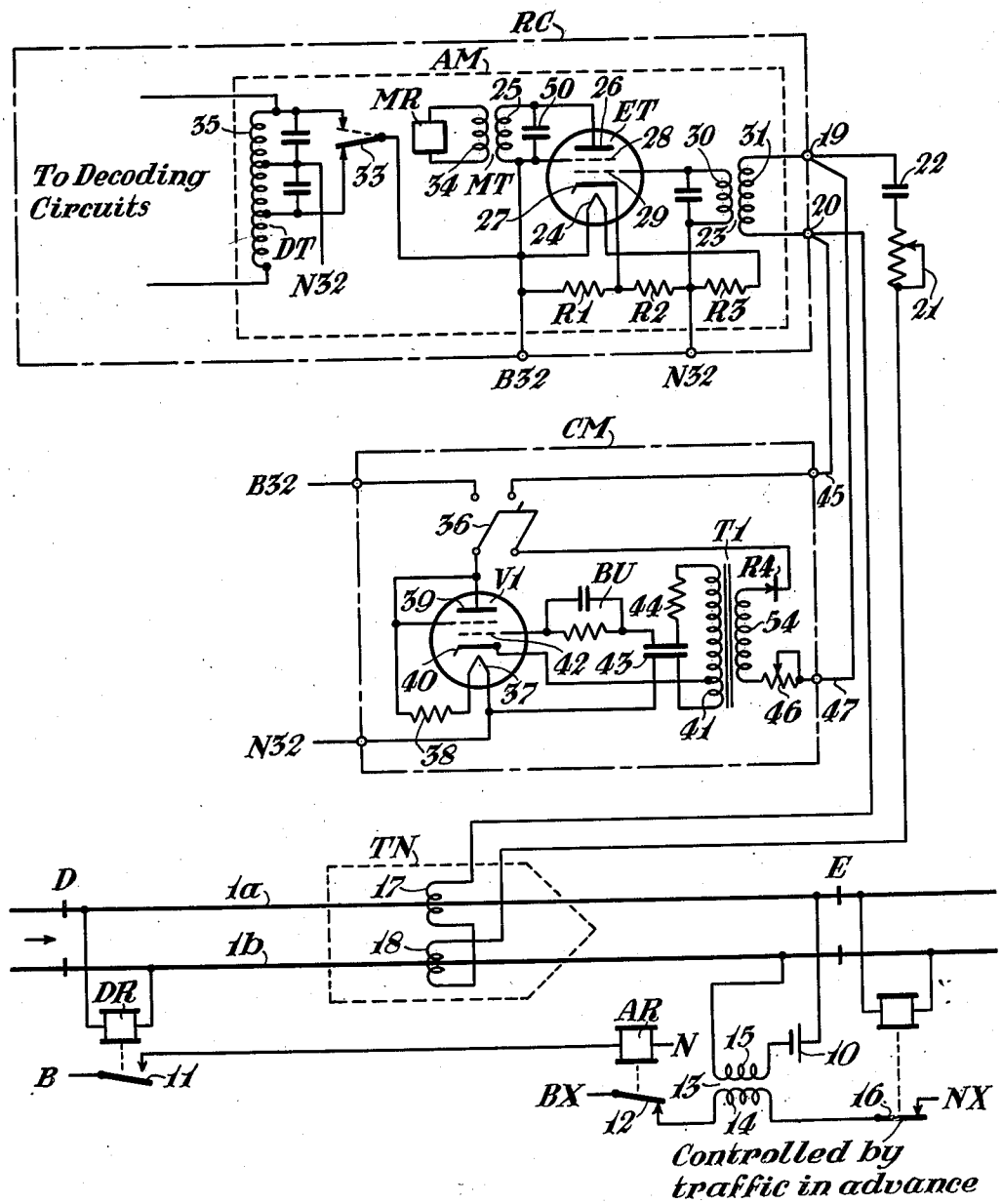
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ELECTRONIC CODING MEANS FOR SIGNALING SYSTEMS

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Controlled by traffic in advance

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ELECTRONIC CODING MEANS FOR SIGNALING SYSTEMS

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My invention relates to electronic coding means for signaling systems and particularly to electronic coding means for signaling systems using coded alternating current.

There are many forms of signaling systems that use coded alternating current. For example, railway train control systems generally use receiving apparatus that is selectively responsive to alternating current periodically varied at different code rates. Receiving apparatus, commonly called a receiver, of this type of a train control system is shown in Letters Patent of the United States No. 2,462,454, granted on February 22, 1949, to Leslie R. Allison for Train Carried Cab Signal Apparatus. There is also a type of train control system in which the receivers respond to noncoded alternating current, such a receiver being shown in Letters Patent of the United States No. 2,269,239, granted January 6, 1942, to Leslie R. Allison, for Railway Traffic Controlling Apparatus.

These train control systems make use of track circuits which are provided with means for supplying to the rails at the exit end of the track section alternating current according to traffic conditions in advance of the track section. Inductors are mounted on the locomotive or train for inductive relation with the rails and an electromotive force having the characteristics of the rail current is induced in the inductors as the locomotive moves through the track section. The electromotive forces picked up by the train carried inductors are applied to the receiver for the operation thereof. Some railroads may have divisions on which a train control and cab signal system using coded alternating current is installed and other divisions on which a system using noncoded alternating current is installed. Heretofore, a locomotive of such a railroad must be equipped with both forms of receivers if the locomotive is to be operated over the different divisions and the cab signals used. Again, a railroad having a cab signal and train control installation in which noncoded alternating current is used may find it desirable to convert such an installation to a system using coded alternating current. The conversion of such an installation may require some period of time and during the conversion period the locomotives must be equipped with both the old and the new forms of receivers if cab signal protection is to be obtained during the conversion period.

Furthermore, many railroads using coded alternating current for the control of wayside and/or cab signals provide coding means for each

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track section to code the alternating current supplied to the track rails, the coding means or code transmitter having moving contacts which periodically interrupt the current at different predetermined code rates.

In view of the foregoing circumstances, a main object of my invention is the provision of electronic coding means having no moving parts for signaling systems using coded alternating current.

Another feature of my invention is the provision of coding means or code modulators that can be mounted with a receiver responsive to coded energy to operate the receiver when it is being supplied with noncoded energy.

Still another feature of my invention is the provision of an electronic coding means of the type here involved which is small and compact so that it can be installed in the standard equipment box provided for housing the usual code responsive receiver.

Other features, objects and advantages of my invention will appear as the specification progresses.

In order to obtain the foregoing objects, features and advantages of my invention, I provide an electron tube oscillator capable of supplying a sinusoidal voltage having the frequency of the code rate or a selected one of the code rates with which an associated receiver responds together with a rectifier or asymmetric unit. This voltage of the oscillator is impressed upon the circuit to which the alternating current energy is supplied through the rectifier. For one half cycle of the oscillator voltage the rectifier or asymmetric unit will not conduct and there is substantially no effect on the alternating current being supplied to the signaling circuit. During the other half cycle of the oscillator voltage the associated asymmetric unit conducts and the path through the oscillator output and the asymmetric unit forms a low impedance path for the alternating signaling current and it in effect shunts the alternating signaling current. In other words the oscillator is a low impedance source connected in multiple with a high impedance signaling source with the result the signaling circuit connected to receive the signaling current is in effect short-circuited at a code rate corresponding to the frequency of the oscillator.

I shall describe one form of apparatus embodying my invention and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of electronic coding means embodying my invention when used with

a train control system that is provided with receivers responsive to coded alternating current and which coding means is here shown as mounted on a train with the receiver for code operation of the receiver when the locomotive on which the receiver is mounted is operated over a track circuit supplied with noncoded alternating current.

It is to be understood that my invention is not limited in its use to train carried apparatus and this one application illustrates the principle of the apparatus, there being many other places where the apparatus is useful.

Referring to the drawing, the reference characters 1*a* and 1*b* designate the track rails of a railroad over which traffic normally moves in the direction indicated by an arrow, and which rails are formed by the usual insulated rail joints with a track section D—E. This section D—E would be one section of a series of track sections of a signal system. The track section D—E is provided with a track circuit which as here shown includes a direct current track relay DR connected across the rails at the entrance end of the section and a track battery 10 connected across the rails at the exit end of the section. It follows that when the section D—E is unoccupied, that is, when a train, shown conventionally at TN is not present in the section, the track relay DR is energized by the current supplied to the rails by battery 10 but that when the train TN occupies the section so that its wheels and axles shunt the rails, the relay DR is deenerized and released. The relay DR would be used to control signal and other circuits in any of the well-known arrangements but which signal circuits are not shown for the sake of simplicity since they form no part of my present invention.

In the drawing the track relay DR also governs a line circuit for an approach relay AR located at the exit end of the section, the arrangement being such that when the relay DR is energized closing its front contact 11, the line circuit is closed and the approach relay AR is energized by current supplied to the line circuit from a source, the terminals of which are indicated at B and N. When a train enters the section D—E shunting the track relay DR, the relay is released opening its front contact 11 to interrupt the line circuit and the approach relay AR is deenergized and released closing its back contact 12.

The track circuit for the section D—E is also provided with a source of alternating current and alternating current is at times superimposed on the direct current supplied to the track rails and which alternating current is available for control of cab signal apparatus. A track transformer 13 is provided with a primary winding 14 and a secondary winding 15. The primary winding 14 is connected to a source of alternating current, the terminals of which are indicated at BX and NX. Specifically, the connection for the primary winding 14 extends from terminal BX of the alternating current source through back contact 12 of the approach relay AR, primary winding 14 and a traffic controlled contact 16 of a track relay for the section next in advance, to terminal NX. The secondary winding 15 of the track transformer 13 is interposed in series with the connection of battery 10 to the track rails. Consequently, when the approach relay AR is released closing back contact 12 and the traffic conditions in advance of the section D—E are such that the contact 16 is closed, the primary winding 14 is energized and alternating current is supplied from the secondary winding 15 of the track transformer to the track rails of the section D—E. The alternating current source BX—NX may be of the commercial frequency of 60 cycles per second or it may be a special frequency of the order of 80 or 100 cycles per second, which is often used in cab signal systems. It is to be understood that the invention is not limited to these frequencies and other frequencies can be used.

The train TN is equipped with cab signal and train control apparatus which includes as essential elements a pair of inductors 17 and 18, a receiver RC and a coding means or code modulator CM. The inductors 17 and 18 are mounted on the train ahead of the leading pair of wheels and in inductive relation with the rails. Thus, an electromotive force is induced in each of the inductors due to the alternating current supplied to the rails through the track transformer 13. The electromotive force thus induced in the inductors is of a value proportional to the magnitude of the alternating current flowing in the rails and it has the same frequency and characteristics as the rail current.

The two inductors 17 and 18 are connected in series for adding their electromotive forces when the alternating current flowing in the track rails flows in the rails in opposite directions at any given instant. The inductors 17 and 18 are connected across the input terminals 19 and 20 of the receiver RC, the connection to the terminal 19 including a limiting resistor 21 and a tuning capacitor 22. Thus the inductors 17 and 18 serve as a source of alternating signaling current for the receiver RC due to the electromotive force induced therein by the alternating current flowing in the track rails.

The receiver RC which is indicated as a whole by the dot and dash rectangle, may be any one of several different forms of receivers which are selectively responsive to coded alternating current and, as stated hereinbefore, this receiver may be similar to that shown in the Allison Patent No. 2,462,454. Such receivers will include an amplifier unit which in the drawing is indicated as a whole by the dotted rectangle AM. This amplifier unit includes an input transformer 23, an electron tube ET, an output or master transformer MT, a code following relay MR and a decoding transformer DT. The receiver RC is supplied with power from a convenient train carried source, the terminals of which are indicated at B32 and N32, the terminal B32 being the positive terminal. The train carried source would usually be the 32 volt direct current train lighting generator or battery but other sources of power may be used. A voltage divider comprising resistors R1 and R2 in series is connected across the power source to provide the different voltages required for the amplifier unit AM.

The tube ET is shown as an indirectly heated tetrode which is designed for operation from a 32 volt source of direct current, but other types of tubes can be used. A heater 24 is connected across the power source through a resistor R3 and the tube ET is constantly heated. An anode-cathode circuit for the tube is formed from the positive terminal B32 through a primary winding 25 of the master transformer MT, anode 26 and tube space to cathode 27 and thence to the junction terminal of the two resistors R1 and R2 of the voltage divider. The screen grid 28 of the

tube ET is connected to the high voltage side of the voltage divider and preferably the primary winding 25 of the master transformer MT is provided with a by-pass capacitor 50. The control grid 29 of the tube is connected to the negative terminal N32 through secondary winding 30 of the input transformer 23, this connection for the control grid completing a control grid-cathode circuit in which the control grid is biased negative in potential with respect to the cathode by the voltage drop of the resistor R2 of the voltage divider. A primary winding 31 of the input transformer 23 is connected across the input terminals 19 and 20 of the receiver, and the circuit formed with the inductors 17 and 18 is tuned to resonance at the frequency of the alternating rail current by capacitor 22.

Since the screen grid 28 is provided with a positive potential with respect to the cathode equal to the voltage drop of resistor R1 and the control grid 29 is provided with a negative potential with respect to the cathode by the voltage drop of resistor R2, a given normal anode current flows in the anode circuit. The parts are preferably proportioned so that the anode current is substantially zero in the absence of any input or signal voltage applied to the input terminals 19 and 20. In other words, the tube ET is preferably normally biased to cutoff, that is, when no signal voltage is applied to the control grid.

The master relay MR is preferably a stick polar relay operated to reversibly actuate its polar armature 33 in response to electromotive forces of opposite polarity and of a given value. The winding of the relay MR is connected across the secondary winding 34 of the master transformer MT and the relay is operated in step with the impulses of electromotive force induced in the secondary winding 34 due to variations of the anode current flowing in the primary winding 25, the relay MR being operated to one position in response to an increase in the anode current and operated to its other position in response to a decrease in the anode current.

It will be understood that the invention is not limited to the condition where the tube ET is biased to cutoff and an adjustment of the tube can be used where the bias of the tube is such that a given value of anode current normally flows and the current is varied above and below this given value.

As here shown, the decoding transformer DT is an autotransformer having a portion of its winding 35 supplied with direct current from the B32—N32 source when the armature 33 of the master relay is operated to one of its positions and another portion of the winding 35 is supplied with direct current when the armature 33 is operated to its other position. It follows that an alternating electromotive force is developed across the winding 35 when the relay MR is operated, the frequency of the electromotive force corresponding to the rate at which the relay is operated. The alternating electromotive force thus developed in the decoding transformer is applied to decoding circuits selectively responsive to the different code frequencies of the electromotive force. The decoding circuits in turn selectively govern cab signals and other train control devices. These decoding circuits and their control of the cab signals are not shown since they form no part of my invention and a showing thereof is not required for a full understanding of the invention. These decoding circuits and their control of the cab signals may be similar to those shown in the aforementioned Allison Patent No. 2,462,454.

The coding means or code modulator of the invention is indicated as a whole by a dot and dash rectangle CM. The coding means CM includes an electron tube oscillator V1, a transformer T1 and a rectifier R4, together with a double pole single throw switch 36.

The electron tube V1 is shown as a tetrode but other forms of tubes can be used. When the switch 36 is closed the B32—N32 power source is connected to the heater 37 of the tube V1 through a resistor 38 and the tube is heated and made active. An anode circuit for the tube V1 extends from the terminal B32 through the closed position of the switch 36, anode 39 and tube space to cathode 40 and a portion of the winding 41 of the transformer T1, connection to one plate of a capacitor 43 and thence to the other terminal N32 of the power source. A control grid-cathode circuit for tube V1 is formed from control grid 42 through a biasing unit BU, connection to one plate of the tuning capacitor 43, a resistor 44, and the upper portion of winding 41 of the transformer T1 to the cathode 40.

The tuning capacitor 43 is connected across the winding 41 through the resistor 44 and the parts are so proportioned that oscillations are generated in the usual manner, the frequency of the oscillations being made to correspond to a given code rate to which the receiver RC responds. For a better understanding of the invention I shall assume that the receiver RC is operable to provide a clear cab signal when energized at a code rate of 180 cycles per minute or 3 cycles per second and that the oscillator V1 of the code modulator is proportioned to generate oscillations of 3 cycles per second.

The output of the oscillator includes a secondary winding 54 of transformer T1. The secondary winding 54 is connected across the input terminals 19 and 20 of the receiver RC by the upper terminal of the secondary winding 54 being connected to the input terminal 20 through rectifier R4, one blade of the switch 36 and wire 45, and the lower terminal of the secondary winding 54 being connected to the input terminal 19 through a resistor 46 and wire 47. It is to be pointed out that the resistor 46 may not be needed.

The asymmetric unit R4 is preferably a half wave rectifier element, such as a germanium crystal, a copper oxide rectifier or a selenium rectifier. Thus, the output of the oscillator V1 is connected across the input terminals 19 and 20 of the receiver RC in series with the asymmetric unit R4 and in multiple with the inductors 17 and 18 which form a source of noncoded alternating current due to the electromotive force induced therein by noncoded alternating rail current.

In describing the operation of the apparatus I shall assume that the switch 36 is closed so that the oscillator V1 is active and the output thereof is connected to the input terminals 19 and 20 of the receiver RC. It is to be recalled that the alternating voltage supplied by the inductors 17 and 18 is of the order of 100 cycles per second and that the frequency of the oscillator is of the order of 3 cycles per second. During one half cycle of the oscillator voltage, that is, for the half cycle that the lower terminal of the secondary winding 54 as viewed in the

drawing is the positive terminal, the rectifier unit R4 is nonconductive thereto. During this half cycle period of the oscillator, one half cycle of the 100 cycle signaling current is blocked out from the path through the oscillator output winding 54 by the rectifier R4 and during the other half cycle of the signaling current the oscillator voltage opposes the flow of the signaling energy through the winding 54. Thus the 100 cycle alternating current supplied to the input winding 31 of the receiver is little attenuated during the half cycle of the oscillator the rectifier R4 is blocking. During the half cycle of the oscillator voltage the top terminal of the winding 54 is the positive terminal the rectifier unit R4 is conductive thereof. The parts are proportioned so that the oscillator voltage is relatively high as compared with the signaling voltage as impressed upon the input terminals 19 and 20 of the receiver. Furthermore, the rectifier R4 is selected to be worked at a relatively high portion of its nonlinear characteristic. Consequently, the path through the oscillator winding 54 and the rectifier R4 substantially shunts both half cycles of the signaling voltage during the half cycle that the oscillator voltage is passed by the rectifier R4 and substantially no signaling voltage is supplied to the input winding 31 of the receiver RC. In other words, the oscillator V1 is a low impedance source connected in multiple with a high impedance source during this one half cycle of the oscillator voltage and the high impedance source comprising the inductors 17 and 18 is in effect short-circuited. The energy supplied from the oscillator to the receiver winding 31 is of such a low frequency that it has little or no effect on the amplifier AM which is tuned to the relatively high frequency signaling current.

It follows from the foregoing that the signaling voltage from the inductors 17 and 18 is supplied to the amplifier AM at substantially full value during one half cycle of the oscillator voltage and the signaling voltage is substantially shunted and reduced to substantially zero value during the other half cycle of this oscillator voltage. Consequently the signaling voltage as supplied to the amplifier of the receiver is coded by being periodically varied at the code rate of 180 times per minute or 3 times per second, that is, at a code rate corresponding to the frequency of the oscillator.

The net result of this action is that the receiver RC is energized at a code rate corresponding to the frequency of the oscillator, the code following relay MR is code operated at a rate corresponding to the frequency of the coding means in response to noncoded signaling current supplied by the inductors 17 and 18, and a clear signal indication or an indication corresponding to the frequency of the oscillator V1 is effected notwithstanding the fact that the signaling current supplied to the track circuit is noncoded.

It is to be observed that the tuning capacitor 43 of the oscillator is provided with four lead wires, two to each of its plates, and each plate is included in series in a circuit and an open circuit due to a defective plate of the capacitor will render the oscillator inoperative and the fault will be immediately detected by the receiver RC not being operated to provide a proper cab signal.

The coding means or code modulator here provided has the advantages that it has no moving parts, it is comparatively simple and of small construction so it can be mounted in the usual equipment box provided for housing an associated receiver. In practicing the invention I have found that the coding means here disclosed will provide satisfactory and reliable operation over a wide variation in temperature and also over a relatively wide variation in the voltage of the power source.

As stated hereinbefore, the electronic coding means here provided is not limited in its use to train carried apparatus. For example, it is apparent that the coding means could be used with the wayside apparatus to code the signaling current as it is supplied to the track circuit. Furthermore, while a half-wave rectifier is employed in the output of the oscillator, it is apparent that a so-called full-wave bridge type rectifier unit could be used in the output of the oscillator and the signaling current coded in a manner similar to that accomplished by the coding means here provided.

Although I have herein shown and described but one form of electronic coding means for signaling systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a signaling system, the combination comprising, a winding to be energized by an alternating current of a given frequency and coded by being periodically varied at a given code rate, a source of alternating current of said given frequency, a circuit to connect said source to said winding and including inductance and capacitance to tune the circuit to resonance at said given frequency, an oscillator generating an alternating voltage of a frequency equal to said code rate, a nonlinear device, another circuit to connect said oscillator and device in series to said winding in multiple with said source, and said another circuit varying the alternating current of said source supplied to said winding at a code rate equal to the frequency of the oscillator voltage due to said nonlinear device.

2. In a signaling system, the combination comprising, a circuit element to be energized by an alternating current of a given frequency and coded by being periodically varied at a given code rate, a source of alternating current of said given frequency, means to connect said source to said circuit element, coding means including an electron tube oscillator and a rectifier, said oscillator operable to generate oscillations of a frequency equal to said given code rate and having an output winding to which said oscillations are supplied, said output winding and said rectifier in series connected to said circuit element in multiple with said source, and said coding means substantially suppressing said alternating current during alternate half cycles of said oscillations due to said rectifier and thereby coding at said given code rate the energization of said circuit element by said alternating current.

3. In a signaling system, the combination comprising, a winding to be energized by an alternating current of a given frequency and coded by being periodically varied at a given code rate, a source of alternating current of said given frequency, a circuit to connect said source to said winding and including inductance and capacitance to tune the circuit to resonance at said given frequency, coding means including an elec-

tron tube oscillator and a rectifier, said oscillator operable to generate oscillations of a frequency equal to said given code rate and of a voltage relatively high compared to the voltage of said alternating current, said oscillator having an output winding to which said oscillations are supplied, and said output winding and said rectifier in series connected to said first-mentioned winding in multiple with said source, whereby said coding means substantially suppresses said alternating current during alternate half cycles of the oscillations due to their voltage and the nonlinear characteristic of said rectifier and the first-mentioned winding is energized by alternating current coded at said given code rate.

4. In combination, a winding, a source of alternating voltage of a relatively high frequency, circuit means to connect said source to said winding and including capacitance to tune the circuit to resonance at said high frequency, an oscillator generating an alternating voltage of a relatively low frequency, rectifying means, another circuit to connect said oscillator and rectifying means to said winding in multiple with said source, said another circuit in effect shunting said alternating voltage of high frequency away from said winding during the half cycle of the low frequency alternating voltage said rectifying means is conductive whereby the energy supplied to said winding is periodically varied at a code rate corresponding to said low frequency, and signalling means controlled by the coded energy thus supplied to said winding.

5. In combination, an input circuit, a source of alternating signaling voltage of a given frequency, circuit means to couple said source to said input circuit for supplying energy thereto, said circuit means including capacitance to tune the circuit means to resonance at said given frequency, an oscillator generating an alternating voltage of a frequency lower than said given frequency, a current rectifier, another circuit to connect said oscillator and said rectifier to said input circuit in multiple with said source, said another circuit in effect shunting said signaling voltage during the half cycle of the oscillator voltage said rectifier is conductive due to the nonlinear characteristic of the rectifier whereby the energy supplied to said input circuit by said source is periodically varied at a code rate determined by the frequency of said oscillator, and signaling means controlled by said input circuit responsive to said coding of the signaling voltage.

6. In combination, signaling means effectively responsive to alternating voltage which is coded by being periodically varied at a given code rate, a source of noncoded alternating voltage having connections to said signaling means for supplying energy thereto, said alternating voltage being of a frequency higher than said code rate, an oscillator generating oscillations of a frequency equal to said given code rate, an asymmetric device, and means to connect said oscillator and said device to said signaling means in such a manner as to effectively shunt said source of alternating voltage on alternate half cycles of said oscillations.

7. In combination, a receiver including an amplifier and a relay operable in response to an alternating voltage of a given frequency and coded at a given code rate, said receiver having an input circuit tuned to resonance at said given frequency, a source of alternating current of said given frequency having connections for supplying its energy to said input circuit, coding means including an electron tube oscillator generating an alternating voltage of a frequency equal to said given code rate and having an output winding to which said oscillator voltage is supplied, a rectifier, another circuit including said output winding and rectifier connected to said receiver input circuit, and said another circuit in effect suppressing the alternating voltage of said source supplied to said input circuit during alternate half cycles of said oscillator voltage due to said rectifier and thereby coding the energy supplied to said input circuit at said given code rate.

8. In combination, a signaling receiver including a code responsive relay means operable when an alternating voltage coded by being periodically varied at a given code rate is supplied thereto, said receiver having a pair of input terminals to which said relay means is connected, a control circuit receiving at times noncoded alternating current and electrically coupled to said input terminals for supplying an alternating voltage thereto, coding means including an oscillator and a rectifier, said oscillator operable to generate oscillations of a frequency equal to said given code rate, said oscillator connected to said input terminals in series with said rectifier to impress alternate half cycles of said oscillations on said terminals, and said oscillator connections and the oscillations generated by the oscillator substantially suppressing said alternating voltage supplied by said control circuit at said code rate for operating said relay means in response to said noncoded alternating current of the control circuit.

9. In combination, a signaling receiver including a code following relay means operated when supplied with recurrent pulses of alternating voltage of a given code rate, a pair of terminals for said receiver and across which terminals said relay means is connected, a control circuit receiving noncoded alternating current, a relatively high impedance inductor coupled to said control circuit and connected across said terminals to impress on the terminals a noncoded alternating voltage in response to said control circuit current, an electron tube oscillator tuned to generate oscillations of a frequency substantially equal to said code rate, a half-wave rectifier, a relatively low impedance winding receiving said oscillations from said oscillator, circuit means including said winding and said rectifier in series connected across said terminals, and said circuit means forming a low impedance path in multiple with said high impedance inductor which substantially suppresses said noncoded alternating voltage during the half cycles of the oscillations passed by said rectifier and said relay means is supplied with pulses of alternating voltage of said code rate in response to said noncoded alternating current of the control circuit.

10. In combination, a receiving means which is operable in response to periodic interruptions of alternating voltage at different selected code rates, a pair of terminals across which said receiving means is connected, a control circuit which is supplied with noncoded alternating current, an inductor coupled to said control circuit and connected across said terminals for supplying thereto noncoded alternating voltage in response to said control circuit current, an oscillator operable to supply to an output winding an alternating voltage of a frequency substantially equal to a selected one of said code rates, a half-wave rectifier, circuit means including said out-

put winding and said rectifier in series connected across said terminals, and said output winding and rectifier proportioned in such a manner as to substantially shunt said alternating voltage during the half cycle of said oscillator voltage the rectifier is conducting to substantially interrupt said noncoded alternating voltage at the frequency of said oscillations for operation of the receiving means in response to the noncoded current of the control circuit.

11. In combination, a receiving means which is operable in response to periodic variations of alternating voltage at different selected code rates, a pair of terminals across which said receiving means is connected, a control circuit which is supplied with noncoded alternating current, an inductor coupled to said control circuit and connected across said terminals for supplying thereto noncoded alternating voltage in response to said control circuit current, an electron tube oscillator tuned to generate oscillations of a frequency corresponding to a selected one of said code rates, an output winding receiving said oscillations from said oscillator, a half-wave rectifier, circuit means including said output winding and said rectifier connected across said pair of terminals, said output winding and rectifier proportioned to form a low impedance path during the half cycle said rectifier is conducting and substantially suppress at said terminals said voltage supplied by said inductor whereby the inductor voltage applied to the receiving means is periodically varied at said selected code rate.

12. In a signaling system, a code following relay means responsive to alternating voltage which is periodically interrupted at a given code rate, a transformer having a primary and a secondary winding, said secondary winding being connected to said relay means, an inductor receiving at times a noncoded alternating voltage and connected to said primary winding to supply said alternating voltage thereto; a code modulator including an electron tube oscillator, an output winding and a half-wave rectifier; said oscillator tuned to generate oscillations of a frequency equal to said given code rate, said output winding coupled to said oscillator to receive said oscillations, said output winding and rectifier in series connected to said primary winding in multiple with said inductor, said output winding having a relatively low impedance compared to the impedance of said inductor and the output winding substantially shunts said inductor during the half cycles of said oscillations the rectifier is conducting whereby the voltage of said inductor is substantially interrupted at said code rate and said relay means is operated in response to said noncoded alternating voltage received by the inductor.

13. In combination, a signaling receiver including a code responsive relay means operable when an alternating voltage coded by being periodically varied at a given code rate is supplied thereto, said receiver having a pair of input terminals to which said relay means is connected, a control circuit receiving at times noncoded alternating current and electrically coupled to said input terminals for supplying said alternating voltage thereto, a code modulator including an electron tube oscillator and a half-wave rectifier, said oscillator tuned to generate oscillations of a frequency corresponding to said given code rate, a winding adapted to receive said oscillations from the oscillator, circuit means including said winding and said rectifier in series connected to said input terminals to impress alternate half cycles of the oscillations on the terminals, and said circuit means and the oscillations effective to code said alternating voltage at said code rate for said relay means to be operated in response to said noncoded alternating current of the control circuit.

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No references cited.