

[54] REMOTE CONTROL SYSTEM
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Related U.S. Application Data

[60] Division of Ser. No. 178,376, Sept. 7, 1971, Pat. No. 3,747,108, which is a continuation of Ser. No. 840,806, July 10, 1969, abandoned, which is a continuation-in-part of Ser. No. 749,746, Aug. 2, 1968, abandoned.

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[51] Int. Cl. H04b 7/00
[58] Field of Search 343/225-228; 340/164 R, 171 R; 178/66 A; 325/37, 30, 45, 131, 134, 145, 344, 320, 452; 332/14, 16 T

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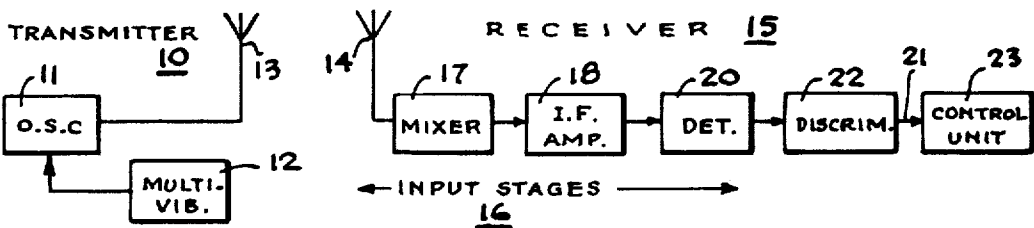
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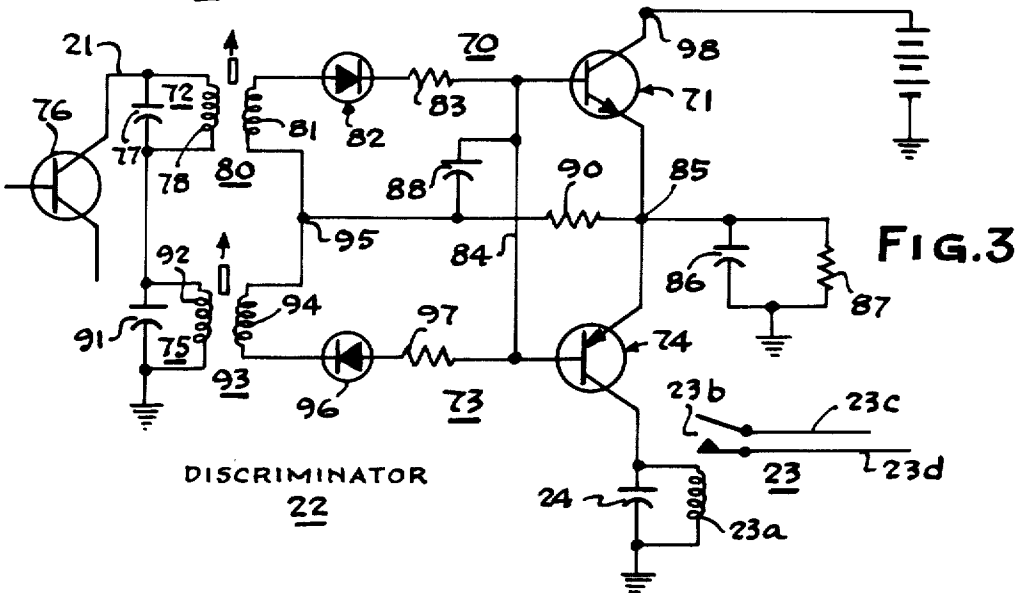
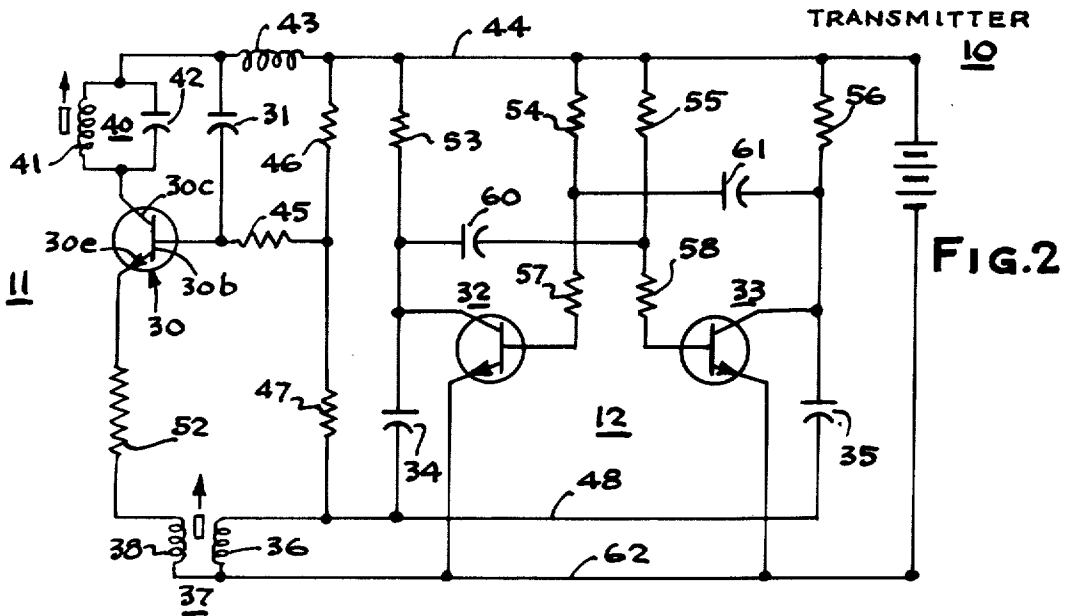
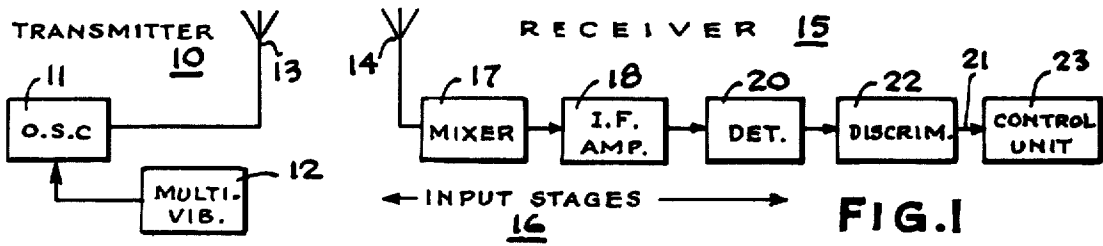
Primary Examiner—Marshall M. Curtis
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[57] ABSTRACT

A transmitter includes an oscillator stage with one feedback circuit to sustain carrier-frequency oscillations, and another feedback circuit, in which a pair of capacitors are successively coupled across a transformer winding by a multivibrator circuit, to modulate the carrier signal between two different audio frequencies at a predetermined repetition rate. In a modified construction one of the tones can be changed to a third tone by switching an additional capacitor in parallel with one of the two capacitors. The receiver discriminator circuit includes a pair of frequency-selective channels for gating on a transistor in each channel. A capacitor is charged through the first transistor and discharged through the second to energize a relay winding if the alternation of transistor conduction is substantially at the predetermined repetition rate. The modified receiver construction includes a third frequency-selective channel, a third transistor, a second relay, and a diode gating circuit whereby the second relay is energized when the first and third tones are received.

4 Claims, 5 Drawing Figures





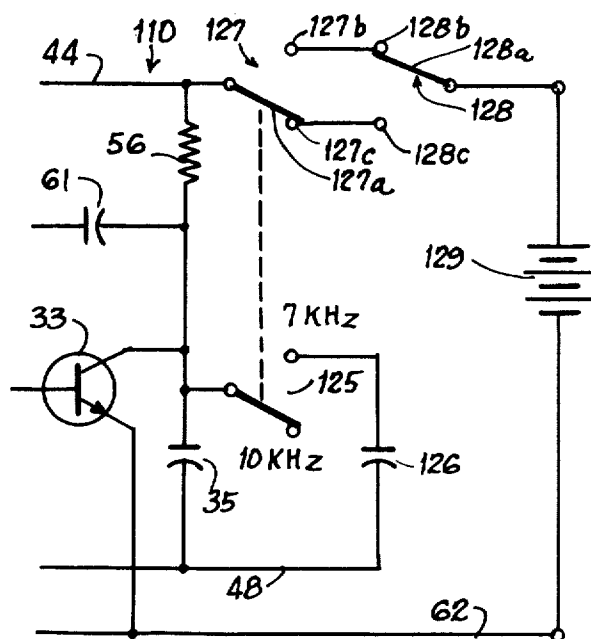


FIG. 4

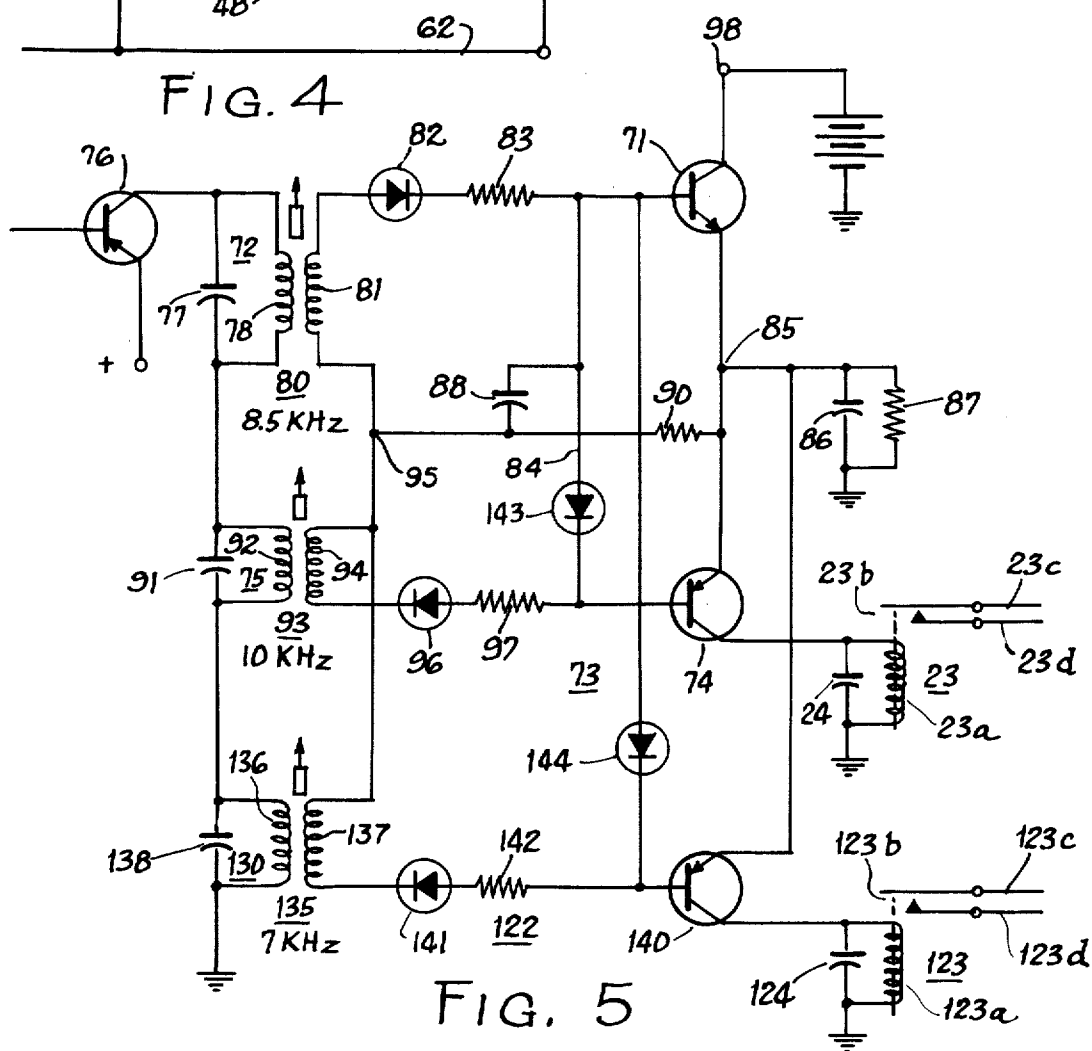


FIG. 5

REMOTE CONTROL SYSTEM

This application is a division of my co-pending application, Ser. No. 178,376 filed Sept. 7, 1971, now U.S. Pat. No. 3,747,108, of July 17, 1973, which is a continuation of patent application Ser. No. 840,806 filed July 10, 1969, now abandoned, which is a continuation-in-part of my application, Ser. No. 749,746, filed Aug. 2, 1968, now abandoned.

Remote control systems find utility in applications such as the opening and closing of garage doors, tuner rotation for channel switching in television sets, guidance of scaled-down aircraft and ships, and related operations. In each of these arrangements it is mandatory to provide maximum reliability of system operation while at the same time maintaining a compact, economical system. High reliability has proved difficult to obtain with a control signal in or near the radio frequency spectrum because so many common objects produce spurious signals across a wide band of frequencies. One example of a source of spurious signals is the diathermy machine which has been determined to produce spurious signals across a very broad portion of the audio frequency spectrum.

It is therefore a primary consideration of the present invention to produce a remote control system of enhanced reliability without sacrificing economy and physical compactness.

A corollary consideration is the production of such a system with enhanced reliability by reason of requiring more than one audio frequency signal to "unlock" the operating circuit in the receiver.

Another salient consideration is the attainment of high reliability by insuring that the receiver operating circuit is only unlocked with receipt of the proper audio frequency signals which in addition are alternating at a predetermined repetition rate.

The receiver of the present invention is connected to operate a relay or other control unit upon receipt of a carrier signal modulated at first and second frequencies which alternate at a predetermined repetition rate. A conventional input circuit demodulates the received carrier signal to apply first and second signals to a discriminator circuit. A pair of semiconductor switches connected in the discriminator circuit are successively operated as the first and second input signals are received from the input circuit. Circuit means, which in a preferred embodiment is a capacitor, is coupled in the discriminator circuit such that the control unit is operated in response to alternate operation or conduction of the first and second semiconductor switches at the predetermined repetition rate. Means is also provided to apply a potential difference to the discriminator circuit to operate the control unit when the appropriately modulated carrier signal is received.

Enhanced reliability of the remote control system is obtained by incorporating the discriminator circuit in the receiver which insures the control unit will not be actuated unless appropriate keying signals are received. The key to unlock the discriminator circuit and produce the desired operation includes not only the receipt of at least two pre-assigned frequency signals but also alternation of these signals at a predetermined repetition rate. Many control channels can be made available by utilizing different combinations of the carrier frequency, the modulating frequencies, and the repetition rate. With the described arrangement a high degree of reliability of control unit operation is attained

without requiring either a transmitter or receiver of undue complexity, expense or physical size.

The transmitter of the inventive system includes an oscillator circuit and a multivibrator circuit. The oscillator in a preferred embodiment includes a transistor having input, output and common elements, with a first feedback circuit coupled between the input and output elements to sustain oscillations at the carrier frequency. A second feedback circuit, which includes a variable impedance arrangement, is coupled between the common and input elements to sustain oscillations at a modulating audio frequency. The multivibrator circuit is connected to vary the effective value of the variable impedance arrangement at the predetermined repetition rate, thus to modulate the carrier signal with corresponding first and second audio frequency signals.

A modified construction involves a switching arrangement to change one of the impedances in the transmitter, so that first and third tones will be produced, rather than the first and second tones. The receiver involves first, second and third frequency-selective channels; first, second and third semiconductor switches; first and second control units; and a diode gating arrangement whereby the receipt of the first and second tones operates the first control unit, while the receipt of the first and third tones operates the second control unit.

THE DRAWINGS

In the several figures of the drawing like reference numerals identify like components, and in the drawing:

FIG. 1 is a block diagram of a remote control system constructed in accordance with the inventive principles;

FIG. 2 is a schematic diagram of a transmitter circuit suitable for use in the system of FIG. 1;

FIG. 3 is a schematic diagram of a discriminator circuit and control unit shown more generally in FIG. 1;

FIG. 4 is a fragmentary schematic diagram of a modified transmitter, similar to the transmitter of FIG. 2; and

FIG. 5 is a schematic diagram of a modified discriminator and control unit, for use with the modified transmitter of FIG. 4.

GENERAL SYSTEM ARRANGEMENT

FIG. 1 shows a transmitter 10 for providing a carrier signal modulated at first and second frequencies which alternate at a predetermined repetition rate. An oscillator stage 11 is connected so that its high frequency output signal is modulated between two different audio frequencies at a predetermined repetition rate established by the circuit constants in a multivibrator circuit 12. Accordingly, the modulated carrier signal is transmitted over an antenna 13, and a fraction of the radiated signal is received at the antenna 14 of a receiver 15.

For purposes of this explanation, receiver 15 is understood to include an input circuit 16 comprising conventional units such as mixer circuit 17, intermediate-frequency amplifier 18, and a second detector stage 20, in addition to antenna 14. Together these components are considered as an input circuit which receives the modulated carrier signal at antenna 14 and demodulates the received signal to provide, on line 21, signals at the modulation frequencies produced in transmitter 10. Responsive to a determination by a novel and unob-

vious discriminator 22 that the prescribed signals at the first and second modulation frequencies have been received, and further that such signals are alternating at the predetermined repetition rate, control unit 23 is operated to effect a desired controlled operation such as the opening or closing of a garage door or the rotation of a television tuner. Because the components described collectively as input circuit 16 are well known both in construction and operation to those skilled in this art, a more detailed explanation of these stages will not be set out in this description.

TRANSMITTER CIRCUIT

In FIG. 1, oscillator stage 11 includes an NPN transistor 30 having an input element or base 30b, an output element or collector 30c, and a common element or emitter 30e. A first feedback circuit is coupled through capacitor 31 between input element 30b and output element 30c for sustaining oscillations at the carrier frequency. Multivibrator circuit 12 includes a pair of active switching units 32, 33, shown as NPN type transistors connected in a known multivibrator or flip-flop configuration such that alternate conduction of the two switching units successively switches capacitors 34 and 35 across secondary winding 36 of a transformer 37. The transformer includes a primary winding 38 connected in a second feedback circuit coupled between common element 30e and input element 30b of oscillator 11 to effect alternate modulation of the carrier signal. The modulation frequencies are determined by the different capacitance values of capacitors 34, 35 and the repetition rate is predetermined by the values of the circuit components in multivibrator circuit 12. Those skilled in the art will appreciate that certain substitutions can be made in the indicated arrangement without departing from the inventive concept or practice. By way of example the depicted NPN type transistors can be replaced by equivalent PNP type transistors, with a concomitant reversal of polarity of the applied energizing and signal voltages.

Considering now the circuit of transmitter 10 in more detail, the collector and base of oscillator transistor 30 may be considered analogous to the output and input elements of other equivalent switching devices, such as electron-discharge tubes. Likewise emitter 30e is a common element, and the cathode of an electron-discharge tube is also considered as a common element in the analogous circuit. Collector 30c is coupled through a tuned circuit 40, comprising an adjustable inductor 41 parallel-connected with a capacitor 42, and through a choke 43 to a first energizing conductor 44. Feedback capacitor 31 is coupled to the common connection between choke 43 and tuned circuit 40, and also coupled to the common connection between base 30b and a resistor 45. Resistor 45 is coupled to the common connection between voltage divider resistors 46 and 47 connected between first energizing conductor 44 and conductor 48.

Emitter 30e is coupled through a resistor 52 to primary winding 38 of transformer 37. Multivibrator circuit 12 includes resistors 53-58 and capacitors 60 and 61 connected in a well known multivibrator or flip-flop configuration to provide successive conduction and non-conduction of active switching units 32 and 33 when an appropriate unidirectional potential difference is applied between first energizing conductor 44 and a second energizing conductor 62. When transistor

32 is conducting and transistor 33 is nonconducting, capacitor 34 is coupled across secondary winding 36 to reflect a certain impedance through the transformer into the second feedback circuit coupled to the base and emitter of oscillator stage 11, thus to modulate the transmitter carrier signal at a first audio modulation frequency. As transistor 33 is subsequently rendered conductive and switches off transistor 32 in a well known action, capacitor 34 is isolated from the modulation circuit and capacitor 35 is coupled across secondary winding 36 to modulate the transmitter output signal at a second audio frequency. The alternation rate of the modulation is dependent upon the circuit components 53-61 within multivibrator circuit 12. From another standpoint transformer 37, together with capacitors 34 and 35, can be considered as a variable impedance arrangement coupled in the second feedback circuit of the oscillator, such that the multivibrator circuit varies the effective impedance value of this arrangement between first and second values at a predetermined repetition rate. Other types of transmitters can be utilized in connection with the receiver of this invention provided that the resultant carrier signal is modulated by at least two different frequencies alternating at a predetermined repetition rate.

DISCRIMINATOR CIRCUIT

FIG. 3 depicts discriminator circuit 22 which includes a first channel 70 connected to operate a first semiconductor switch 71 upon passage of a first signal at one preassigned modulating frequency through tuned circuit 72, and a second channel 73 for operation of a second semiconductor switch 74 when a second signal at the other modulating frequency is passed through its tuned circuit 75. Successive operation of transistors 71, 74, at the predetermined repetition rate is effective to operate control unit 23, which for purposes of this explanation is shown as a relay having a winding 23a and a contact set 23b for transmitting a control signal over conductors 23c, 23d to any desired component when a properly modulated carrier signal is received.

An audio amplifier or isolation stage 76 is shown in FIG. 3 and may be considered a part of conventional input circuit 16, the details of which are not pertinent to an understanding of discriminator circuit 22 and operation of the invention. Tuned circuit 72 comprises a capacitor 77 parallel coupled with primary winding 78 of transformer 80, which includes a secondary winding 81. Circuit 72 is tuned to pass a signal only at the first of the two modulating frequencies determined by the circuit of transmitter 10. When a signal of this frequency is passed through the tuned circuit the voltage at the top of winding 81 is positive-going, to pass current through diode 82 and resistor 83 and thus gate on semiconductor switch 71, shown as an NPN type transistor. The base of transistor 71 is coupled to resistor 83 and also over conductor 84 to the base of the PNP type transistor 74, and the emitters of these two semiconductor switches are connected in common at a common connection point 85. A parallel circuit comprising capacitor 86 and resistor 87 is coupled between point 85 and a plane of reference potential, commonly designated "ground." A series circuit comprising a capacitor 88 and a resistor 90 is connected in series between conductor 84 and common connection point 85.

The second channel in the receiver includes tuned circuit 75 comprising a capacitor 91 coupled in parallel with primary winding 92 of transformer 93, which includes a secondary winding 94. The upper end of winding 94 is connected to a common terminal 95, which is also connected to the lower end of secondary winding 81 and to the common connection between capacitor 88 and resistor 90. When a signal of the second modulating frequency passes through tuned circuit 75, a negative-going signal appears at the bottom of secondary winding 94 so that, through diode 96 and resistor 97, second transistor switch 74 is turned on. Terminal 98 is provided so that an energizing unidirectional potential difference can be applied between this terminal and ground to energize the discriminator circuit. A capacitor 24 is connected across relay winding 23a in conventional fashion.

When the demodulated signal at line 21 includes components at both the modulated audio frequencies, first and second signals are passed through both tuned circuits 72, 75 to gate on transistors 71, 74. It is evident that if both modulating signals are present simultaneously, voltages of opposite polarity appearing in the first and second channels will in effect cancel each other. Assuming that the modulating signals are received at the predetermined repetition rate, transistor 71 is gated on so that current flows from terminal 98 through the collector-emitter path of transistor 71 and through capacitor 86 to ground, to charge capacitor 86 during this portion of an operating cycle. Then, as the second signal of the second modulating frequency appears at line 21, transistor 71 is switched off and the transistor 74 is gated on. This action completes a circuit which allows capacitor 86 to discharge, at least partially, through the emitter-collector path of transistor 74 and winding 23a of relay or control unit 23 to effect contact closure.

It is emphasized that to unlock the discriminator circuit and actuate relay 23, not only must the two selected frequency signals be received but in addition they must alternate at the predetermined repetition rate. If the repetition rate of the received signals is higher than the predetermined rate, the integrating effect of capacitor 88 will prevent operation of control unit 23. The time constant of the RC combination of 86, 87 is sufficiently short to preclude operation of the relay when the repetition rate of the received signal is significantly lower than the predetermined repetition rate.

In a preferred embodiment of the invention the transmitter circuit of FIG. 2 was operated with a d-c potential difference of 22.5 volts applied between first and second energizing conductors 44, 62 with the polarity of the voltage on conductor 44 being positive relative to that on the second energizing conductor 62. Thus conductors 44, 62 are considered means for energizing the transmitter in that the applied potential difference passes over these conductors to the transmitter components. Similarly, in FIG. 3, terminal 98 and the various points referenced by the ground symbol are considered as means for applying a potential difference to the discriminator circuit, with the potential at terminal 98 being 30 volts positive relative to ground.

Further to enable those skilled in the art to make and use the invention with a minimum of experimentation, the table below sets out typical circuit values suitable to produce a carrier signal alternating at 240 Mega-

hertz, with modulating audio frequencies of 8 and 11 Kilohertz, and a predetermined repetition rate of 200 Hertz. For these operating values the circuit components were as follows:

Transmitter 10	
Component	Identification or Value
30	A415
32, 33	2N3860
42	2 picofarads
31	10.0 picofarads
34	0.017 microfarads
60, 61	0.047 microfarads
35	0.033 microfarads
43	1.5 microhenries
52	470 ohms
45	3.3 kiloms
46	47 kiloms
47	2.2 kilohms
53, 56	10 kiloms
54, 55	100 kiloms
57, 58	8.2 kilohms
Discriminator 22	
71	T I S 98
74	T I S 93
82	IN 4148
96	IN 4148
77	.022 microfarads
91	.033 microfarads
88	1.0 microfarads
86	5.0 microfarads
24	10.0 microfarads
83	1.2 kilohms
97	1.2 kilohms
90	470 ohms
87	5.6 kilohms

FIGS. 4 and 5 illustrate a modified remote control system, whereby two separate and distinct functions can be controlled remotely, using only one transmitter and one receiver. This is in contrast to the system of FIGS. 1-3, whereby only one function can be controlled remotely. The system of FIGS. 4 and 5 can be used for many different remote control applications. For example, the system is well adapted for controlling the opening and closing of two separate and distinct garage doors.

FIG. 4 shows a fragment of the modified transmitter 110, while FIG. 5 shows a fragment of the modified receiver 115. The transmitter 110 is capable of transmitting a radio signal which is modulated with either of two different pairs of tones. Thus, for example, the tones of the first pair may be at 8.5 Kilohertz and 10 Kilohertz, while the tones of the second pair are at 8.5 Kilohertz and 7 Kilohertz. It will be understood that these frequencies are cited merely by way of example, and that many other combinations of frequencies may be employed. It is convenient to select the pairs of tones so that one tone is common to both pairs. This tone is the one at 8.5 Kilohertz in the above mentioned example.

As before, the receiver 115 of FIG. 5 is capable of demodulating the radio signal and separating the three tones. When the tones of the first pair are received alternately at the correct repetition rate, the first control unit 23 is operated, as in the case of the system of FIGS. 1-3. However, the receiver 115 incorporates a modified discriminator 122, constructed and arranged so that a second control unit 123 is actuated when the tones of the second pair are received alternately at the correct repetition rate.

The illustrated control unit 123 is in the form of a relay having a coil 123a and a pair of normally open contacts 123b. Output leads 123c and 123d are connected to the contacts 123b. A capacitor 124 is connected in parallel with the winding 123a.

The details of the modified transmitter 110 are shown in FIG. 4. The modified transmitter 110 is the same as the previously described transmitter 10 in most respects. However, instead of simply providing two fixed capacitors 34 and 35, provision is made for changing the capacitance in one of the capacitor circuits. As shown in FIG. 4, a switch 125 is provided for connecting a third capacitor 126 in parallel with the second capacitor 35. When both capacitors 35 and 126 are in the circuit, the frequency of the corresponding tone is reduced. Thus, in accordance with the previously mentioned example, the capacitor 35 may be of such a value as to produce a tone having a frequency of 10 Kilohertz. The frequency of the tone may be reduced to 7 Kilohertz when the capacitor 126 is switched in parallel with the capacitor 35.

In the embodiment of FIG. 4, a second switch 127 is ganged with the selector switch 125. The illustrated switch 127 comprises a contactor 127a which is movable between contacts 127b and c. The contactor 127a engages the contact 127b when the selector switch 125 is closed. When the selector switch 125 is open, the contactor 127 engages the contact 127c.

The embodiment of FIG. 4 also includes an on-off switch 128 having a contactor 128a which is movable between contacts 128b and 128c. It will be seen that the contactor 128a is connected to the positive terminal of the power supply 129. The contacts 128b and c are connected to the contacts 127b and c.

The arrangement of the switches 125, 127 and 128 is such that the transmitter 110 can be turned off by operating the switch 128. If the switches 125 and 127 are then reversed in position, the transmitter will be turned on, and the selection of the tones will be changed. For the closed position of the switch 125, tones of 7 Kilohertz and 8.5 Kilohertz are produced alternately at the repetition rate of the multivibrator 12. For the open position of the switch 125, tones of 8.5 Kilohertz and 10 Kilohertz are produced alternately. It will be realized that these particular frequencies are subject to change over a wide range and are mentioned merely by way of example.

The discriminator 122 of FIG. 5 is the same in most respects as the discriminator 22 of FIG. 3. Corresponding components have been given the same reference characters in FIG. 5 as in FIG. 3. In order to operate the additional relay 123, the discriminator 122 is provided with an additional tuned circuit 130, comprising a transformer 135 with primary and secondary windings 136 and 137. A capacitor 138 is connected in parallel with the primary winding 136, so as to tune the winding to the frequency of the third tone. Thus, in accordance with the previously mentioned example, the frequency selective circuit 130 may be tuned to 7 Kilohertz, while the first and second circuits 72 and 75 are tuned to 8.5 Kilohertz and 10 Kilohertz, respectively.

To actuate the second relay 123, the discriminator 122 is also provided with a third electronic switching device, preferably in the form of a transistor 140, similar to the transistor 74. The relay winding 123a is connected between the collector of the transistor 140 and the ground. The emitter of the transistor 140 is con-

nected in the same way as the emitter of the transistor 74, to the junction lead 85. Thus, the transistor 140 is adapted to discharge the capacitor 86 through the relay winding 123a, when the transistor 140 is conductive.

It will be seen that a diode 141 and a resistor 142 are connected in series between one side of the secondary winding 137 and the base of the transistor 140. The other or return side of the winding 137 is connected to the junction lead 95, the same as the return sides of the other secondary windings 81 and 94. The diode 141 is polarized so as to develop negative signal voltages on the base of the transistor 140.

To perform automatic switching or gating operations, the discriminator 122 is provided with two additional diodes 143 and 144. The diode 143 is connected in series with the lead 84, between the bases of the transistors 71 and 74. The diode 144 is connected between the bases of the transistors 71 and 140. Both diodes 143 and 144 are polarized so as to transmit positive signals from the base of the transistor 71 to the bases of the transistors 74 and 140.

When the first and second tones are being received, the relay will be actuated. If, on the other hand, the first and third tones are being received alternately, the second relay 123 will be actuated.

The first tone, which may be at 8.5 Kilohertz, for example, is transmitted by the tuned transformer 80 and is rectified by the diode 82, so that a positive signal is produced on the base of the transistor 71. This positive signal causes the transistor 71 to be conductive, so that the capacitor 86 is charged from the power supply through the collector-emitter path of the transistor 71. The positive signal is transmitted by the diodes 143 and 144 to the bases of the transistors 74 and 140, so as to cause both of these transistors to be non-conductive.

When the second tone is being received, it is transmitted by the tuned transformer 93 and rectified by the diode 96 so as to produce a negative signal on the base of the transistor 74. This signal causes the transistor 74 to be conductive, so that the capacitor 86 is discharged through the transistor 74 and the relay winding 23a to ground. The diode 143 is effective to transmit the negative signal to the base of the transistor 71, so that it is rendered nonconductive. However, the diode 144 blocks the transmission of the negative signal to the base of the transistor 140 so that it remains nonconductive. The second tone may be at a frequency of 10 Kilohertz for example.

The third tone, which may be at a frequency of 7 Kilohertz, for example, is transmitted by the tuned transformer 135 and is rectified by the diode 141, so that a negative signal is applied to the base of the transistor 140. It is thereby rendered conductive so that the capacitor 86 will be discharged through the transistor 140 and the relay coil 123a to ground. The negative signal is transmitted by the diode 144 to the base of the transistor 71 so as to render it non-conductive. However, the diode 143 blocks the transmission of the negative signal to the base of the transistor 74.

Thus, when the first and second tones are received alternately, the capacitor 86 is charged through the transistor 71 for the duration of the first tone, and then is discharged through the transistor 74, for the duration of the second tone. The relay 23 is thereby actuated. When the first and third tones are being received alternately, the capacitor 86 is alternately charged through the transistor 71 and discharged through the transistor

140 and the relay winding 123a. The relay 123 is thereby actuated.

This discussion presupposes that the tones are being alternated at the correct repetition rate. If the repetition rate is much too high, the integrating effect of the capacitor 88 will prevent operation of the relays 23 and 123. If the repetition rate is much too low, the capacitor 86 will be discharged sufficiently by the resistor 87 to prevent operation of the relays 23 and 123.

The relays 23 and 123 may be employed to operate opening motors for two different garage doors. This is only one example of the many applications for which the system of FIGS. 4 and 5 may be employed.

It will be understood by those skilled in the art that the values of the components for the embodiment of FIGS. 4 and 5 may be varied over a wide range to suit various conditions. However, it may be helpful to present one set of values which have been found to be satisfactory. The values and characteristics of the components for the embodiment of FIGS. 4 and 5 may be the same as previously given for the embodiment of FIGS. 1, 2 and 3, except as set forth in the following table. The values in the following table presuppose that the three tones are to be a 8.5, 10 and 7 Kiloherzt. and that the repetition rate is to be at 150 Hertz:

Component	Value or Type
34	.020 microfarads
35	.015 microfarads
60, 61	.1 microfarads
124	10 microfarads
126	.015 microfarads
140	T 1 S 93
141, 143, 144	IN 4148
142	1.2 kilohms

Various other modifications, alternative constructions and equivalents may be employed, as will be understood by those skilled in the art.

I claim:

1. A remote control system, comprising a transmitter including a carrier oscillator for producing a radio frequency carrier signal, modulation oscillation means for modulating said carrier signal with modulation frequency signals in the high audio frequency range, pulse generator means for producing repetitive pulses at a predetermined repetition rate corresponding to a low audio frequency range, means connected to said pulse generator means and operable by said pulses for repetitively changing the frequency of said modulation frequency signals between first and second substantially different modulation frequencies in the high audio range, a receiver including an input circuit for receiving and demodulating said carrier signal thereby producing first and second tone signals alternating at the pulse generator rate, an output control device, and means for actuating the output control device electrically connected between the input circuit and the output control device, said actuation means impressing an actuating signal on the output control device only responsive to audio signals of the frequency of the first and second modulation frequencies which alternate between the first and second modulation frequencies at the rate of the pulse generator.

2. A remote control system, comprising a transmitter including a carrier oscillator for producing a radio fre-

quency carrier signal, modulation oscillation means for modulating said carrier signal with modulation frequency signals in the high audio frequency range, pulse generator means for producing repetitive pulses at a predetermined repetition rate corresponding to a low audio frequency range, means connected to said pulse generator means and operable by said pulses for repetitively changing the frequency of said modulation frequency signals between first and second substantially different modulation frequencies in the high audio range, a receiver including an input circuit for receiving and demodulating said carrier signal to produce first and second repetitively alternating tone signals at the first and second different modulation frequencies, first means operable by one of said tone signals for producing positive control pulses, second means operable by the other tone signal for producing negative control pulses, an integrating capacitor, charging means connected from said first and second means to said integrating capacitor for charging said capacitor with said positive and negative control pulses, first and second electronic switching means having respective control input electrodes connected in common to said integrating capacitor, an energy storage capacitor, an output control device, first output means connecting said first electronic switching means to said energy storage capacitor for charging said energy storage capacitor through said first electronic switching means in response to integrated pulses of one polarity across said integrating capacitor, and second output means for connecting said second electronic switching means between said energy storage capacitor and said output control device for discharging said energy storage capacitor into said output control device in response to integrated pulses of the opposite polarity across said integrating capacitor, said integrating capacitor preventing actuation of said output control device in response to tone signals alternating at a repetition rate substantially greater than the predetermined repetition rate.

3. A system according to claim 2, including a discharging resistor connected to said energy storage capacitor to prevent operation of said output control device in response to tone signals having a repetition rate substantially less than the predetermined repetition rate.

4. A transmitter for a remote control system, comprising a carrier frequency signal source, modulation means for modulating said source with a modulation frequency signal, said modulation means including an oscillator with a resonant circuit for determining the modulation frequency, at least one reactance element, and a free-running pulse generator including at least one electronic switch rendered alternatively conductive and non-conductive at a predetermined repetition rate, means connecting said reactance element and said electronic switch in a series circuit across said resonant circuit, said electronic switch thereby alternately connecting and disconnecting said reactance element into and from said resonant circuit to change the tuning thereof and thereby change said modulation frequency signal between two different modulation frequencies at said predetermined repetition rate.

* * * * *