

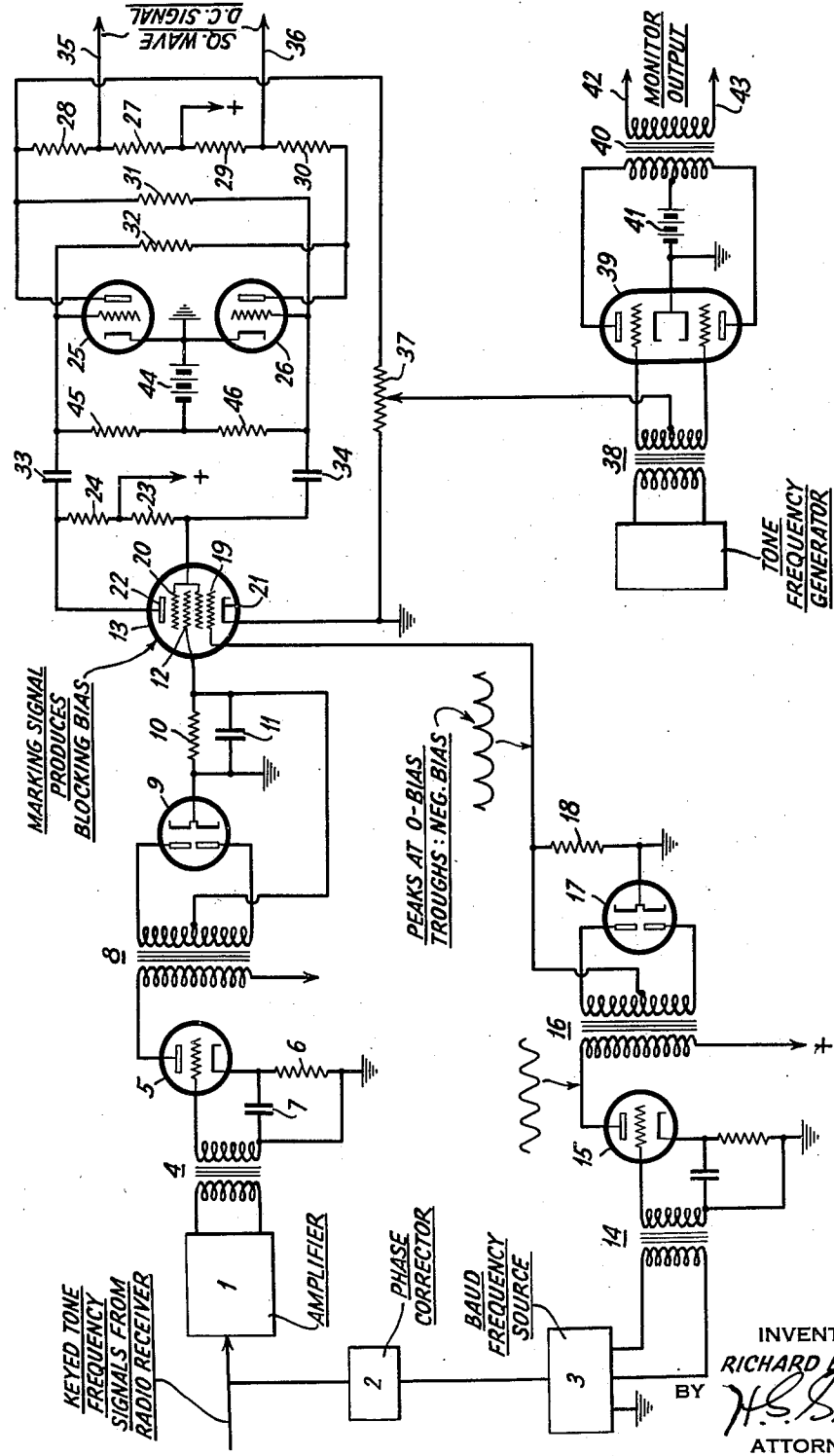
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TELEGRAPH SIGNAL REGENERATOR

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TELEGRAPH SIGNAL REGENERATOR

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This invention relates to a telegraph signal regenerator and more particularly to an electronic system for regenerating synchronous signals which may have been deformed in traveling through the conducting medium from the transmitter to the receiver.

It is an object of my invention to provide a regenerator which is simple in construction, easy to maintain, and which requires a minimum number of parts.

It is a more specific object of my invention to provide a regenerator which eliminates, insofar as possible, mechanical commutation means, and which provides dependable regeneration of the received telegraph signals.

It is a still further object of my invention to provide a regenerator which depends for its operation upon properly timed locally generated impulses, these impulses being coordinated with the received signals for controlling a so-called locking circuit of more or less conventional type.

I am aware of the fact that other inventors have developed signal regenerative means which are electronic in action and which are suitable for reshaping telegraph signals. However, in carrying out my invention I have found it possible to greatly simplify the circuit arrangements heretofore known and to provide a simple, rugged and reliable device with no moving parts and the least possible variation in its operating characteristics.

In carrying out my invention I provide means dependent upon the normal rate of reception of the signalling elements for controlling a low frequency generator the periodicity of which is preferably one half that of the signalling bauds. The output of this generator is held in synchronism by means well known in the art. Such means, for example, may be of the type known and described in my Patent #2,212,447. In that patent I showed a synchronous corrector applicable to a receiving distributor for a multiplex telegraph system. Such a corrector may, however, be employed for maintaining the frequency and phase of the herein shown baud frequency source so that it will be synchronized with the mean frequency of reception of the marking signal peaks.

More recent improvements in phase correctors are shown in United States Patents 2,258,151 and 2,258,152, both granted to Shenk. Shenk also teaches how to maintain an oscillator correctly phased in respect to a train of incoming telegraph signals with which it is to be synchronized.

Various types of low frequency generators may, of course, be employed. For example, it is pos-

sible to use a tuning fork vibrator; or one may adopt an electronic oscillator in combination with a frequency divider, or any other means for enabling the oscillator to develop an output to which the baud frequency is harmonically related.

As will be seen from a more detailed description of the invention, the incoming signals to be reshaped are first rectified and then impressed upon one of two control grids of a suitable multi-electrode tube for blocking the electronic emission to the anode of this tube during the presence of a marking signal. Another control grid in this tube has impressed thereon a periodic zero bias which is sharply peaked by virtue of rectification of the output from the baud frequency source. The troughs of the control waves between these peaks maintain a negative bias so as to block the tube completely.

The output from the aforementioned tube is used to control a locking circuit which is preferably designed more or less in accordance with the teachings of J. L. Finch, whose U. S. Patent #1,948,103 will illustrate a device of that type.

Other features of the invention will now be explained in more detail, reference being made to the accompanying drawing the sole figure of which represents a preferred circuit arrangement for carrying out my invention.

In the drawing I show an amplifier 1 the input side of which is fed from any suitable radio receiver by which incoming telegraph signals may be sensed. These signals are also impressed upon a phase corrector 2 the function of which is to maintain a suitable fixed phase relation between moments intermediate the front and back edges of the marking signals and the occurrence of output peaks from the baud frequency source 3.

The amplified signals are fed to a transformer 4 which includes a secondary winding connected between the cathode and the control grid of a discharge tube 5. The input circuit also includes a grounded cathode resistor 6, and a shunt capacitor 7.

In practice the received signal is usually tone-modulated. Accordingly the tone frequency appears in the output from the tube 5 at high amplitude during a marking signal and at negligible or zero amplitude during a spacing signal.

The output circuit of the discharge tube 5 includes the primary winding of a transformer 8. The terminals of the secondary of this transformer are connected respectively to anodes of a diode rectifier tube 9. The secondary of transformer 8 is also center-tapped and connected to

the cathode of tube 9 through a cathode resistor 10. This resistor is shunted by a capacitor 11. The cathode is preferably grounded.

The rectified and filtered signal is then applied across resistor 10 to the second control grid 12 of a mixer tube 13.

The baud frequency source 3 produces a sine wave which is applied across transformer 14 to the grid of an amplifier tube 15. This sine wave is then impressed across a transformer 16 and to a diode rectifier 17 whose anodes are respectively connected to the terminals of the secondary winding on transformer 16. The cathode of this rectifier tube 17 is preferably grounded and is connected through a resistor 18 to a center tap on the secondary of transformer 16.

The output from the rectifier 17 develops sharply peaked voltages across the resistor 18 so that these peaks result in impressing a zero bias on the first control grid 19 of the mixer tube 13. The troughs of the wave developed in resistor 18 produce a negative bias on the grid 19. The peaks are periodic and appear equal to the keying speed; that is, the baud frequency of the received signal.

During signal marking time the current through the rectifier 9 causes the second grid 12 to block current to the anode of the mixer tube 13. However, the sharply peaked pulses from the rectifier 17 permit transient currents to pass to the screen 20. It will be seen, therefore, that at times the screen 20 may draw current when the anode of the tube 13 does not draw appreciable current. At other times the anode can be made to draw substantially twice as much current as the screen by virtue of a zero bias impressed upon the grid 12, while the grid 19 is also at zero bias. The circuits to be controlled under these different conditions will now be described.

The mixer tube 13 has a grounded cathode 21 and an anode 22 which is fed with a suitable positive potential as indicated by the plus sign of a conductor leading to a junction point between two resistors 23 and 24. Resistor 24 is in the anode circuit, while resistor 23 is in the screen grid circuit.

A locking circuit is shown comprising two discharge tubes 25 and 26. These tubes may be triodes, if desired, or, optionally, tubes of any other suitable type. As shown, the cathodes of these tubes 25 and 26 are grounded and their grids are negatively biased by virtue of the source 44 feeding through resistors 45 and 46 to their respective grids. The anodes of the tubes 25 and 26 are fed with a suitable positive potential with respect to the grounded cathodes, this potential being applied through resistors 27 and 28 to the anode of tube 25, also through resistors 29 and 30 to the anode of tube 26.

A resistor 31 forms a connection between the anode of tube 25 and the control grid of tube 26. Similarly a resistor 32 forms a connection between the anode of tube 26 and the grid of tube 25.

The tubes 25 and 26 operate substantially in accordance with conventional locking circuits of which the aforementioned Finch Patent #1,948,103 gives a typical example. The rectified signal applied to grid 12 is merely a conditioner and all action of the mixer tube 13 in its effect on the tubes 25 and 26 is timed by the occurrence of the zero bias peaks on grid 19 which derive from the rectifier 17.

When the tube 13 is blocked by marking signal impressed on grid 12 the peaks applied to 19 will cause no current to flow in anode 22 but will

cause the current pulses to flow in screen grid 20. These pulses cause a momentary voltage drop in resistor 23, which, in turn, is applied through condenser 34 as a negative pulse on the grid of tube 26. This causes a diminishing of the plate current, and, therefore, an increase in the plate potential of tube 26. This increased plate potential is applied to grid of 25 through the voltage divider action of resistors 32 and 45. This in turn causes an increase in the plate current of tube 25 and a decrease in the plate potential, which, in turn, is applied through the voltage divider action of resistors 31 and 46 to further reduce the grid potential on tube 26. This action is continued until the complete blocking of 26 is obtained by virtue of the locking circuit action. Because tube 26 is completely blocked, subsequent current pulses through screen grid 20 of tube 13 will have no effect so long as the marking condition of the received signal persists.

If at some time between successive zero bias pulses from tube 17 the received signal changes from mark to space, then grid 12 will permit these subsequent pulses to appear as current in anode 22. The amount of current drawn by screen grid 20 on these subsequent pulses will also be decreased over the current drawn during the prior pulses. The result of this is that although negative pulses are still applied through condenser 34 to grid of tube 26 they are more feeble than previously, while, at the same time, negative pulses are applied through condenser 33 to grid of tube 25. By virtue of the usual locking circuit action the state will thereby be reversed and will become tube 25 blocking and tube 26 passing.

The relative values of the voltages and resistances as used in the locking circuit arrangement just now described are so chosen that either of two stable conditions will be insured such that one tube is always conductive while the other tube is blocked. In other words, the arrangement for controlling the tubes 25 and 26 is, as the name implies, a locking circuit arrangement. Whichever one of the resistor pairs 27—28 or 29—30 develops the greater voltage drop compared with the other, that condition determines which of the two tubes 25 or 26 shall be rendered conductive while the other is blocked.

An important consideration governing the accuracy of timing of the square wave output from the anode circuits of the tubes 25 and 26 is based upon the cooperative action between the two grids 12 and 19 in the mixer tube 13. It should be remembered, therefore, that the grid 19 is intermittently controlled in accordance with a dependable baud frequency source 3. Aberrations from the normal times of the received signal changing from marking to spacing impulses and vice versa have no effect upon the timing of the front and back edges of the square wave of output the locking circuit.

In order to utilize the square wave D. C. signal which is delivered by the tubes 25 and 26, I preferably connect a utilization device to points intermediate between the resistors 27 and 28, on the one hand, and between resistors 29 and 30, on the other hand. It will be clearly understood by those skilled in the art that, due to variations in the over-all voltage drop through resistors 27 and 28 in comparison with that through resistors 29 and 30, the terminal 35 will be either positively or negatively biased with respect to terminal 36.

In order to monitor the output from the locking circuit by an auxiliary means I preferably connect the anode of tube 25 through a voltage divider 27

to ground. An intermediate tap on the voltage divider 37 is then connected to a mid-tap on the secondary winding of a transformer. The secondary terminals of this transformer are connected respectively to two grids in a duplex triode amplifier tube 39. The anodes of this tube are connected respectively to the terminals of a transformer primary while the transformer itself is indicated at 40. A mid-tap on this transformer primary is fed with positive anode potential from the source 41, the negative terminal of which is connected to the cathode of tube 39.

The transformer 38 is used to impress a tone frequency from any suitable source 42 on the grids of the tube 39. This tone frequency may be sensed in any monitoring device to which the output leads 43 may be connected. Thus the tone frequency will be applied to the monitoring device during the marking signal times, as when the grids of the tube 39 are positively biased by the marking signals.

Various modifications of my invention will suggest themselves to those skilled in the art in view of the foregoing disclosure. The scope of the invention is, therefore, limited only in accordance with the claims.

I claim:

1. In a telegraph signal regenerator, a locking circuit for keying the marking impulses of a signal train, a source of oscillations having a frequency to which the baud frequency of the impulses of said signal train is harmonically related, a phase corrector responsive to said impulses for maintaining a suitable phase relation between the output peaks of said oscillation source and the baud centers which are determined by said impulses, two rectifiers one of which is subject to control by said signal impulses and the other of which is fed with energy from said source of oscillations, a multi-electrode discharge tube including a cathode, an anode, first and second control grids, and screening electrodes which intervene between the two said control grids, also between the second control grid and the anode, means for causing sharply peaked rectified impulses from said oscillation source to be applied to the first said control grid thereby to unblock the discharge path in said tube as far as the first screening electrode, means interconnecting the signal-controlled rectifier with the second control grid for unblocking the discharge path in said tube between the screening electrodes and the anode during spaces between the marking elements of said signal train, means for shifting said locking circuit from a first to a second state of electrical stability in response to the unblocking of said tube only as far as the screening electrodes, and means for shifting said locking circuit from the second to the first state of electrical stability in response to the complete unblocking of said tube from cathode to anode.

2. The combination according to claim 1 and including in the last two stated means resistors which are disposed, in the first case, between the screening electrodes of said tube and a source of direct current potential negatively connected to the cathode of said tube; and, in the second case, between the anode of said tube and said source of direct current potential, and means including resistive and capacitive input circuit connections to said locking circuit whereby it is caused to be shifted from each state of electrical stability to the other.

3. In the art of telegraph signal regeneration by means of a local baud frequency source, a pair

of rectifiers, a multi-grid discharge tube and a locking circuit having two states of electrical stability for delivering a square wave output signal representing marking and spacing elements of a message code, said marking and spacing elements being of baud-unit length and multiples thereof, the method which comprises adjusting a predetermined phase of said baud frequency source in accordance with the normal centers of the marking elements of baud unit length, separately rectifying the energy of said marking elements and the energy of said baud frequency source, causing a first grid of said discharge tube to be controlled by sharp zero-bias peaks and negative troughs derived from the rectification of energy from said baud frequency source, causing a third grid of said discharge tube to be fed with a blocking bias potential derived from the rectification of energy from said marking elements, causing said third grid to receive a zero-bias with respect to the cathode during spacing elements, causing a second grid to screen the third grid and a fourth grid to screen the anode from electronic emission in said tube, causing one of said states of electrical stability to be assumed by said locking circuit when a sharply peaked unblocking bias is delivered by the rectified energy from said baud frequency source after conditioning the bias on the third grid to a zero value in the presence of a spacing signal, and causing the other of said states of electrical stability to be assumed when a similar sharply peaked unblocking bias is delivered from said baud frequency source after conditioning the bias on the third grid to a cut-off value in the presence of a marking signal.

4. A telegraph signal regenerator comprising a rectifier operable in response to the impress thereon of marking signal potentials, a multi-grid discharge tube adapted to draw anode current in response to the removal of blocking biases from certain two of its grids, means for deriving one of said blocking biases from the action of said rectifier, a sharply peaked baud frequency source for supplying the other of said blocking biases in the sense that the sharp energy peaks from said source produce a zero-bias on that one of said grids which is connected thereto, means for synchronizing said source with the baud frequency of said signal potentials, a source of anode and screen grid potential connecting the cathode of said tube through resistive elements to the anode of said tube and to certain grids thereof other than those subject to a blocking bias, a locking circuit having two states of electrical stability, means for producing one of said states in response to the unblocking of said tube so as to draw anode current, and means for producing the other of said states in response to the partial unblocking of said tube so as to draw screen grid current to the substantial exclusion of anode current.

5. A telegraphs signal regenerator according to claim 4 in combination with a tone frequency generator for modulating a square wave output from said locking circuit.

6. A signal regenerator comprising a source of telegraph signals, a local source of alternating current the frequency of which is proportionate to the baud frequency of said signals, means for correcting the phase of said source in accordance with the baud frequency of said signals, means for rectifying said alternating current and for deriving therefrom pulses of

sharp discontinuity, a keying device having two states of stability, and means including a discharge tube of the mixer type having at least four electrodes, of which separate grids are separately controlled by said telegraph signals and by the sharp peaks of said pulses respectively, for so influencing said keying means as to shift the same from one to the other of said states of stability in the presence of a marking signal, and in the opposite direction in the presence of a spacing signal.

7. A telegraph signal regenerator comprising a locking circuit having two states of electrical stability, a control device for said locking circuit constituted by a discharge tube having a cathode, an anode, a first control grid, a second control grid and at least two interconnected screen grids, a source of baud frequency impulses for producing a blocking bias on said first control grid, said source being sharply peaked in a direction to minimize the times of application of an unblocking bias to said grid, means for synchronizing said impulses with a mean of baud centers as defined by a received train of marking signals, means for causing said marking signals to apply a blocking bias to said second control grid, means operative when the first grid alone is unblocked by said source for causing said tube to draw screen grid current in excess of anode current and thereby to establish one of said states of electrical stability in said locking circuit, and means operative in the absence of a marking signal and when the unblocking of both control grids enables said tube to draw anode current, for establishing the other of said states of electrical stability in said locking circuit.

8. In a signal regenerator of the type which shifts a keying device from one to another of two states of electrical stability, where each shift is accomplished substantially at one of the normal baud centers of the incoming signals, a discharge tube for controlling said keying device, said tube having a cathode, an anode, and a plurality of grids including two control grids, means for rectifying energy derived from the incoming signals, means for applying a blocking bias to one of said control grids in response to the rectification of a marking signal, a source of baud frequency oscillations, means for correcting the phase of said source in accordance with the baud frequency of the incoming signals, means, including a rectifier, for producing a train of sharply peaked impulses at baud frequency as a derivative from said source, and means for maintaining a cut-off bias on the other of said control grids in the presence of the wave troughs between said sharply peaked impulses, whereby said discharge tube is caused to shift the electrical stability states of said keying device only at the sharp peaks of said impulse train.

9. The combination according to claim 8 wherein said discharge tube possesses a screen grid connected through a resistor to an anode potential source, and said tube functions in such manner that in the presence of a marking signal electrons are collected predominantly by said screen grid, whereas in the presence of a spacing signal electrons are collected predominantly by said anode.

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