to said bi-stable multivibrator; a second selectively operable control means for conditioning said bi-stable multivibrator for operation upon receipt of a trigger pulse and for actuating said free-running multivibrator; and means for utilizing said pulse outputs of both multivibrators to provide a series of keying control pulses in accordance with the actuation of said first and second control means.

11. In a keyer: a free-running multivibrator having a pulse output and having two sections, one normally conducting and the other normally non-conducting; a control device connected with the normally nonconducting section of said multivibrator and maintaining it in the nonconducting condition, selectively operable control means connected with said control device for actuating the control device to condition the normally nonconducting section of said multivibrator for operation; means including a feedback loop coupled between said normally conductive section and said control device for maintaining said control device conducting for a predetermined length of time; and means for deriving keying control pulses from said multivibrator.

12. In a keyer: a free-running multivibrator having a pulse output and having two sections, one normally conducting and the other normally nonconducting; a control device including an electron discharge device having anode, cathode, and control electrodes, said anode and cathode connected to the said normally nonconducting section of said multivibrator and maintaining it in the nonconducting condition; selectively operable control means connected with said control electrode of said electron discharge device for actuating the control device to condition the normally nonconducting section of said multivibrator for operation; and means for deriving keying pulses from said multivibrator.

13. In a keyer: a free-running multivibrator having a pulse output and having a first, normally conducting electron discharge device and a second, normally nonconducting electon discharge device; a control device including a third normally non-conducting electron discharge device coupled to said second device and maintaining said second device in the normally nonconducting state and including a selectively operable control means coupled to said third electron discharge device for actuating said third electron discharge device to condition said second electron discharge device for operation; and means for deriving keying control pulses from said multivibrator.

14. In a keyer: a first switching device having input and output terminals in a normally closed position; a second switching device having input and output terminals in a normally open position; a first feedback path connected between the input terminals of said second device and the output terminals of said first device; a second feedback path connected between the input terminals of said first device and the output terminals of said second device; a third switching device having input and output terminals coupled to the output terminals of said second device and maintaining said second device in an open position; a third feedback path coupled between the output terminals of said second device and the input terminals of said third switching device; a fourth switching device connected to said third device for actuating it from an open to a closed position; and means coupled to said first switching device for utilizing the output pulse of said first switching device.

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