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SYSTEM FOR THE CONVERSION AND RETRANSMISSION OF CONTROL SIGNALS

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FIG. 1

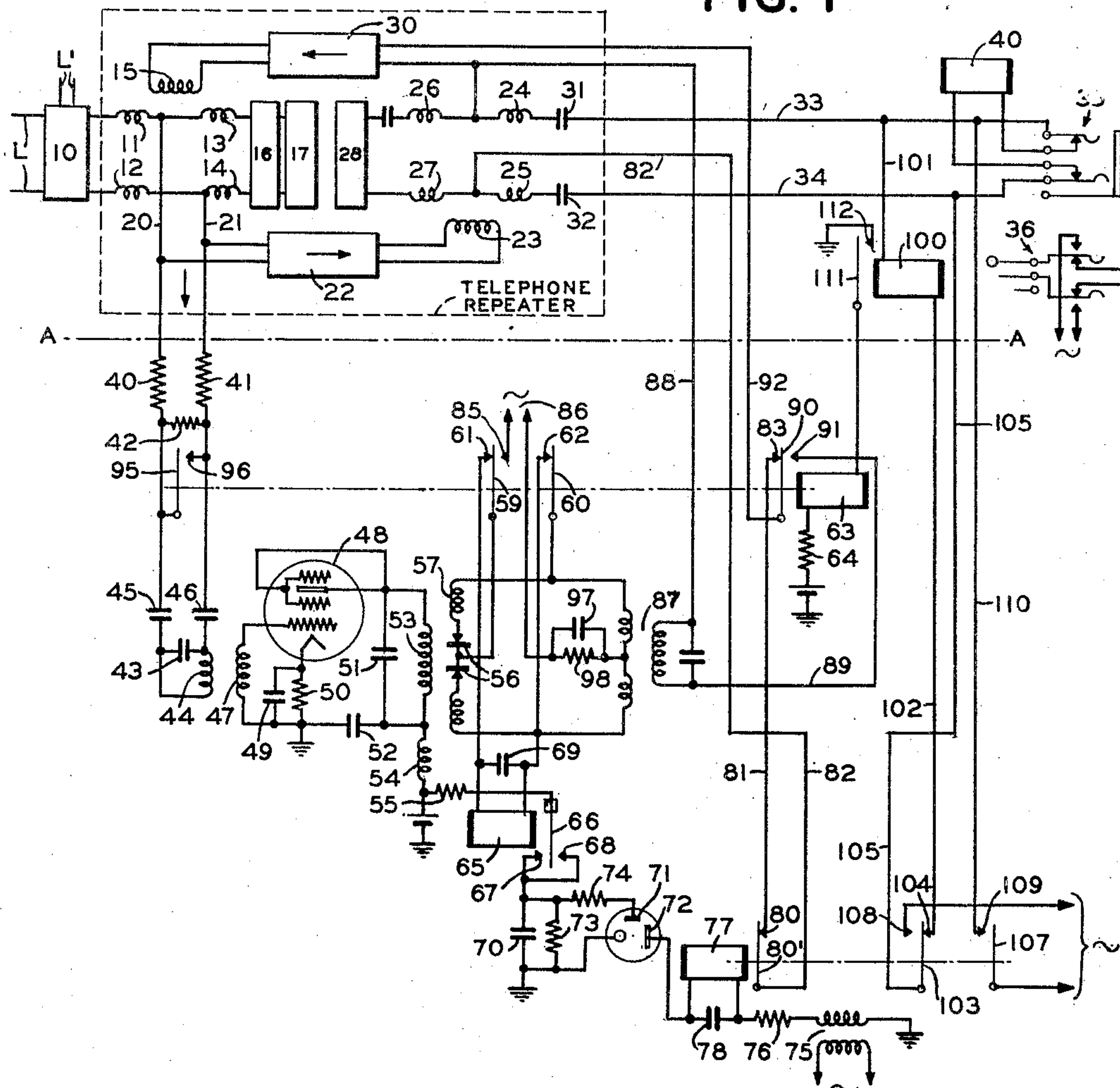
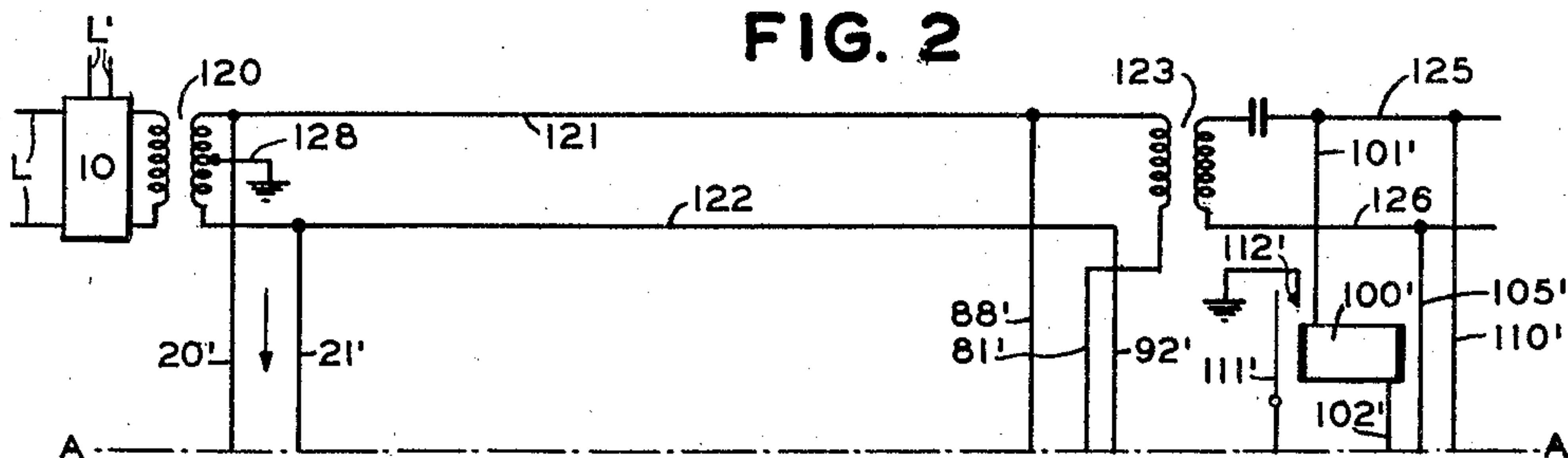


FIG. 2



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SYSTEM FOR THE CONVERSION AND RE-TRANSMISSION OF CONTROL SIGNALS

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15 Claims. (Cl. 179—84)

This invention relates generally to an improved system for the conversion and retransmission of ringing, calling, selecting, or other control signals, and particularly to a conversion circuit which receives from a subscriber's line or terminal switchboard a low frequency ringing or other signaling current, converts it to a higher frequency current and applies it to an outgoing line, and conversely receives a voice frequency signaling current and converts it to a lower frequency signaling current for application to the subscriber's line or terminal switchboard.

The transmission of ringing and other signaling or supervisory currents over communication circuits, such as a telephone line, preferably is accomplished within the frequency range of the working or speech signals normally transmitted over such circuits because the repeaters and other equipment are particularly adapted for the transmission of such frequencies while discriminating against other frequencies. For example, for ringing over telephone circuits a frequency within the voice range, such as 1,000 cycles, is often used. On the other hand, the usual ringing devices of subscriber's sets or terminal switchboard apparatus preferably are operated at relatively low frequencies, such as frequencies of 20 cycles.

Because of the complexity and expense which would be involved in the direct transmission of low frequency ringing currents over voice frequency transmission systems, it is common to provide a conversion device, referred to as a voice frequency ringer, which receives from the local subscriber's line or terminal switchboard the low frequency ringing current, converts it to a higher frequency current of the order of 1,000 cycles and applies it to the outgoing long distance line, and conversely receives a 1,000 cycle voice frequency current from the line and converts it to a low frequency ringing current for application to the local subscriber's loop. An important characteristic of such devices is that they should be immune to operation by ordinary speech currents, since they must remain constantly connected to the line in readiness to perform their ringing function. Discrimination between the ringing currents and the speech currents has heretofore been accomplished by a number of methods, the instant invention providing an improved and more efficient method of performing this function.

An object of the instant invention is an improved system and apparatus for transmitting signaling currents for ringing, calling, selecting or other supervisory or control purposes over a

communication circuit, and which is not subject to interference from talking or other intelligence signals or currents carried by the circuit.

Another object is an improved means for discriminating between ringing or other control currents and speech currents in a communication circuit.

A further object is an improved system of the character disclosed which employs in combination frequency discrimination, delay and modulation, and may in addition utilize power level distinction.

A still further object is apparatus of the character disclosed which comprises a relatively simple and inexpensive assembly of elements, and in which a number of single elements are employed each of which is adapted to perform two or more functions in the circuit.

Other objects and advantages of the invention will be apparent from the following detailed description, taken in connection with the accompanying drawing, in which:

Fig. 1 is a schematic of a composite ringer circuit embodying the principles of the invention, and employing repeater apparatus; and

Fig. 2 is a schematic of a subscriber's station circuit which may be substituted for the repeater apparatus shown in Fig. 1.

The voice frequency ringer disclosed herein provides satisfactory and reliable signaling through the use of a relatively simple and inexpensive assembly of elements. The reliability and simplicity are achieved by the transmission for ringing purposes of a voice frequency current, for example, 1,000 cycles, modulated at a lower frequency, for example, 60 cycles, and the reception of such currents by means of a tuned circuit, amplifier, detector, tuned reed device and a delay circuit. A feature of the ringer is its employment of single units for the performance of two or more functions, such as (1) sending oscillator tuning and received signal selection, (2) sending oscillator and receiving amplifier, (3) sending modulator and receiving first detector, and (4) receiving relay, mechanical delay device and 60 cycle selection.

Referring to Fig. 1, there are shown a telephone line L and a telegraph line L' connected to a composite set 10 in conventional manner, the composite set being connected to a conventional two-wire, two-way telephone repeater with its balancing networks. A 22 type telephone repeater is satisfactory for this purpose and is schematically indicated in the rectangle on the drawing. As is well known, the telephone repeater

has embodied therein a hybrid coil arrangement 11—15, a network 16 for balancing the composite set 10, and a network 17 for balancing the line. To the hybrid bridge coil arrangement is connected, by means of conductors 20 and 21, a repeater unit 22 for repeating the incoming telephone signals, the repeater terminating in a second hybrid coil arrangement 23—27, the latter being connected through blocking condensers 31 and 32 and talking conductors 33 and 34 to a switchboard jack 35, the jack being adapted to receive a switchboard plug 36. A ring-down relay or other signal device 40 is connected across the break contacts of the jack springs, as shown. A repeater unit 30, which is coupled to the hybrid coil arrangement 11—15, repeats the outgoing telephone speech currents to the line L. A compromise line network 28 is employed to take care of the switchboard circuits and apparatus.

The voice frequency ringer is connected to the incoming line by means of a potentiometer or leak assembly 40—42 for the reception of the incoming 1,000 cycle ringing currents, the potentiometer being connected to a 1,000 cycle tuned circuit 43—46. This tuned circuit is coupled to an amplifier-oscillator circuit 47—54. The amplifier-oscillator is followed by a modulator-detector circuit 56, 57, 61, including a self-biasing condenser-shunted resistor circuit 97, 98, and a 60 cycle tuned reed relay arrangement 65—69. Connected to the contacts 67 and 68 of the relay is a gas tube delay circuit 70—73. Relays 63, 77 and 100 control various of the elements as hereinafter set forth.

An incoming call from the line L enters the ringer with all of the relay contacts in the position shown in Fig. 1. The 1,000 cycle tone is selected by the tuned circuit 43—46, and then amplified and rectified to produce a 60 cycle current for application to the tuned reed device 65, 66. The amplitude of vibration of the reed 66 gradually increases until, after a short predetermined delay, it strikes against both the front and back contacts 67 and 68 to send a series of charging pulses into the condenser 70. When the charge on this condenser has reached a sufficient voltage, the gas tube 72 becomes conductive and causes the operation of relay 77, which in turn applies 20 cycle ringing current to the subscriber's line through the armatures 103 and 107 and make contacts 108 and 109.

A high order of discrimination against false ringing by speech currents is obtained, and is due in large measure to the inherent selectivity and delay characteristics peculiar to the tuned reed relay in association with the gas tube delay circuit. The tuned reed 66 is not only very sharply selective, but due to its inertia a substantial time period of the order of one second is required for it to reach full amplitude. Selectivity and delay characteristics of this magnitude have heretofore been found difficult to obtain by means of electrical filters and networks alone. The peculiar signal combination comprising a voice frequency tone divided into approximately equal marking and spacing periods at the rate of 60 per second or other low frequency rate does not persist in ordinary speech or noise currents for sufficient time to cause contacting of the reed. As further insurance against false ringing, an additional delay of any desired amount may be achieved through adjustment of the network 55, 70, 73, 74, which connects the contacts of the reed relay to the gas tube device. Approximately one-half second initial delay here with a one second final

hold-over has been found satisfactory in a ringer of the type illustrated.

On an outgoing call, the relay 100 is responsive to 20 cycle ringing currents sent from the switchboard or subscriber's line, and through its armature 111 and make contact 112 causes the operation of relay 63, which upon closure of its contacts 95, 96 converts the amplifier 43 to a 1,000 cycle oscillator, and through the armature 59 and make contact 85 applies a 60 cycle ringing current from the source 86 to the modulator to produce a 60 cycle modulated 1,000 cycle tone. Through transformer 87 and armature 99 and make contact 91 of relay 63, and conductors 88, 89 and 92, this tone is transmitted to the outgoing repeater unit 30 of the telephone repeater. Transmission of this tone to the line L continues as long as the 20 cycle ringing current is applied to relay 100.

As above set forth, the voice frequency ringer in Fig. 1 is shown in its normal condition, that is, the telephone circuit is in condition for speech transmission while the ringer lies immune to such signals but will be responsive to the peculiar 60 cycle modulated 1,000 cycle incoming signal which it is adapted to receive. The potentiometer 40—42 is of high impedance in order to prevent serious loss of speech currents and is arranged to supply a relatively small voltage to the 1,000 cycle tuned circuit 43—46, which is connected to the amplifier circuit 47—54. The amplifier preferably embodies a tube 48 of high mutual conductance, for example, a type 6AC7, which is connected as a triode and is arranged to apply a suitable biasing potential to its grid by means of the self-biasing resistor 50 shunted by a condenser 49. Condensers 51 and 52 are employed in the amplifier circuit in a conventional manner.

The amplifier output is connected by means of the transformer winding 53 to a first detector arrangement comprising the transformer winding 57 and the full wave rectifier device 56. The rectifiers conveniently may be of the copper oxide or similar inert type, although other known types may be employed. The output of the detector is connected through armatures 59 and 60 and break contacts 61 and 62 of relay 63 to the tuned reed relay 65, which is set in operation by the rectified 60 cycle component. A condenser 69 shunted across the winding of relay 65 serves to by-pass the 1,000 cycle carrier.

When the amplitude of the tuned reed 66 has sufficiently increased, the contacts 67 and 68 of the relay 65 transmit a succession of charges to a condenser 70 to build up a voltage which, when applied to the control or starting electrode 71 of the gas tube 72, will cause the tube to become conducting and pass current across its main electrodes. The rate of building up this voltage, or the delay, is determined by the relative sizes of the condenser 70 and the series resistor 55 and the leak resistor 73. Upon operation of this tube, relay 77 operates and causes the application of 20 cycle ringing current to the subscriber's line through its armatures 103, 107 and make contacts 108, 109, the armature 103 being connected by conductor 105 to one side 34 of the talking circuit, and contact 109 being connected by conductor 110 to the other side 33 of the talking circuit. Contact 108 and armature 107 have connected thereto a source of 20 cycle ringing current.

The plate or space current potential for the glow discharge tube 72 is obtained from a 60

cycle supply 75 so that the relay 77 receives current only during the positive half cycles. Plate current will, therefore, cease to flow as soon as the incoming signal ceases and the charge on the condenser 70 has had time to subside below the normal firing potential of the tube 72. Chattering of relay 77 under the influence of this rapidly interrupted circuit is prevented by a shunting condenser 78, the resistance 76 serving to limit the current supplied to the tube 72. At the same time contact 104 of relay 77 is opened, and thus the circuit comprising conductor 102, relay 100 and conductor 101 is open and prevents the relay 100 from responding to the locally applied 20 cycle current. The break contact 80 of relay 77 is opened by armature 80', and this opens the circuit 82, 81, 83, 90 and 92 to prevent ringing by the telephone repeater during the switching operations. This 20 cycle current will be continuously applied to the signaling device 40 during the receipt of the modulated 1,000 cycle ringing current plus a small additional hold-over period.

To send an outgoing call, 20 cycle ringing current is sent by the operator or subscriber, through the plug 36 and jack 35, and make contacts 103, 104 of relay 77, to the relay 100 which, by the closure of its contacts 111, 112 operates relay 63 and converts the amplifier 48 to a 1,000 cycle oscillator by the simple process of short-circuiting its input circuit through condensers 45, 46 by means of make contacts 95, 96. This reduces the input impedance of the tuned circuit to a value such as to permit oscillation of the circuit. With the impedance 42 operatively connected in the circuit, as when receiving the incoming 1,000 cycle carrier, this dampens the circuit to a sufficient extent to prevent oscillation of the circuit, but when the impedance 42 is disabled by closure of the contacts 95 and 96 the gain of the tube 48 is sufficient to overcome the attenuation losses in the tuned circuit, and the circuit oscillates at a frequency of 1,000 cycles and thus controls the oscillation of the tube 48. In the illustrative embodiment shown, the element 42 has a resistance of approximately 600 ohms, the condensers 45 and 46 each have a value of 0.01 mfd., and the condenser 43 has a value of 0.02 mfd. If the impedance of the element 42 were appreciably less than 600 ohms, an additional resistor could be inserted in series with either of the condensers 45 and 46 of a value such that it would dampen the circuit sufficiently to prevent oscillation thereof when receiving the incoming carrier, and which when shunted out or otherwise disabled by contacts such as 95, 96 would reduce the impedance of the tuned circuit to permit oscillation thereof when the tube 48 is operated as an oscillator. Amplifier tube 48 is preferably of the high mutual conductance type so that it will oscillate readily when its input and output circuits are tuned to the same frequency, a suitable self-biasing resistor 50 and condenser 49 being used. In the circuit shown in the figure, the condenser 49 preferably has a value of 3.5 mfd., and the resistor 50 has a value of 100 ohms. At the same time contacts 59 to 62 disconnected the tuned reed relay and applied a 60 cycle current from source 86, through contacts 59 and 85, to the midpoints of the two transformers 57 and 87 to cause 60 cycle modulation, by means of the rectifier device 56, of the 1,000 cycle current from the oscillator. This modulated current is then transmitted, by means of the contacts 90, 91 of relay 63, into the input of the transmitting

amplifier 30 of the telephone repeater and will continue to flow so long as the 20 cycle ringing current is applied to relay 100. Any tendency for self-oscillation or singing to occur through the loop circuit comprising the telephone repeater amplifiers or the telephone repeater and composite ringer is prevented by reason of the short-circuiting contacts 95, 96 and the open circuit contact 83.

The condenser-shunted resistance arrangement 97, 98 of the modulator performs the important function of self-biasing the rectifier elements 56 to provide optimum performance. By means of the resistance 98 in conjunction with appropriate level adjustment of the applied voltages, distortionless 100% modulation of the 1,000 cycle tone by the 60 cycle sine wave may be obtained. The by-pass condenser 97 employed in conjunction with the resistance 98 reduces the impedance of the resistor 98 to the 1,000 cycle carrier but by proper adjustment of the voltages may be omitted, if desired.

In the foregoing description the voice frequency ringer was applied to the terminals of a telephone circuit through the intermediary of the 22 type telephone repeater. An advantage was gained thereby from the transmitting gain of the repeater and from the conjugate relation between the transmitting and receiving circuits. Such a repeater, however, is not essential to the proper functioning of the ringer. Fig. 2 illustrates the application of the ringer to the terminal of a circuit located entirely between a repeater and a terminal circuit. The functioning of the various elements below the line A—A in Fig. 2 is the same as in the previous description of Fig. 1. The composite set 10 is coupled, by means of a transformer 120, to the telephone talking circuit 121, 122, and the telephone circuit is repeated through the transformer 123 to the conductors 125 and 126. The reference numerals having a prime mark added in Fig. 2 identify the same elements in Fig. 1 in which the prime mark is omitted from the corresponding reference numerals.

A terminal station at a composited line is shown for purposes of illustration, but the ringing circuit does not have to be changed if the station is an intermediate station coupled through a composited line by means of a bridge or other coupling device instead of the composite set shown. The ringer as shown here may be applied to other types of lines, one example of which would be the terminal of a carrier telegraph channel. The 1,000 cycle ringing current would be handled by the carrier channel in the same way as speech currents but would be converted at either terminal to the required 20 cycle ringing frequency, and vice versa.

Specific frequencies for the line ringing current, the modulation frequency, and the subscriber's ringing current have been mentioned in the foregoing description, but these are merely illustrative, and a wide range of choice is available. It may be convenient in certain cases to use the same frequency for the modulation frequency and for the subscriber's ringing current, provided it is sufficiently constant in frequency for service with the tuned reed receiving relay. Also, the armatures 103, 107 and contacts 108, 109 may be employed to control a source of direct current or pulsating current for operating a signal device such as the device 40, various of such devices being known in the art.

The system illustrated is not limited to use on

telephone circuits but may be used on any type of transmission system where it is desired to transmit a distinctive ringing, regulatory, supervisory, or other control functions, and irrespective of whether the control signal lies within the voice frequency range or above this range into the carrier spectrum, and therefore the invention is not intended to be limited except as indicated by the scope of the appended claims.

What is claimed is:

1. A signal conversion system for alternatively receiving an incoming signaling current of predetermined frequency and for transmitting an outgoing signaling current of the same frequency, comprising a circuit tuned to said frequency for selecting the incoming signaling current, a thermionic tube coupled to said tuned circuit and having circuit connections to enable the tube to function either as an amplifier for said incoming signaling current or as an oscillator for generating said outgoing signaling current, means including an impedance operatively connected to said tuned circuit for applying the incoming signaling current to the tuned circuit, said impedance damping the tuned circuit and preventing the tube from operating as an oscillator, switching means for disabling said impedance to cause the tube to operate as an oscillator and generate the outgoing signaling current, and means for controlling said switching means to enable the system to operate alternatively for the reception and transmission of said signaling current.

2. A signal conversion system for alternatively receiving an incoming signaling current of predetermined frequency and for transmitting an outgoing signaling current of the same frequency, comprising a circuit tuned to said frequency for selecting the incoming signaling current, a thermionic tube coupled to said tuned circuit and having circuit connections to enable the tube to function either as an amplifier for said incoming signaling current or as an oscillator for generating said outgoing signaling current, means including an impedance operatively connected to said tuned circuit for applying the incoming signaling current to the tuned circuit, said impedance damping the tuned circuit and preventing the tube from operating as an oscillator, switching means for shunting said impedance to cause the tube to operate as an oscillator and generate the outgoing signaling current, and means for controlling said switching means to enable the system to operate alternatively for the reception and transmission of said signaling current.

3. A signal conversion system for alternatively receiving an incoming signaling current of predetermined frequency and for transmitting an outgoing signaling current of the same frequency, comprising a circuit tuned to said frequency for selecting the incoming signaling current, a resistance bridged across said tuned circuit for applying the incoming signaling current to the tuned circuit, a thermionic tube coupled to said tuned circuit and having circuit connections to enable the tube to function either as an amplifier for said incoming signaling current or as an oscillator for generating said outgoing signaling current, said resistance damping the tuned circuit and preventing the tube from operating as an oscillator, switching means for disabling said resistance to permit the tube to operate as an oscillator and generate the outgoing signaling current, and means operable at will for control-

ling said switching means to enable the system to operate alternatively for the reception and transmission of said signaling current.

4. A signal conversion system for alternatively receiving an incoming signaling current of predetermined frequency and for transmitting an outgoing signaling current of the same frequency, comprising a circuit tuned to said frequency for selecting the incoming signaling current, a potentiometer having at least a portion thereof bridged across said tuned circuit for applying the incoming signaling current to the tuned circuit, a thermionic tube coupled to said tuned circuit and having circuit connections to enable the tube to function either as an amplifier for said incoming signaling current or as an oscillator for generating said outgoing signaling current, said portion of the potentiometer damping the tuned circuit and preventing the tube from operating as an oscillator, switching means for disabling said portion of the potentiometer to permit the tube to operate as an oscillator and generate the outgoing signaling current, and means operable at will for controlling said switching means to enable the system to operate alternatively for the reception and transmission of said signaling current.

5. In a conversion system, means for receiving and selecting an oscillating signaling current of a given frequency which is modulated by a current of lower frequency, means including a detector-modulator circuit for receiving and demodulating said oscillating signaling current and producing a current having a frequency corresponding to the modulation frequency, said last named circuit comprising an input transformer winding having two sections and a full wave rectifier connected intermediate said sections in series therewith, and an output transformer winding in circuit with said input transformer winding, conductors respectively connected to the midpoint of said rectifier and to the midpoint of said output transformer winding, and switching means for connecting the detector-modulator circuit to a relay responsive to the modulation frequency when an incoming signaling current is being received, and for connecting said conductors to a source of modulating current when the circuit is being operated as a modulator.

6. In a conversion system, means for modulating an oscillating signaling current of a given frequency with a current of another frequency, comprising a modulator circuit having an input transformer winding for receiving a current of said given frequency, a full wave rectifier connected in series with said input winding, an output transformer winding in circuit with said input transformer winding, conductors respectively connected to the midpoint of said rectifier and to the midpoint of said output transformer winding and to a source of modulating current, and means for biasing said rectifier comprising a resistance in series with one of the said conductors connected to said output transformer winding and the said rectifier and said source of modulating current.

7. In a conversion system, means for receiving and selecting an oscillating signaling current of a given frequency, which is modulated by a current of lower frequency, means including a detector-modulator circuit for receiving and demodulating said oscillating signaling current and producing a current having a frequency corresponding to the modulation frequency, said last named circuit comprising an input transformer

winding having two sections and a full wave rectifier connected intermediate said sections in series therewith, and an output transformer winding in circuit with said input transformer winding, conductors respectively connected to the midpoint of said rectifier and to the midpoint of said output transformer winding, switching means for connecting the detector-modulator circuit to a relay responsive to the modulation frequency when an incoming signaling current is being received, and for connecting said conductors to a source of modulating current when the circuit is being operated as a modulator, and means for biasing said rectifier comprising a resistance in circuit with the conductor connected to the midpoint of said transformer output winding and said source of modulating current, and a condenser in shunt with said biasing resistance.

8. A signal conversion system for alternatively receiving an incoming signaling current of higher frequency modulated by a current of lower frequency and for generating and transmitting an outgoing signaling current of higher frequency modulated by a current of lower frequency, said system comprising a plurality of unitary devices each adapted selectively to perform at least two functions, one of said devices comprising a sending oscillator and receiving amplifier unit, and another of said devices comprising a sending oscillator tuning and a received signal selection unit for said signaling current, circuit connections for causing said second device to operate as a receiving selection unit and said first device to operate as a receiving amplifier, means including switching means for changing the constants of said selection unit to cause it to operate as a tuner for the sending oscillator, means including a relay for controlling the operative position of said switching means, and means operable at will for transmitting current to said relay to cause the latter to actuate the switching means to condition said second device to operate as a sending oscillator tuning device and said first device to operate as a sending oscillator.

9. A signal conversion system for alternatively receiving an incoming signaling current of higher frequency modulated by a current of lower frequency and for generating and transmitting an outgoing signaling current of said higher frequency modulated by a current of said lower frequency, said system comprising a plurality of unitary devices each adapted selectively to perform at least two functions, one of said devices comprising a sending oscillator and receiving amplifier unit, and another of said devices comprising a sending oscillator tuning and a received signal selection unit for said signaling current, circuit connections including a damping impedance causing said second device to operate as a receiving selection unit, switching means for disabling the damping impedance and cause said selection unit to operate as a tuner for the sending oscillator, means including a relay for controlling the operative position of said switching means, and means operable at will for transmitting current to said relay to cause the latter to actuate the switching means to disable the damping impedance and condition said second device to operate as a sending oscillator tuning device and said first device to operate as a sending oscillator.

10. A signal conversion system for alternatively receiving an incoming signaling current of higher frequency modulated by a current of lower frequency and for transmitting an outgoing signaling

current of said higher frequency modulated by a current of said lower frequency, said system comprising a plurality of unitary devices each adapted selectively to perform at least two functions, one of said devices comprising a sending oscillator and receiving amplifier unit, a second of said devices comprising a sending oscillator tuning and a received signal selection unit, circuit connections for causing said second device to operate as a receiving selection unit and said first device to operate as a receiving amplifier, means including switching means for changing the constants of said selection unit to cause it to operate as a tuner for the said sending oscillator, a third device alternatively operable as a sending modulator and a receiving first detector, another switching means for changing the circuit connections of the third device to apply a source of modulating current thereto and cause it to operate as a sending modulator, relay means for controlling the operative positions of both of said switching means, and means operable at will for transmitting current to said relay means to cause the latter to actuate the switching means concurrently to condition said second unit to operate as a sending oscillator tuning device and said first device to operate as a sending oscillator and said third device to operate as a sending modulator.

11. A signal conversion system for alternatively receiving an incoming signaling current of higher frequency modulated by a current of lower frequency and for transmitting an outgoing signaling current of said higher frequency modulated by a current of said lower frequency, said system comprising a plurality of unitary devices each adapted selectively to perform at least two functions, one of said devices comprising a sending oscillator and receiving amplifier unit, a second of said devices comprising a sending oscillator tuning and a received signal selection unit, circuit connections for causing said second device to operate as a receiving selection unit and said first device to operate as a receiving amplifier, means including switching means for changing the constants of said selection unit to cause it to operate as a tuner for the said sending oscillator, a third device alternatively operable as a sending modulator and a receiving first detector, a fourth device comprising a tuned reed relay responsive to the incoming modulation frequency detected by said first detector for controlling a receiving circuit and for operating as a time delay device with respect to the received signaling current, another switching means for changing the circuit connections of the third and fourth devices to disable the fourth device and apply a source of modulating current to the third device and cause it to operate as a sending modulator, relay means for controlling the operative positions of both of said switching means, and means operable at will for transmitting current to said relay means to cause the latter to actuate the switching means concurrently to condition said second unit to operate as a sending oscillator tuning device and said first device to operate as a sending oscillator and to disable said fourth device and cause said third device to operate as a sending modulator.

12. A signal conversion system comprising means for receiving and selecting an incoming alternating signaling current of a predetermined frequency modulated by a current of lower frequency

quency, said means including a circuit tuned to the frequency of the said alternating signaling current, a rectifier circuit operatively connected to said tuned circuit for demodulating the received signaling current and producing a current having a frequency corresponding to the modulating frequency, a delay circuit operatively connected to said detector circuit comprising a relay responsive to the detected modulating frequency and having a vibratile armature with a periodicity such that the armature reaches a given amplitude only after a predetermined time interval, means including a source of current and contact elements associated with said vibratile armature for producing a different signaling current when the armature reaches said given amplitude, and means for applying said different signaling current to the outgoing circuit of the conversion system.

13. A conversion system for converting a higher frequency signaling current to a lower frequency signaling current, comprising a source of incoming alternating signaling current modulated by a current of lower frequency, means for receiving and selecting said signals including a circuit tuned to the frequency of the said alternating signaling current, a first delay circuit responsive to said selected signals comprising a relay responsive to the modulating frequency and having a vibratile armature with a periodicity such that the armature reaches a given amplitude only after a predetermined time interval, means including contacts associated with said vibratile armature for producing impulses corresponding in frequency to said modulating frequency when the armature reaches said given amplitude, a second delay circuit comprising means for storing said impulses and a delay device responsive to the stored impulses, and means controlled by the last named delay device for applying a low frequency signaling current to the outgoing circuit of the conversion system.

14. A conversion system for converting a higher frequency signaling current to a lower frequency signaling current, comprising a source of incoming alternating signaling current modulated by a current of lower frequency, means for receiving and selecting said signals including a

circuit tuned to the frequency of the said alternating current, a first delay circuit responsive to said selected signals comprising a relay responsive to the modulating frequency and having a vibratile armature with a periodicity such that the armature reaches a given amplitude only after a predetermined time interval, means including contacts associated with said vibratile armature for producing impulses corresponding in frequency to said modulating frequency when the armature reaches said given amplitude, a second delay circuit comprising means for storing said impulses and a gaseous conduction tube responsive to the stored impulses for starting the tube, a source of low frequency signaling current, and means controlled by said gaseous conduction tube for applying said last named low frequency signaling current to the outgoing circuit of the conversion system.

15. A conversion system for converting a higher frequency signaling current to a lower frequency signaling current, comprising a source of incoming alternating signaling current modulated by a current of lower frequency, means for receiving and selecting said signals including a circuit tuned to the frequency of the said alternating current, a first delay circuit responsive to said selected signals comprising a relay responsive to the modulating frequency and having a vibratile reed with a periodicity such that the reed reaches a given amplitude only after a predetermined time interval, means including contacts associated with said vibratile reed for producing impulses corresponding in frequency to said modulating frequency when the armature reaches said given amplitude, a second delay circuit comprising a condenser for storing said impulses and a gaseous conduction tube having a starting electrode in circuit with said condenser and responsive to the stored impulses for starting the tube, impedance means also in circuit with the starting electrode, the relative sizes of said condenser and impedance means determining the amount of delay in starting the tube, a source of low frequency signaling current, and relay means controlled by said tube for applying said low frequency signaling current to the outgoing circuit of the conversion system.

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