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GARAGE DOOR REMOTE CONTROL SYSTEM

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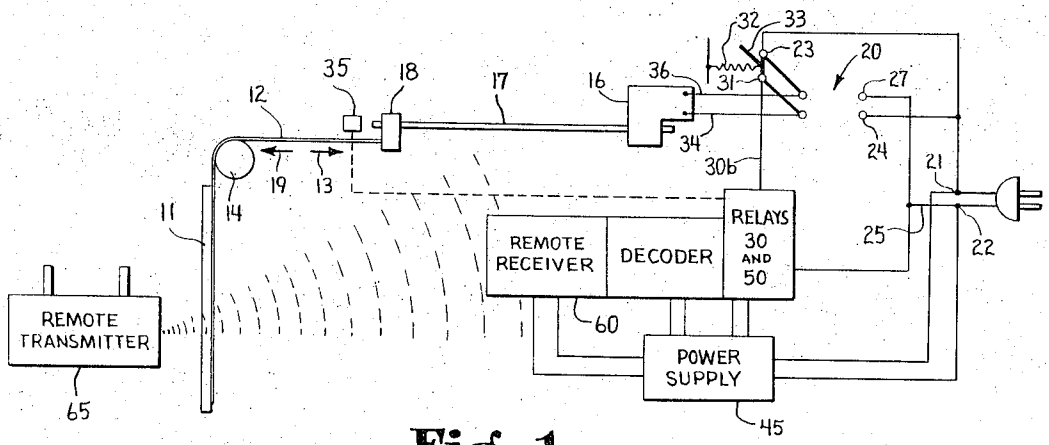


Fig. 1.

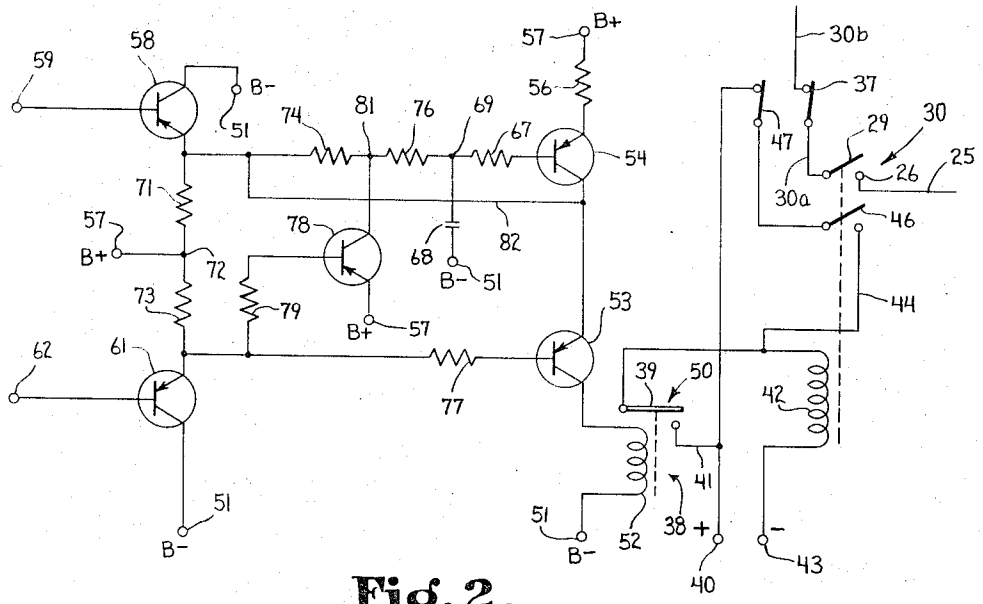


Fig. 2.

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GARAGE DOOR REMOTE CONTROL SYSTEM

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ABSTRACT OF THE DISCLOSURE

A system including a door, an electric motor to open the door, and a relay operable to energize the motor. A decoder having one signal input for a signal produced in response to a remote transmitter signal at one frequency, and another signal input for a signal produced in response to a remote transmitter signal at another frequency. A transistor circuit in said decoder and including first and second normally non-conducting transistors in series with a relay operating coil, the circuit also including a capacitor normally keeping the first transistor shut off, and a third transistor in the circuit responsive to a signal at the one signal input to turn on the first transistor and keep the second transistor turned off while a signal is present at the one signal input. A fourth transistor responsive to a signal at the other input to turn on the second transistor when there is no signal at the one input, and to turn on a fifth transistor to shut off the first transistor, whereby the relay coil is energized only after application of signals at the inputs in the proper sequence and not simultaneously, the decoder automatically returning to its initial state after removal of the input signals therefrom.

Background and description

This invention relates generally to systems for opening and closing garage doors by remote wireless control, and more particularly to a system responding only to remote transmission of two different predetermined signal frequencies in sequence and within a predetermined time period.

Various types of garage door openers have been devised for responding to control signals transmitted from a remote location, whereby a person driving up to a garage door can open the door without getting out of his vehicle. Some of these devices respond to the transmission of signals at a certain frequency to cause the door to open. These devices are subject to compromise by a burglar who may also have a transmitter capable of transmitting at the required frequency.

It is therefore a general object of the present invention to provide a system which is not subject to tampering by burglars.

A further object is to provide a system requiring transmission of signals of two different frequencies in order to open a door.

A further object is to provide a system making it impossible for a burglar to open the door by employing the two required frequencies simultaneously.

Described briefly, a typical embodiment of the present invention includes a garage door with a drive motor for opening the same, and a relay for closing the motor circuit to open the door. A remote control signal transmitter is employed which is capable of producing signal outputs at two different frequencies. A remote control signal receiver is responsive to received signals of one of the transmitter frequencies to produce a signal at one output, and it is responsive to received signals of the other transmitter frequency to produce a signal at another output. One signal output is connected to one input of a

novel decoder circuit and the other signal output is connected to another input of the decoder circuit, the decoder circuit being operable to control a relay in the motor circuit.

The decoder circuit is constructed to respond to the input signals thereto for closing the motor circuit only if:

(1) a first signal of a predetermined time duration is received thereby, at the one input, and;
(2) a second signal is received at the other input within a predetermined time period subsequent to termination of the first signal.

It is only when these signals are received in sequence, that the output circuit of the decoder will be closed to activate the relay. If the second input signal is received while the first signal is still being received, the decoder will not produce the relay action.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

FIG. 1 illustrates schematically the complete garage door remote centrol system, with the door and the drive mechanism being shown on a much smaller scale than the other components, to conserve space.

FIG. 2 is a schematic diagram of the decoder and relay components of the system.

Referring now to the drawings in detail, and particularly FIG. 1 thereof, a garage door **11** is shown in the closed position, this door being of a well known type, comprising hinged sections and capable of being opened by pulling the cable **12** in the direction of the arrow **13**. The cable passes over pulley **14**.

To drive the cable in the direction of the arrow **13**, a reversible motor **16** is employed having an output drive screw **17** on which the nut member **18** is carried and driven linearly. The nut member is connected to the cable. During forward operation of the motor it drives the screw in one rotational direction, and the cable is pulled in the direction of the arrow **13**. When the motor is reversed, it drives the screw in the other direction, and the cable in allowed to return in the direction of the arrow **19**. Either the weight of the door itself or suitable door return spring means, or both, can be employed to keep the cable taut when the drive motor is operated in reverse, to allow the door to close.

Power to drive the motor is supplied to input terminals **21** and **22** from a suitable power line, such as one supplying 110 volt alternating current electrical energy, for example. One of these terminals **21** is connected to poles **23** and **24** of a manual switch **20**. The other terminal **22** is connected through conductor **25** to a contactor **26** of relay **30** (FIG. 2) and to a pole **27** of the switch **20**. The movable contactor **29** of the relay **30** is connected through conductor (**30***a*, **30***b*) to the pole **31** of the manual switch. The illustrated switch is a double-pole, double-throw switch which normally makes contact between motor lead **34** and pole **31** and contact between motor lead **36** and pole **23**. A spring **32** normally keeps the switch in this condition. It may be manually operated however by pulling the handle **33** so as to electrically connect the poles **24** and **27** with motor leads **34** and **36**, respectively for reversing the motor to close the door. When the switch is in the position shown, and the contacts of relay **30** are closed, terminal **22** is connected through the relay **30** and pole **31** of switch **20** to the motor lead **34**. Terminal **21** is connected to the motor lead **36** through pole **23** of the switch **20**. Under these conditions the motor operates to drive the cable in the direction **13** to open the door.

A normally-closed, door-operated switch **37** (FIG. 2) may be employed between relay contactor **29** and the pole

31 so that, when the door is opened to a predetermined extent, the door will strike button 35 (FIG. 1) to open switch 37 and deenergize the motor.

The contacts 29 and 26 of relay 30 are closed by the decoder circuit operating relay 50 which includes the operator solenoid 38, movable contactor 39, and fixed contactor 41. Contactor 41 is connected to the positive terminal 40 of a direct current source of electrical energy and the contactor 39 is connected to the negative terminal 43 through the operating coil 42 for the relay 30. Conventional power supply means 45 may be employed to provide the desired potentials at terminals 40 and 43 as well as at supply inputs to the decoder and remote receiver. However terminals 40 and 43 could be connected to an alternating current source such as at terminals 21 and 22 (FIG. 1) if desired. A holding circuit is provided by the contactor 44 connected to the upper end of the coil 42. Contactor 46 of the holding circuit is connected through the normally-closed door-operated switch 47 to the terminal 40. Switch 47 like switch 37, is normally closed, but is opened when the door has opened to the extent desired so that it operates the button 35 (FIG. 1).

Referring further to FIG. 2, the output circuit of the decoder extends from power supply source 57 of positive direct current potential (B+) through resistor 56, through the emitter-collector path of transistor 54 and the emitter-collector path of transistor 53, and through the operating coil 52 of relay solenoid 38 to a source 51 of negative direct current potential (B—) derived from the power supply. Both of these transi tors are normally maintained in the non-conducting state so that no current flows through the output circuit of the decoder. Therefore the contacts 39 and 41 of relay 50 are normally open. It is only when the output circuit of the decoder is closed (i.e. conducting current) that the solenoid 38 is energized to close the contacts 39 and 41 of the relay 50.

Referring further to FIG. 2, a first control transistor 58 has the base electrode thereof connected to terminal 59 to receive an input signal from a first channel of remote control signal receiver 60 when the remote receiver is receiving signals of a first predetermined frequency from the remote control signal transmitter 65. Similarly the control transistor 61 has its base electrode connected to the terminal 62 to receive a signal input from a second channel of the remote receiver when the receiver is receiving signals of a second predetermined frequency. To operate the illustrated decoder with the PNP transistors therein as shown, the remote control signal receiver must produce negative going signals. This can readily be accomplished in any of a variety of ways well known in the art. Obviously, a decoder responsive to positive going signals would also be within the scope of this invention.

The collector of transistor 58 is connected to the source 51 of negative direct current electrical energy (B—). Likewise the collector of transistor 61 is connected to source 51. A capacitor 68 is connected between the B— source 51 and the junction 69 between resistor 76 and resistor 67.

The emitter of transistor 58 is connected through resistor 71 to the B+ source 57. Likewise the emitter of transistor 61 is connected through resistor 73 to terminal 72. The emitter of transistor 58 is also connected through resistors 74 and 76 to the junction 69, and resistor 77 is connected between the emitter of transisor 61 and the base of output transistor 53. An additional transistor 78 is provided, with its base electrode connected through the resistor 79 to the emitter of transistor 61. Transistor 78 has an emitter connected to B+ source 57, and the collector thereof is connected to junction 81 between resistors 74 and 76. A conductor 82 is connected directly between the emitter of transistor 58 and the emitter of transistor 53.

Operation

When no signal is present at either of the terminals 59 and 62, all of the five transistors are non-conducting. Capacitor 68 is holding a positive charge thereon derived from the B+ source through resistors 71, 74 and 76 so that the junction 69 is at a positive potential biasing transistor 54 off. When the remote control signal receiver receives signals at a first predetermined frequency, it will produce a negative going output signal at terminal 59. This signal will turn on transistor 58 and produce a negative pulse at the emitter thereof. This pulse discharges capacitor 68 through resistors 74 and 76, and during discharge of capacitor 68, the potential at junction 69 drops sufficiently to forward bias transistor 54. Transistor 54 will then remain conductive after the negative pulse is removed, because capacitor 68 must charge up again before it can again bias transistor 54 to a non-conductive state.

During the period of time that transistor 54 is conducting and capacitor 68 is recharging, if an appropriate negative signal is provided by the remote control signal receiver to the terminal 62, it will forward bias transistor 61 to produce a negative pulse at the emitter thereof. This pulse will cause output transistor 53 to conduct and will also cause transistor 78 to conduct. Transistor 53 thus completes the output circuit between terminal 51 and B+ source 57, energizing the operating coil 52 of the relay 53 to close the contacts 39 and 41 thereof. This energizes coil 42 and closes the relay 30 to start the door control motor 16 to open the door.

Transistor 78, when conducting, rapidly recharges capacitor 68 and this expedites the rise of potential at junction 69 to turn off transistor 54 and thus open the decoder output circuit. Of course this would normally occur before the garage door had sufficiently opened, so the holding circuit in relay 30 continues the opening of the garage door.

From the foregoing description, it can be understood that if the negative signal is not applied to input terminal 62 before capacitor 68 has recharged, the decoder output circuit will not be closed. This is because the charge on capacitor 68 will have risen to turn off transistor 54 before the signal is applied at terminal 62. This means that even though a negative signal is later applied to terminal 62, and turns on transistor 53, transistor 54 already will be turned off and the output circuit will be open, preventing activation of the relays. So it is seen that to operate the door of the present system, it is necessary to transmit the second required frequency within a predetermined time period after transmission of the first frequency. This time period is determined primarily by the time constant of the charging circuit for capacitor 68, which charging circuit includes resistors 71, 74, and 76 between junction 72 and the junction 69.

Another feature of the operation of the circuit may be best appreciated if we consider first a method by which a burglar might attempt to determine the frequencies required for operating the system. He could employ two variable frequency generators. It is conceivable that by sweeping the band of frequencies producible by these generators, the first frequency required by the remote receiver could be generated just prior to the second predetermined frequency. This would ordinarily operate the system of the present invention. To avoid this result, the emitter of transistor 58 is connected directly by conductor 82 to the emitter of transistor 53. When the first predetermined frequency causes the remote receiver to apply a negative signal to the base of transistor 58, a negative pulse is produced at the emitter thereof and applied through conductor 82 to the emitter of transistor 53. If this pulse is present when the negative signal from the other channel of the remote receiver is applied to the base of transistor 61, it will prevent the development of a forward bias across transistor 53. Therefore it is appar-

ent that the simultaneous application of negative signals to terminals **59** and **62** will not close the output circuit. In other words, the negative pulse at the emitter of transistor **58** must be terminated before the negative pulse at the emitter of transistor **61** can serve to activate the relay.

An unauthorized person attempting to open a door controlled by the system of the present invention, might apply a transmitted signal at the second predetermined frequency which would maintain a negative signal at the input terminal **62**. Then with another signal generator he could transmit a range of frequencies until they reached the one which would cause the remote receiver to apply a negative signal to terminal **59**. However the signal at terminal **59** will not be able to discharge capacitor **68** sufficiently to forward bias transistor **54**, because the presence of the negative signal at the emitter of transistor **61** keeps transistor **78** conducting to maintain a potential at junction **69** which is at or near the B+ potential. Thus the presence of the negative signal at terminal **62** disables a signal at terminal **59** from forward biasing transistor **54**, and the relay cannot be operated.

From the foregoing description, it will be apparent that the negative signal at terminal **59** should be a short pulse and should be received prior to the signal at terminal **62**, in order to activate the relay. Also the signal at terminal **62** should be received within a short period of time after the signal at terminal **59**, and this period of time is determined by the time constant of capacitor **68** and the resistor network including resistors **71**, **74**, **76**, which are associated therewith.

One example of components and values thereof which can be employed in the decoder, is as follows:

Description

Transistor—

58	PNP	2SB 56
61	PNP	2SB 56
78	PNP	2SB 56
54	PNP	2SB 56
53	PNP	2SB 56

Value

Capacitor **68**	microfarads	10
Resistor—		
67	ohms	10000
71	do	1000
73	do	1000
74	do	30000
76	do	10000
77	do	10000
79	do	10000
56	do	100

Direct current potentials:

Terminal—

57	volts pos	6
51	volts neg	6
59	V. DC neg [1]	0.80
62	V. DC neg [1]	0.80

Relay coil **52**—Pull-in current minimum .01 ampere at 10 V. DC.

[1] With respect to emitter potential.

Power supplies are available which can be coupled to the line voltage input and apply the desired direct current voltages to the remote receiver, decoder, and to the relay terminals **40** and **43**. Wireless remote control for this invention may employ supersonic or radio or other types of remote control signal transmitters and receivers and the transmitter may be of the two-button type as shown, or some other type of manual transmitter actuator may be employed. Examples of types which may be used are:

Manufacturer:	Model description
Admiral	5 D9.
Andrea	RCR–1.
Zenith	400 Space Command.

Transmiter-receiver systems of the general types shown and described in United States Patents 2,817,025 and 2,923,918 issued Dec. 17, 1957, and Feb. 2, 1960, respectively, to Robert Adler, and 2,871,463 issued Jan. 27, 1959, to Robert W. Beckwith, may be used, if desired.

Of course it is possible within the scope of the present invention to employ transmitters and receivers capable of producing more than two different frequencies.

While the invention has been disclosed and described in some detail in the drawings and foregoing description, they are to be considered as illustrative and not restrictive in character, as other modifications may readily suggest themselves to persons skilled in this art and within the broad scope of the invention, reference being had to the appended claims.

The invention claimed is:

1. A door opening system comprising:

a door;

a motor connected to said door and operable, when energized, to open said door;

a wireless signal transmitter, said transmitter having a first manual actuator operable, when actuated, to transmit wireless waves at a first frequency, and said transmitter having a second manual actuator operable, when actuated, to transmit wireless waves at a second frequency;

wireless signal receiver and decoder means said decoder means having an output circuit coupled to said motor to energize said motor when said output circuit is closed;

first control circuit means coupled to said output circuit and including means receiving signals at said first frequency and responsive thereto to close a first portion and hold open a second portion of said output circuit;

and second control circuit means coupled to said output circuit and including means receiving signals at said second frequency and responsive thereto during absence of signals at said first frequency to close a second portion of said output circuit and then open said first portion thereof;

and charge storage means coupled to said first control circuit means and to said second control circuit means, said storage means being chargeable to open said first portion of said output circuit and prevent said control circuit means from closing said output circuit unless signals of said second frequency are received within a predetermined time after termination of reception of signals at said first frequency.

2. A door opening system comprising:

a door;

a motor connected to said door and operable, when energized, to open said door;

a supersonic signal transmitter, said transmitter having a first manual actuator operable, when actuated, to transmit supersonic air-borne waves at a first frequency, and said transmitter having a second manual actuator operable, when actuated, to transmit supersonic air-borne waves at a second frequency;

supersonic signal receiver means and decoder means, said decoder means having an output circuit coupled to said motor to energize said motor when said output circuit is closed;

first control circuit means coupled to said output circuit and including means receiving signals at said first frequency and responsive thereto to close a first portion and hold open a second portion of said output circuit;

and second control circuit means coupled to said output circuit and including means receiving signals at said second frequency and responsive thereto during absence of signals at said first frequency to close a second portion of said output circuit in series

with said first portion to complete said output circuit and then open said first portion thereof;

and charge storage means coupled to said first control circuit means and to said second control circuit means, said storage means for chargeable to open said first portion of said output circuit and prevent said first control circuit means from closing said first output circuit portion while signals of said second frequency are received.

3. In a control system, the combination comprising:

mechanical drive means;

switch means coupled to said drive means and to a first source of electrical energy, said switch means including an operator operable, when activated, to couple said drive means to said source;

decoder means including first and second normally-open switches coupled to said operator and a source of electrical energy, and said decoder means having first and second signal inputs;

receiver means responsive to reception of wireless signals of a first character to provide a signal at said first input, and responsive to reception of wireless signals of a second character to provide a signal at said second input,

said switches, when both are closed, activating said operator;

and said decoder means being normally responsive to a signal at said second input to hold open said first switch during presence of said signal at said second input.

4. In a control system, the combination comprising:

mechanical drive means;

switch means coupled to said drive means and to a first source of electrical energy, said switch means including an operator operable, when activated, to couple said drive means to said source;

decoder means including first and second normally-open switches coupled to said operator and a source of electrical energy, and said decoder means having first and second signal inputs;

receiver means responsive to reception of wireless signals of a first character to provide a signal at said first input, and responsive to reception of wireless signals of a second character to provide a signal at said second input,

said switches, when both are closed, activating said operator;

said decoder means being normally responsive to a signal at said first input to close said first switch and hold open said second switch during presence of said signal at said first input.

5. In a control system, the combination comprising:

mechanical drive means;

relay means coupled to said drive means and to a first source of electrical energy, said relay means including an operator operable, when activated, to couple said drive means to said source;

decoder means including first and second normally-open switches coupled to said operator and a source of electrical energy, and said decoder means having first and second signal inputs;

receiver means responsive to reception of wireless signals of a first character to provide a signal at said first input, and responsive to reception of wireless signals of a second character to provide a signal at said second input,

said switches, when both are closed, activating said operator;

and said decoder means being normally responsive to a signal at said second input to hold open said first switch during presence of said signal at said second input;

said decoder means being normally responsive to a signal at said first input to close said first switch and hold open said second switch during presence of said signal at said first input.

6. In a garage door control system, the combination comprising:

a supersonic signal transmitter, said transmitter having a first manual actuator operable, when actuated, to transmit supersonic air-borne waves at a first frequency, and said transmitter having a second manual actuator operable, when actuated, to transmit supersonic air-borne waves at a second frequency;

a door;

a door drive motor coupled to said door;

relay means coupling said motor to a first source of electrical energy, said relay means including an operator;

a relay control circuit coupled across a second source of electrical energy and including first and second switching transistors with their emitter-collector paths in series with said second source and with said operator;

a first charge storage capacitor connected to a base electrode of said first transistor and to a source of positive direct current charging potential, said storage capacitor being charged by said source of charging potential and normally back-biasing said first transistor so that it is non-conductive;

said source of positive charging potential being coupled to a base electrode of said second transistor and normally back-biasing said second transistor so that it is non-conductive;

a third switching transistor having its emitter coupled to said storage capacitor and its collector coupled to a source of negative direct current discharging potential;

a supersonic remote control signal receiver having first and second outputs and adapted to produce a negative signal at said first output in response to reception of a supersonic remote control signal of said first frequency, and adapted to produce a negative signal at said second output in response to reception of a remote control signal of said second frequency;

said first output being connected to the base electrode of said third transistor to forward bias and thereby render said third transistor conductive in response to reception of a remote control signal of said first frequency to connect said capacitor to said source of negative discharging potential for discharge of the positive charge on said capacitor and development of a negative charge thereon to forward bias and enable conduction by said first transistor;

a fourth switching transistor coupled to the base electrode of said second transistor and to said source of negative discharging potential, said fourth transistor having a base electrode coupled to said second output of said remote control signal receiver, said fourth transistor being thereby forward biased and rendered conductive in response to reception of a remote control signal of said second frequency to connect the base electrode of said second transistor to said source of discharging potential to forward bias and enable conduction by said second transistor;

a fifth switching transistor coupled between said storage capacitor and said source of charging potential, said fifth transistor having a base electrode coupled to said source of positive charging potentail to normally back-bias and keep said fifth transistor non-conductive, the base electrode of said fifth transistor also being coupled through the emitter-collector path of said fourth transistor to said source

of negative discharging potential when said fourth transistor is conductive, to thereupon render said fifth transistor conductive and provide a charge on said storage capacitor sufficient to render said first transistor non-conductive;

and conductor means connecting said second transistor to said third transistor whereby conduction by said second transistor is prevented when said third transistor is conducting.

7. In a garage door control system, the combination comprising:

a door;

a door drive motor coupled to said door;

relay means coupling said motor to a first source of electrical energy, said relay means including an operator;

a relay control circuit coupled across a second source of electrical energy and including first and second switching transistors with their emitter-collector paths in series with said second source and with said operator;

a first charge storage capacitor connected to a base electrode of said first transistor and to a source of positive direct current charging potential, said storage capacitor being charged by said source of charging potential and normally back-biasing said first transistor so that it is non-conductive;

said source of positive charging potential being coupled to a base electrode of said second transistor and normally back-biasing said second transistor so that it is non-conductive;

a third switching transistor having its emitter coupled to said storage capacitor and its collector coupled to a source of negative direct current discharging potential;

a remote control signal receiver having first and second outputs and adapted to produce a negative signal at said first output in response to reception of a remote control signal of a first frequency, and adapted to produce a negative signal at said second output in response to reception of a remote control signal of a second frequency;

said first output being connected to the base electrode of said third transistor to forward bias and thereby render said third transistor conductive in response to reception of a remote control signal of said first frequency to connect said capacitor to said source of negative discharging potential for discharge of the positive charge on said capacitor and development of a negative charge thereon to forward bias and enable conduction by said first transistor;

a fourth switching transistor coupled to the base electrode of said second transistor and to said source of negative discharging potential, said fourth transistor having a base electrode coupled to said second output of said remote control signal receiver, said fourth transistor being thereby forward biased and rendered conductive in response to reception of a remote control signal of said second frequency to connect the base electrode of said transistor to said source of discharging potential to forward bias and enable conduction by said second transistor;

a fifth switching transistor coupled between said storage capacitor and said source of charging potential, said fifth transistor having a base electrode coupled to said source of positive charging potential to normally back-bias and keep said fifth transistor non-conductive, the base electrode of said fifth transistor also being coupled through the emitter-collector path of said fourth transistor to said source of negative discharging potential when said fourth transistor is conductive, to thereupon render said fifth transistor conductive and provide a charge on said storage capacitor sufficient to render said first transistor non-conductive;

and conductor means connecting said second transistor to said third transistor whereby conduction by said second transistor is prevented when said third transistor is conducting.

8. In a garage door control system the combination comprising:

a door;

a door drive motor coupled to said door;

relay means coupling said motor to a first source of electrical energy, said relay means including an operator;

a relay control circuit coupled across a second source of electrical energy and including first and second electronic switching devices in series with said second source and with said operator;

a first charge storage device connected to a control electrode of said first switching device and to a source of charging potential, said storage device being charged by said source of charging potential and holding said first switching device non-conductive;

said source of charging potential being coupled to a control electrode of said second switching device and holding said second switching device non-conductive;

a third electronic switching device coupled to said storage device and to a source of discharging potential;

a remote control signal receiver having first and second outputs and adapted to produce a signal at said first output in response to reception of a remote control signal of a first frequency, and adapted to produce a signal at said second output in response to reception of a remote control signal of a second frequency;

said first output being connected to a control electrode of said third switching device to render said third switching device conductive in response to reception of a remote control signal of said first frequency to connect said storage device to said source of discharging potential for discharge of said storage device to enable conduction by said first switching device;

a fourth electronic switching device coupled to a control electrode of said second switching device and to said source of discharging potential, said fourth switching device having a control electrode coupled to said second output of said remote control signal receiver, said fourth switching device being thereby rendered conductive in response to reception of a remote control signal of said second frequency to connect the control electrode of said second switching device to said source of discharging potential to enable conduction by said second switching device;

a fifth electronic switching device coupled between said storage device and said source of charging potential, said fifth switching device having a control electrode coupled to said source of charging potential to normally keep said fifth switching device non-conductive, the control electrode of said fifth switching device also being coupled through said fourth switching device to said source of discharging potential when said fourth switching device is conductive, to thereupon render said fifth switching device conductive and provide a charge on said storage device sufficient to render said first switching device non-conductive;

and conductor means connecting said second switching device to said third switching device whereby conduction by said second switching device is prevented when said third switching device is conducting.

9. In a garage door control system the combination comprising:
a door;
a door drive motor coupled to said door;
relay means coupling said motor to a first source of electrical energy, said relay means including an operator;
a relay control circuit coupled across a second source of electrical energy and including first and second switching devices in series with said second source and with said operator;
a first charge storage device connected to a control member of said first switching device and to a source of charging potential, said storage device being charged by said source of charging potential and holding said first switching device non-conductive;
said source of charging potential being coupled to a control member of said second switching device and holding said second switching device non-conductive;
a third switching device coupled to said storage device and to a source of discharging potential;
a remote control signal receiver having first and second outputs and adapted to produce a signal at said first output in response to reception of a remote control signal of first frequency, and adapted to produce a signal at said second output in response to reception of a remote control signal of second frequency;
said first output being connected to a control member of said third switching device to render said third switching device conductive in response to reception of a remote control signal of said first frequency to connect said storage device to said source of discharging potential for discharge of said storage device to enable conduction by said first switching device;
a fourth switching device coupled to a control member of said second switching device and to said source of discharging potential, said fourth switching device having a control member coupled to said second output of said remote control signal receiver, said fourth switching device being thereby rendered conductive in response to reception of a remote control signal of said second frequency to connect the control member of said second switching device to said source of discharging potential to enable conduction by said second switching device;
a fifth switching device coupled between said storage device and said source of charging potential, said fifth switching device having a control member coupled to said source of charging potential to normally keep said fifth switching device non-conductive, the control member of said fifth switching device also being coupled through said fourth switching device to said source of discharging potential when said fourth switching device is conductive, to thereupon render said fifth switching device conductive and provide a charge on said storage device sufficient to render said first switching device non-conductive;
and conductor means connecting said second switching device to said third switching device whereby conduction by said second switching device is prevented when said third switching device is conducting.

10. In a control system, the combination comprising:
a source of electrical energy;
first and second switching devices in series with said energy source and with a load device;
a first charge storage device connected to a control member of said first switching device and to a source of charging potential, said storage device being charged by said source of charging potential and holding said first switching device non-conductive;
said source of charging potential being coupled to a control member of said second switching device and holding said second switching device non-conductive;
a third switching device coupled to said storage device and to a source of discharging potential;
a remote control signal receiver having first and second outputs and adapted to produce a signal at said first output in response to reception of a remote control signal of a first frequency, and adapted to produce a signal at said second output in response to reception of a remote control signal of a second frequency;
said first output being connected to a control member of said third switching device to render said third switching device conductive in response to reception of a remote control signal of said first frequency to connect said storage device to said source of discharging potential for discharge of said storage device to enable conduction by said first switching device;
a fourth switching device coupled to a control member of said second switching device and to said source of discharging potential, said fourth switching device having a control member coupled to said second output of said remote control signal receiver, said fourth switching device being thereby rendered conductive in response to reception of a remote control signal of said second frequency to connect the control member of said second switching device to said source of discharging potential to enable conduction by said second switching device;
a fifth switching device coupled between said storage device and said source of charging potential, said fifth switching device having a control member coupled to said source of charging potential to normally keep said fifth switching device non-conductive, the control member of said fifth switching device also being coupled through said fourth switching device to said source of discharging potential when said fourth switching device is conductive, to thereupon render said fifth switching device conductive and provide a charge on said storage device sufficient to render said first switching device non-conductive;
and conductor means connecting said second switching device to said third switching device whereby conduction by said second switching device is prevented when said third switching device is conducting.

11. In a control system the combination comprising:
a source of electrical energy;
first and second switching devices in series with said energy source and with a load device;
a first charge storage device connected to a control member of said first switching device and to a source of charging potential, said storage device being charged by said source of charging potential and holding said first switching device non-conductive;
said source of charging potential being coupled to a control member of said second switching device and holding said second switching device non-conductive;
a third switching device coupled to said storage device and to a source of discharging potential;
a remote control signal receiver having first and second outputs and adapted to produce a signal at said first output in response to reception of a remote control signal of a first frequency, and adapted to produce a signal at said second output in response to reception of a remote control signal of a second frequency;
said first output being connected to a control member of said third switching device to render said third switching device conductive in response to reception of a remote control signal of said first frequency to connect said storage device to said source of discharging potential for discharge of said storage device to enable conduction by said first switching device;

a fourth switching device coupled to a control member of said second switching device and to said source of discharging potential, said fourth switching device having a control member coupled to said second output of said remote control signal receiver, said fourth switching device being thereby rendered conductive in response to reception of a remote control signal of said second frequency to connect the control member of said second switching device to said source of discharging potential to enable conduction by said second switching device;

and a fifth switching device coupled between said storage device and said source of charging potential, said fifth switching device having a control member coupled to said source of charging potential to normally keep said fifth switching device non-conductive, the control member of said fifth switching device also being coupled through said fourth switching device to said source of discharging potential when said fourth switching device is conductive, to thereupon render said fifth switching device conductive and provide a charge on said storage device sufficient to render said first switching device non-conductive.

12. In a garage door control system, the combination comprising:

a relay control circuit including a source of direct current electrical energy and the series combination of first and second transistors and a relay operating coil and a resistor, said series combination being connected across said source;

a control circuit for said first transistor and including a series combination of the emitter-collector path of a third transistor, first, second, and third resistors, and said energy source,

said third transistor having a control signal input from a remote control signal receiver;

a control circuit for said second transistor and including the series combination of the emitter-collector path of a fourth transistor, and a fourth resistor, and said energy source,

said fourth transistor having a control signal input from said remote control signal receiver;

a charge storage device connected through a fifth resistor to one side of said source and to a point in the control circuit for said first transistor, said first transistor being normally non-conductive and preventing discharge of said storage device whereby said storage device derives a charge from said energy source and applies the potential at the one side of said energy source to said control circuit point to bias said first transistor non-conducting,

said third transistor being rendered conductive by an input signal applied to the control signal input thereof and thereupon discharging said storage device to said energy source and biasing said first transistor into conduction,

said fourth transistor being rendered conductive by an input signal applied to the control signal input thereof to thereupon bias said second transistor into conduction,

a fifth transistor connected between said energy source and said second transistor, said fifth transistor having a control signal input connected through a sixth resistance to said one side of said source to normally bias said fifth transistor non-conducting, the control signal input of said fifth transistor being connected to said fourth transistor whereby said fifth transistor is forward biased when said fourth transistor is rendered conductive,

said fifth transistor, when conductive, maintaining a sufficient charge on said charge storage device to prevent said first transistor from conducting when said fourth transistor is conducting,

and a conductor connected between said third transistor and said first transistor and connected through said third transistor directly to said energy source when said third transistor is conducting to prevent current flow into said second transistor when said third transistor is conductive and thus avoid closure of said relay control circuit during the presence of the input signal at said third transistor.

13. In a control system, the combination comprising:

a relay control circuit including a source of direct current electrical energy and the series combination of first and second transistors and a relay operating coil and a resistor, said series combination being connected across said source;

a control circuit for said first transistor and including the series combination of the emitter-collector path of a third transistor, resistance means, and said energy source,

said third transistor having a control signal input from a remote control signal receiver;

a control circuit for said second transistor and including the emitter-collector path of a fourth transistor, in series with said energy source, said fourth transistor having a control signal input from said remote control signal receiver,

a charge storage device connected through a fifth resistor to one side of said source and to a point in the control circuit for said first transistor, said first transistor being normally non-conductive and preventing discharge of said storage device whereby said storage device derives a charge from said source and applies the potential of one side thereof to said control circuit point to bias said first transistor non-conducting,

said third transistor being rendered conductive by an input signal applied to the control signal input thereof and thereupon discharging said storage device to said energy source and biasing said first transistor into conduction,

said fourth transistor being rendered conductive by an input signal applied to the control signal input thereof to thereupon bias said second transistor into conduction,

a fifth transistor connected between said energy source and said second transistor, said fifth transistor having a control signal input connected through a sixth resistance to said one side of said source to normally bias said fifth transistor non-conducting, the control signal input of said fifth transistor being connected to said fourth transistor whereby said fifth transistor is forward biased when said fourth transistor is rendered conductive,

said fifth transistor, when conductive, maintaining a sufficient charge on said charge storage device to prevent said first transistor from conducting when said fourth transistor is conducting.

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