

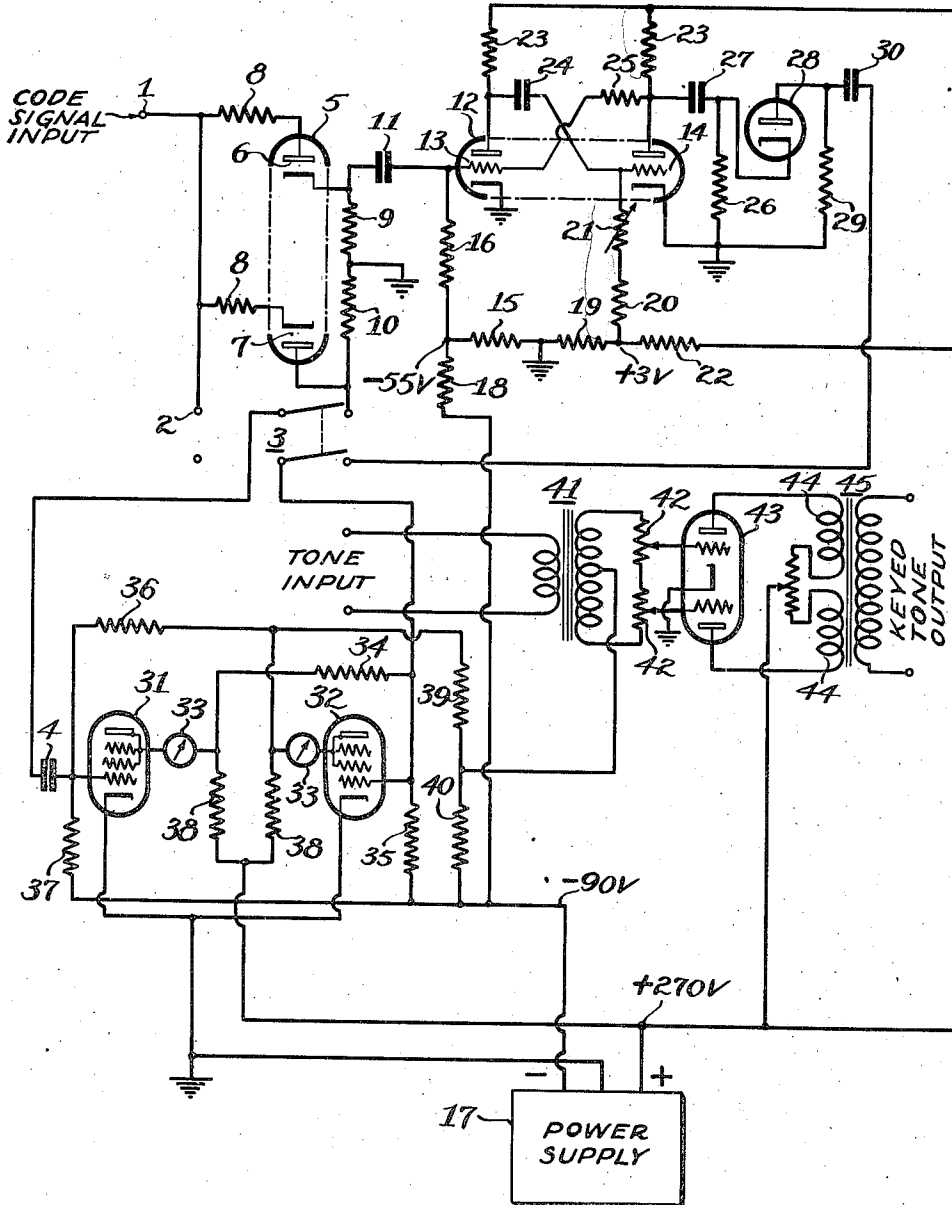
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TELEGRAPHIC KEYING BIAS ADJUSTER

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TELEGRAPHIC KEYING BIAS ADJUSTER

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This invention relates to keying bias adjusters such as may be used in conjunction with telegraph code transmitters. It is well known that code signals when transmitted over radio channels are apt to be distorted at the point of reception and the distortion usually takes the form of elongation of the marking elements of the signals. Efficiency of transmission is, therefore, impaired. In order to overcome this difficulty and to compensate for elongation of the mark signals at the point of reception it has been found desirable to provide means closely associated with the sending apparatus at a telegraph office for controlling the "weight" of the mark signals. While it is true that compensating adjustments could be made at the radio transmitter, upon request to do so, as when the ether channel produces "heavy" or elongated signals, it is found in practice that "weighting" of the signal can best be controlled at the office of origin of the message transmission. Corrective adjustments can be made more expeditiously and more easily by the use of our invention located at the message sending station than could be done in the apparatus of the radio transmitter. For it is at the sending station that a report would be received from the remote receiving station regarding heavy signal reception.

It is an object of our invention to provide a timing circuit in combination with a keying device whereby the time intervals occupied by mark signals are clipped to compensate for distortion which is usually manifested by elongation of the mark signals at the point of reception.

It is another object of our invention to provide a system to be located at a central office for varying the ratio between the time intervals occupied by mark signals and the time intervals occupied by space signals, thereby to improve the characteristics of the signals as received at a remote point.

A still further object is to provide facilities for improving the clarity of reception of signals initiated by a tone keyer of the locking circuit type and to provide adjustments in such facilities so as to allow for different conditions of transmission of code signals over a radio path.

In applying correction for signal distortion it is desirable to shorten the transmitted mark signal elements by an amount equal to the distortion or elongation at the point of reception. Since the distortion is independent of the lengths of the mark signal any applied correction should be governed by distortion alone and not by the speed of keying. From this it can be seen that such correction will be a larger percentage of the

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signal element at high keying speeds than at lower speeds.

In carrying out our invention provision is made for variably adjusting the mark signal time by subtraction from the full marking interval time allotment of a component, the duration of which may be varied from 150 to 3000 microseconds. For example, if the keying speed were to be 250 words per minute, the dot cycle could be adjusted to 20 percent marking and 80 percent spacing.

Our invention will now be described in more detail, reference being made to the accompanying drawing, the sole figure of which shows diagrammatically a preferred circuit arrangement.

Referring to the drawing, we show therein a circuit input terminal 1 to which may be connected any suitable source of code signals. This terminal is directly connected to a terminal 2 of a double pole double throw switch 3. If the switch is thrown to the left, connection will then be made from the terminal 1 to one side of a coupling condenser 4 for applying the marking and spacing elements of code signals directly to a so-called locking circuit. The locking circuit herein illustrated is substantially the same as is to be found fully described in U. S. Patent 1,844,950, granted February 16, 1932, to James L. Finch. When the switch 3 is thrown to the left, our keying bias adjuster is disconnected and a direct coupling will be made between the output of the keying device as applied to the terminal 1 and the input terminal of the locking circuit which is to be controlled by marking pulses of positive polarity and spacing pulses of negative polarity. Our improved keying bias adjuster is, therefore, utilized only when the D. P. D. T. switch is thrown to the right. In this case, the code signals are caused to be impressed upon the electrodes of a twin diode rectifier tube 5 in such a way that positive impulses will flow through the space path 6 while negative impulses will flow through the space path 7. When the tube 5 is activated each of the space paths 6 and 7 constitutes a unidirectional or asymmetrical conductor. The input circuit connections to the tube 5 include resistors 8. The output circuits from tube 5 include resistor 9 connecting a cathode to ground, and resistor 10 connecting an anode to ground. The anode space path 7 is also connected to one of the right-hand terminals of the switch 3 by means of a direct conductive connection, as shown, from the anode to the terminal.

The cathode which is related to the space path 6 of tube 5 is coupled through a capacitor 11 to an input circuit for one of two discharge devices

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herein shown, for example, as being comprehended in a twin triode tube 12. In place of this tube a tube or tubes of different type may be employed. The left-hand triode is labeled 13 and the right-hand triode is labeled 14. The input circuit for devices 13 extends from the grounded cathode through resistors 15 and 16 to the control grid. This grid is normally negatively biased by connection of the negative terminal of a power supply 17 through a resistor 18 to the junction between resistors 15 and 16. An intermediate point between the positive and negative terminals of the power supply 17 is grounded.

The triode discharge device 14 has its input circuit connected between the grounded cathode and resistors 19, 20 and 21 leading to the control grid. A slightly positive bias is normally applied to this grid, this bias being derived from the positive terminal of the power supply 17 which is connected through a resistor 22 to the junction between resistors 19 and 20.

The two anodes in tube 12 are supplied with anode potential from the power supply unit 17, connection being made from the positive supply unit terminal to said anodes through individual resistors 23. The two triode devices in tube 12 are inter-coupled in this manner: the anode for the discharge path 13 is coupled to the grid in the discharge path 14 across a capacitor 24. The anode for discharge path 14 is connected through a resistor 25 to the grid in discharge path 12.

With no marking signal input the space path 13 is biased to cut-off and the space path 14 is conductive, being normally biased slightly positive. This is the static condition of this trigger circuit.

At the front edge of the marking signal a triggering action is produced which renders the space path 13 conductive and blocks the space path 14. This condition, however, is transient and after a delay period which is determined by the time constant of the circuit including capacitor 24 and resistors 21, 20 and 19 the aforementioned static condition of the trigger circuit is restored. At this time the negative pulse produced by the reduction of anode potential in the space path 14 is differentiated by the circuit through capacitor 27 and resistor 26. A resultant surge impulse traverses a diode rectifier tube 28, the cathode of which is connected to the junction between capacitor 27 and resistor 26. The anode of tube 28 is coupled through capacitor 30 and one pole of the DPDT switch to an input circuit of the aforementioned Finch locking circuit comprising tubes 31 and 32. Resistors 26 and 29 interconnect the electrodes of tube 28 for enabling this tube to function.

The aforementioned Finch locking circuit comprises tubes 31 and 32 and their associated circuit connections which are composed for the most part of resistors. While tubes 31 and 32 are shown as pentodes they may if desired be simple triodes since the two grids nearest the anode have been connected to the anode. Indicating instruments 33 are provided for comparing the anode currents in the two tubes.

The locking circuit is so connected as to operate under two conditions of electrical stability. Only one tube draws current at any one time, except at the moment of transition between the two stable conditions. The reduced anode potential in tube 31, for example, when it is conductive, is reflected in a potential drop through resistors 34 and 35 such as to bias the grid in tube 32 to cutoff. Likewise, a reduced anode po-

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tential in tube 32 when it is conductive produces a potential drop through resistors 36 and 37 such as to bias the grid in tube 31 to cutoff. Anode potentials are supplied to these tubes through resistors 38 which are individual to each tube.

The output circuit for tube 32 has a connection thereto which includes resistors 39 and 40 connected between the anode and the negative terminal of source 17. The junction between resistors 39 and 40 is connected to a mid-tap on the secondary winding of a transformer 41. A tone frequency generator (not shown) is connected across the primary winding of transformer 41. The secondary terminals of this transformer are interconnected through two series-connected potentiometers 42. Taps on these potentiometers are directly connected to the control grids in a twin triode amplifier push-pull tube 43. The common cathode of this tube is grounded. The anodes are supplied with positive potential from the power supply source 17 through independent primary windings 44 on an output transformer 45. Tube 43 is a keying tube and the output of transformer 45 is an on-and-off keyed tone. The secondary winding of transformer 45 is connected to any suitable utilization circuit or load, and usually the output of keyed tone signals is sent over a wire line to an outlying radio transmitter station.

Mode of operation

When the switch 3 is thrown to the left both positive and negative signal elements are applied directly across capacitor 4 and resistor 37 for controlling the grid in tube 31. Positive impulses representing marking elements of the signals render tube 31 conductive while negative impulses block the tube. The interaction between tubes 31 and 32 is, however, such that transitions between the conductive and non-conductive states occur with great rapidity and the conductive state in one tube tends to increase the blocking bias in the other tube. Likewise, a blocking bias applied to the grid of one tube raises the anode potential in that tube in such manner that the cross connection to the grid of the other tube puts positive potential on the same and renders the controlled tube conductive. The initial voltage of any signal impulses coupled across the circuit 4, 37 results in a persistence of the control until that voltage is reversed in polarity.

Tube 32 is blocked in response to the application of a positive control pulse across capacitor 4, for rendering tube 31 conductive. For it is then that an increase of positive potential on the anode of tube 32 must develop a positive bias on the grids of tube 43. This tube is, therefore, keyed in such manner as to transfer an available tone frequency wave into the output circuit.

On the other hand, when tube 32 becomes conductive, as a result of blocking tube 31 by a negative impulse of spacing significance, the reduction of anode potential in tube 32 restores a negative bias to the grids of tube 43 and this tube becomes blocked so that no tone frequency wave can be passed through to the output circuit.

In the above explanation of operation it will be seen that the circuit arrangement including tubes 12 and 28 is not used so long as the switch 3 is thrown to the left. The ratio between time intervals occupied by marking and spacing intervals is, therefore, maintained in the keyed tone output circuit the same as in the signals as derived from the original source. Presumably, these signals are transmitted on the basis of 50

percent marking time and 50 percent spacing time.

The following description shows the mode of operation when the switch 3 is thrown to the right and when it is desired to clip the time intervals of the marking signal for the purpose of compensating for elongation of the marking signal elements as transmitted over a radio channel. The spacing elements of the signals are translated through the space path 7 in the twin diode tube 5 and they alone are applied across capacitor 4 and resistor 37 to block the tube 31. Tube 32 is, therefore, rendered conductive in response to the application of negative space signals to the terminal 1. The conductive state in tube 32 causes tube 43 to be blocked as previously explained.

Positive impulses of marking significance are applied to the space path 6 in the tube 5, which drive its cathode positive. A positive surge impulse is then developed across capacitor 11 and resistors 16 and 15 to ground. The control grid in the triode space path 13 is then driven positive and this discharge device becomes conductive. Inter-action with the discharge device 14 produces an eventual blocking action in the latter. After a certain delay period which results from the time constant value of the series circuit including capacitor 24 and resistors 21, 20 and 19, discharge device 14 again becomes conductive, which is its normal state due to the positive bias at the junction between resistors 19 and 22.

Commencing at the moment of transition in device 14 from a non-conductive to a conductive state, capacitor 27 discharges and develops momentarily a negative bias in the diode tube 28. This condition is reflected in a surge impulse of negative polarity across capacitor 30, through switch 3 and resistor 35 to the negative terminal of the power supply source 17. The result of this action is to bias the grid in tube 32 negatively so that this tube becomes blocked. The rise of anode potential in tube 32 then develops a positive bias on the grids of tube 43 and it is at this moment that the delay period terminates and the remainder of the marking impulse time is utilized for keying the tone frequency wave as output from the tube 43 with marking significance. The duration of the rectified surge impulse through tube 28 is preferably made shorter than the shortest element, or dot, of the marking signals because the locking action between tubes 31 and 32 is such as to maintain persistence of the stable state of conductivity in tube 31 and a blocked condition in tube 32 until the commencement of the next spacing signal of negative value which is applied across capacitor 4 for blocking tube 31.

It will be observed from the above description that by adjusting the value of the time constant circuit including capacitor 24 and the resistive impedances in series therewith that we may clip the time intervals of the marking signal elements as much or as little as may be required for introducing compensation for the observed elongation of the marking elements in transit over a radio path. In practice it has been found that the starting time of the marking signal element as delivered to the transmitter may be delayed anywhere from 150 to 3,000 microseconds in order to meet the prevailing conditions of radio transmission over commercial circuits. Such delays are suitable for example when working at a speed of from 250 words per minute up to 500 words per minute. Tests have proven, however, that our signal weight adjuster can be practically applied

under conditions of keying at a speed of 1,000 words per minute, or a Morse keying speed of 400 cycles per second. But the invention may be found operable at even greater speeds.

In the foregoing description we have not specified any particular values to be selected for the various components of the circuit for the reason that different operating conditions may dictate a wide range of values departing from those which we have found practical in a typical instance. Nevertheless, for a fuller understanding of a practical embodiment of the circuit which has been tested and found dependable, it may be of interest to note that we employed a power supply source delivering 250 to 270 volts of positive potential with respect to ground and -90 volts for the negatively biased terminal with respect to ground. Suitable resistors were used so that the junction between resistors 19 and 22 was normally maintained at +3 volts. The voltage at the junction between resistors 16 and 18 was adjusted to substantially -55 volts. The capacitor 24 had a value of .002 mfd. Resistor 19 had a value of 10,000 ohms, resistor 20, 25,000 ohms, and the potentiometer 21 could be varied from 0 to 500,000 ohms. Capacitor 27 had a value of .001 mfd. and resistor 26 had a value of 5 megohms. The values of other components were suitably chosen in accordance with well known radio circuit practice.

It will be understood by those skilled in the art that various modifications may be made in the circuit arrangement as well as in the components therein, so that with such changes there would be no departure from the spirit and scope of the invention itself.

We claim:

1. A keying bias adjuster for use in code signaling, comprising a circuit arrangement having a unidirectional conductor for signals of one polarity, means coupled to the output side of said conductor for producing a delayed response to said signals, a second unidirectional conductor which accepts signals of the opposite polarity, a locking circuit having two mutually interacting discharge devices and separate input and output circuits for the respective devices, means coupling one of said input circuits directly to the output side of said second unidirectional conductor, and means for controlling the other of said input circuits by signals traversing said delayed response producing means.

2. A keying bias adjuster as defined by claim 1 in combination with a push-pull amplifier having input circuits receptive of a modulation frequency wave, and means for keying the operation of said amplifier on and off by signals fed through said locking circuit.

3. A keying bias adjuster as defined by claim 1 in combination with switching means settable in one position to provide control of said locking circuit with delayed action in response to signals of said one polarity, and settable in another position for causing signals of both polarities to bypass the unidirectional conductors and to be applied to one only of the input circuits of said locking circuit, thereby to eliminate said delayed action.

4. In a telegraph keying apparatus, a differentiating circuit having delay action, a unidirectional conductor for feeding signal potentials from a given source through said circuit, an oppositely poled unidirectional conductor coupled to said source, and a locking circuit including a pair of discharge devices and interacting

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control circuits therefor which constitute means for substantially limiting the conductive period in each device to a non-conductive period in the other device, one of said devices being subject to control by signal pulses derived from said differentiating circuit, and the other of said devices having its control circuit directly coupled to the output side of said oppositely poled unidirectional conductor.

5. A keying bias adjuster comprising two unidirectional conductors poled in mutual opposition, a locking circuit of the type having two electron discharge devices the control electrodes and anodes of which are so interconnected through resistive impedances as to maintain alternative conditions of electrical stability, the control electrode in one of said devices being coupled to a particular one of said unidirectional conductors, and means in circuit between the other of said unidirectional conductors and the control electrode in the other of said devices for delaying the response to applied signal pulses.

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6. A keying bias adjuster according to claim 5 in combination with an on-and-off keying circuit to which a tone frequency wave is applied, said keying circuit being subject to control by output pulses derived from said locking circuit.

7. A keying bias adjuster according to claim 5 and including variable means for determining the duration of the delay period of said delaying means in accordance with the compensation required for balanced reception of marking and spacing signal elements.

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