

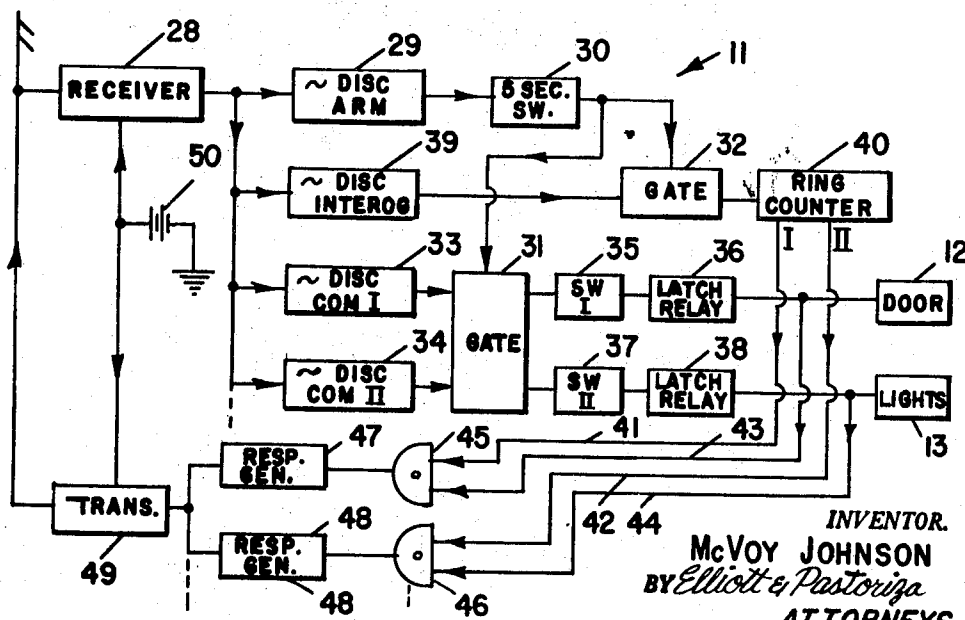
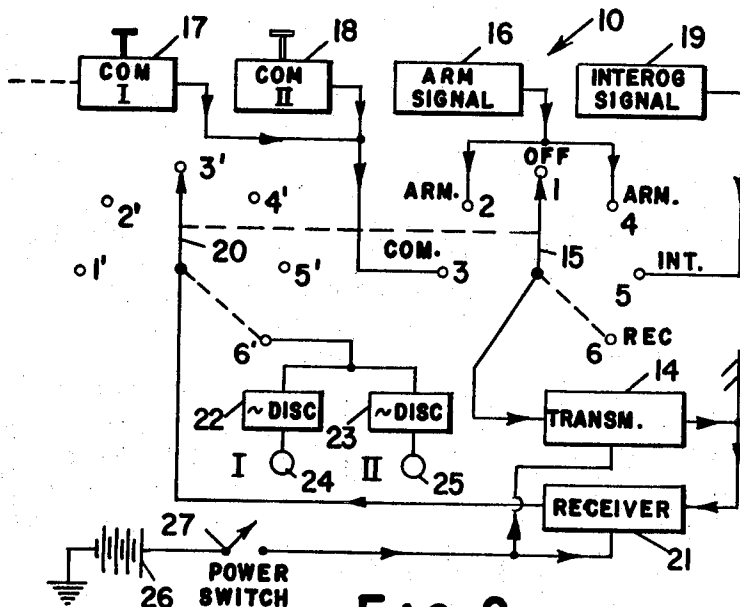
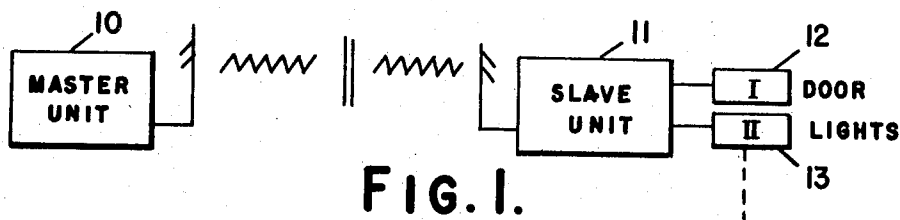
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RADIO CONTROL SYSTEM

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RADIO CONTROL SYSTEM
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ABSTRACT OF THE DISCLOSURE

A radio control system is provided including a master unit for transmitting a coded arming signal and subsequently desired command signals to selected mechanisms to be operated from a remote point. The system also includes a slave unit responsive only to the arming signal to pass the selected command signals to the selected mechanisms. Means are provided for transmitting an interrogating signal to the slave unit and transmitting back from the slave unit signals indicating whether or not the particular mechanisms such as garage doors, lights, windows, or the like have been actuated so that the operator can determine the state or condition of the mechanism.

This invention relates generally to radio control systems and more particularly, to an improved radio control system for actuating one or more selected mechanisms by radio signals from a remote location.

For convenience in both domestic and commercial environments, it is oftentimes desirable to be able to actuate one or more selected mechanisms from a location distant from the mechanisms.

For example, such mechanisms may include garage doors, windows, various lights in a house or office, air conditioning equipment, motors, and the like. The use of radio signals is preferable for such remote operation since it eliminates the inconvenience of wires and provides greater portability of the controlling unit.

One problem encountered with the use of radio signals for triggering the actuation of various mechanisms is the possibility of inadvertent operation of the mechanism resulting from spurious radio signals. Accordingly, any radio control system would desirably include a special coded signal which must first be transmitted before the mechanisms can be operated by a command signal.

Further, it is desirable in the event the mechanism is located at a point not visible to the operator, that means be provided to determine whether or not the mechanism has actually been operated or is in an "on" condition.

With the foregoing considerations in mind, it is a primary object of this invention to provide a vastly improved radio control system for actuating one or more selected mechanisms from a remote location by means of radio command signals.

More particularly, it is an object to provide a radio control system including arming signal generating means for transmitting a coded signal to place the mechanisms in condition to be subsequently operated by a command signal, to the end that operation of the mechanisms will not result from accidentally generated spurious radio signals or by unauthorized transmitters.

Another important object is to provide a radio control system including interrogating signal generating means for enabling the transmitting of an interrogating signal and means for receiving an interrogation response signal to indicate which, if any one or more selected mechanisms, have been actuated.

Other objects of this invention are to provide an improved radio control system including a master unit for generating command signals and a slave unit for actuating one or more of a plurality of mechanisms, which employs

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simple and reliable circuit components, is compact, light and easy to operate.

Briefly, these as well as many other objects and advantages of this invention are attained by providing a master unit including transmitter means for transmitting a coded arming signal and subsequently any selected command signals corresponding to selected mechanisms to be actuated. Also included is a slave unit responsive only to the arming signal to pass the selected command signals to the selected mechanisms to actuate the same. The system further includes means for transmitting an interrogating signal to the slave unit and transmitting back from the slave unit signals indicative of the particular mechanisms that have been actuated to the end that the operator may determine the state or condition of the various mechanisms connected to the slave unit.

A better understanding of the invention will be had by referring to a preferred embodiment thereof as illustrated in the accompanying drawings, in which:

FIGURE 1 is a simple block diagram illustrating the basic units of the radio control system;

FIGURE 2 is a more detailed block diagram showing various components incorporated in the master unit; and,

FIGURE 3 is a detailed block diagram illustrating various components incorporated in the slave unit.

Referring first to FIGURE 1, the radio control system includes a master unit 10 adapted to transmit various command radio signals. These command signals may constitute a carrier wave amplitude modulated at given frequencies individual to the particular command signals transmitted. A slave unit 11 is adapted to receive such command signals and channel them to operate a plurality of mechanisms such as indicated at 12 and 13 connected to the slave unit. By way of example, two such mechanisms are illustrated for operating a garage door and the lights in the garage. While many more mechanisms could be connected to the slave unit as indicated by the dotted lines beneath the mechanism 13, only the two mechanisms are shown for purposes of illustration.

In the operation of the system of FIGURE 1, an operator at a remote location may actuate the master unit 10 to transmit various signals to the slave unit 11 and effect actuation of one or more of the mechanisms 12, 13, and so forth.

As will become clearer as the description proceeds, the master unit also includes an arming signal generating means for placing the slave unit in condition to receive the command signals so that the slave unit cannot be operated by spurious radio signals but only in response to reception of the coded arming signal. Further, the master unit includes interrogating signal generating means to pass an interrogating signal to the slave unit 11 to determine whether or not the door 12 and/or lights 13 have been actuated.

Referring now to FIGURE 2, the components in the master unit for carrying out the various functions above will be described in greater detail. As shown, the master unit includes a transmitter 14 connected to a switch including a switch wiping arm 15. This switch also includes a center contact constituting an "off" terminal 1, a first arming contact 2 disposed adjacent to the center contact 1, and a command contact 3 successively following the arming contact 2. The "off" terminal 1 is open so that when the switch arm 15 is in this position, the transmitter 14 is disconnected. The arming contact 2 connects to an arming signal generating means 16 and the command contact 3 connects to the outputs of a plurality of command signal generating means indicated at 17 and 18, by way of example. These command signal generating means are arranged to be individually selectively actuated by operating suitable pushbuttons associated therewith to pass a

given frequency command signal to the command contact 3.

The switch also includes an additional arming contact 4 disposed adjacent to the center contact 1 on the opposite side from the first arming contact 2. This arming contact 4 connects to the arming signal generating means 16. Successively following the additional arming contact 4 is an interrogating contact 5 connecting to an interrogating signal generating means 19, and a receiver contact 6.

As indicated by the dashed line, the switch wiping arm 15 is ganged to an additional switch arm 20 such that when the switch wiping arm 15 is rotated to engage the receiver contact 6, the additional ganged switch arm 20 will engage a corresponding contact 6'. This corresponding contact 6' is arranged to pass signals received in a receiver 21, connected to the ganged switch arm 20, to a plurality of interrogation response signal discriminating circuits such as indicated at 22 and 23, having their outputs connected to suitable indicators such as lights 24 and 25.

Power for the various signal generating circuits, transmitter, and receiver is provided by a battery 26 and power switch 27 shown in the lower lefthand portion of FIGURE 2.

With the above description of the components of the master unit in mind, the operation of the master unit may be briefly described as follows:

Assume that it is desired to open a garage door and turn on the garage lights and towards this end, assume that the slave unit 11 of FIGURE 1 is connected to actuate these respective mechanisms as indicated at 12 and 13 in response to individual command signals generated in the command signal generators 17 and 18 of FIGURE 2. Initially, the operator will close the power switch 27 to energize the various circuit components. Next, the operator will move the switch wiper arm 15 from the "off" terminal over to the command contact 3. In so moving the arm 15, it will momentarily engage the arming contact 2 resulting in an arming signal from the arming signal generator 16 passing directly to the transmitter 14 through the arming contact 2 and switch arm 15. This arming signal will then place the slave unit 11 of FIGURE 1 in a ready condition to receive a command signal and actuate a corresponding mechanism.

The operator may then select any one of the command signal generating means such as 17 and 18, and if it is desired to first open the garage door prior to turning on the lights, the operator will press the command signal generating means button for the generator 17, thereby passing a signal through the command contact 3 and switch arm 15 to the transmitter 14. As will be clearer as the description proceeds, the slave unit will then pass this particular command signal to operate the door actuating mechanism.

Assuming next that the operator wishes to turn on the lights in the garage, he may then depress the button in the command signal generating means 18, thereby passing a signal through the command contact 3 and switch arm 15 to the transmitter 14. This next selected mechanism will then be actuated by the slave unit and the lights will be energized in the garage.

If now the operator should wish to determine whether the door was actually opened or the lights actually energized, he may move the switch arm 15 back to the "off" terminal and thence in a clockwise direction to the receiver contact 6. In moving the switch wiping arm 15 to the receiver contact 6, the arm 15 will momentarily engage the arming contact 4 and then subsequently momentarily engage the interrogating contact 5.

When the switch 15 engages the additional arming contact 4, the arming signal will then be transmitted to the slave unit 11 to place it in a ready condition, and when the switch arm 15 momentarily engages the interrogating contact 5, an interrogating signal will be trans-

mitted to the slave unit. This interrogating signal will trigger components in the slave unit resulting in a first interrogation response signal of given frequency being transmitted only if the door mechanism 12 is actually open. This first interrogation response signal is received in the receiver 21 of the master unit and passed through the additional ganged switch arm 20, which is now on the contact 6, to the discriminating circuits 22 and 23. Since the first interrogation response signal corresponds to the actuating mechanism for the door, the discriminator 22 which is designed to pass only the given frequency of the signal will pass the signal and energize the light 24 indicating that the door has been actuated.

Automatically thereafter, a second interrogation response signal of another given frequency identifying the mechanism for actuating the lights will be transmitted by the slave unit, received by the receiver 21, and passed by the discriminator 23 to the indicator 25 to energize the same, provided that the lights have actually been energized. The operator of the master unit, even though at a remote location wherein the door or lights may not be visible, can thus determine whether or not they have been actuated.

After the command signals have been transmitted and the interrogation signal transmitted to determine the state of the various mechanisms, the operator may release the power switch 27 to disconnect the battery 26 and thus conserve its energy when the master unit is not being used for transmission and reception purposes.

The manner in which the slave unit effects actuation of the several mechanisms and interrogates the same, as described above, will become clearer by now referring to the detailed block diagram of FIGURE 3 illustrating the various components in the slave unit. As shown, the slave unit 11 includes a receiver 28 having its output connected to an arming signal discriminating circuit 29. The output of the arming signal discriminating circuit 29 in turn connects to a timing control switch means 30, connected to actuate first and second gating circuits 31 and 32 in response to reception of the arming signal from the discriminator circuits are connected to the output of the receiver 28 as shown. Unless the gate 31 is actuated by the timing control switch means 30, signals from the command signal discriminating circuits 33 and 34 are blocked from passing through the gate 31.

As shown, in FIGURE 3, signals passed through the gate 31 will connect to a plurality of switches and latching relays corresponding respectively to the command signal discriminating circuits and indicated at 35, 36, and 37, 38 respectively. Operation of the latch relays 36 and 38 will in turn respectively serve to actuate the door and light mechanisms 12 and 13.

The slave unit also includes an interrogating signal discriminator 39 connected to the output of the receiver 28 and arranged to pass an interrogating signal through the gate 32 when the gate 32 is actuated by the timing control switch means 30. The output of the gate 32 connects to an interrogation control means which may take the form of a ring counter 40 incorporating any suitable circuit for generating successively in time a series of conditioning electrical signals corresponding in number to the number of actuating mechanisms connected to the slave unit. These conditioning signals are passed through output leads 41 and 42 along with signals on branch leads 43 and 44 to a plurality of coincidence circuits, such as indicated at 45 and 46. Signals will only appear on the leads 43 and 44 when the particular mechanisms to which these leads are connected such as the door 12 and lights 13 are actuated. In other words, if the door 12 is not actuated, no signal will appear on the lead 43, whereas if the door 12 is actuated, there

will be provided a signal on the lead 43. Similarly, if the lights 13 are not actuated, no signal will appear on the lead 44, whereas if the lights 13 are actuated a signal will be provided on the lead 44.

The coincidence circuits 45 and 46 may comprise simply "and" circuits which have the property of providing an output signal only when input signals are provided on both input leads simultaneously. Thus, for the coincidence circuit 45 to provide an output signal, it is required that there simultaneously appear a signal on the leads 41 and 43. Similarly, for the coincidence circuit 46 to provide an output signal, it is required that there be simultaneous signals on both the leads 42 and 44.

The outputs from the coincidence circuits 45 and 46 connect to interrogation response signal generators 47 and 48 respectively, the outputs of these generators in turn connecting to a transmitter 49 within the slave unit. Power for the slave unit may be provided by a battery 50.

With the various components of the slave unit as described above in mind, the operation of the slave unit may be described briefly as follows:

When an arming signal is first received in the receiver 28 from the master unit 10 of FIGURE 2, it will be amplified in the receiver 28 and passed to the various discriminating circuits 29, 39, 33 and 34. The arming signal has a given frequency pattern so that it will be discriminated against by the discriminators 39, 33 and 34, but will be passed by the arming discriminator circuit 29. This coded signal will then be passed to the timing control switch means 30 which includes decoding means so that the switch 30 will only be energized when the selected code signal characterizing the given arming signal is received therein. When the switch 30 is energized, the gates 31 and 32 will be placed in an open condition for a given period of time such as five seconds and will then be automatically closed.

After the arming signal has been received in the slave unit 11, it is thus in condition to receive subsequent signals. Assuming that the command signals from the command signal generating means 17 and 18 of FIGURE 2 are then successively passed to the slave unit 11, the first command signal I will be passed by the command signal discriminating circuit 33, which is designed to pass its given frequency, and will be blocked by all of the other discriminating circuits. Thus, the command signal I to operate the garage door will pass from the discriminator 33 through the gate 31 which has been placed in a ready condition by the timing control switch means 30 to actuate the switch 35 and latch relay 36. This action in turn operates suitable power circuits to actuate the door mechanism 12. Actuation of this door mechanism 12 will place a signal on the lead 43 to the coincidence circuit 45, but no output signal from the coincidence circuit will be generated since the other lead 41 is not energized at this time.

When the next command signal II to turn on the lights is received in the receiver 28, this signal will be passed by the command signal discriminator 34 to pass through the gate 31 to the switch 37 and latch relay 38 thereby operating or energizing the lights 13. At this time, a signal will be provided on the lead 44 to the coincidence circuit 46, but again no output will occur from this coincidence circuit since lead 42 is not energized.

If now the operator wishes to interrogate the slave unit to determine if the door and lights were actually operated, the arming and interrogating signals are successively transmitted when the operator places the switch wiper arm 15 of FIGURE 2 from the "off" terminal 1 to the receiver contact 6. In this respect, it should be noted that the timing control switch means 30 has held the gates 31 and 32 open for only five seconds, so that these gates automatically close after the various command signals have been received and perform their func-

tions. Thus, in transmitting the interrogating signal, it is again necessary to open the gates and this is achieved by the arming signal passed from the contact 4 in FIGURE 2 to the transmitter and again received in the arming signal discriminator circuit 29 in the slave unit. The output of the discriminator 29 then operates the timing control switch means 30 to open the gates 31 and 32.

With the gate 32 open, the interrogating signal from the contact 5 and transmitter of FIGURE 2 will be passed through the interrogating signal discriminator circuit 39, and gate 32 to the ring counter 40. There will thus be successively generated conditioning signals on the output leads 41 and 42 from the ring counter. The first output or conditioning signal on the lead 41 will pass to the coincidence circuit 45 and, provided there is a signal on the lead 43, there will then be provided an output from the coincidence circuit 45 to the interrogation response signal generator 47. This generator 47 will then modulate the carrier in the transmitter 49 with a given frequency to send an interrogation response signal back to the master unit 10 of FIGURE 2, which as described, is received on the receiver 21 and passed through the discriminator 22 to the indicator 24. Energization of the light 24 in the master unit will then indicate that the door has been opened.

The next successive conditioning signal from the ring counter 40 will then be applied to the coincidence circuit 46 and if the lights 13 have been energized, the coincidence of the two signals in the circuit 46 will provide an output which will trigger the interrogation response signal generator 48 to provide a given frequency interrogation response signal from the transmitter 49 to the master unit 10. This latter signal is received on the receiver 21 and passed by the discriminator 23 to the indicator 25, energization of this indicator thus advising the operator of the fact that the lights 13 have actually been energized.

The foregoing operations can easily be achieved within the five second interval during which the timing control switch means 30 holds the gates 31 and 32 open.

From the foregoing description, it will thus be evident that the present invention has provided a greatly improved radio control system. Not only may several different mechanisms be operated by the same master unit, but the provision of an arming signal avoids the possibility of any inadvertent or unauthorized operation.

Finally, the interrogating signal generating means enables the operator to selectively and successively interrogate all of the various mechanisms to determine their state.

While only two particular functions such as that of opening a garage door and turning on lights have been described in conjunction with the radio control system, it is to be understood, as stated heretofore, that a greater number of such mechanisms may be actuated as desired. In this latter event, the ring counter 40 in the slave unit would be arranged to generate successively in time, signals corresponding in number to the number of such mechanisms to be actuated. Thus, all of the various mechanisms to be actuated will be successively interrogated in response to the single transmission of the interrogating signal.

It should be understood accordingly, that the invention is not limited to the particular embodiment set forth merely for illustrative purposes.

I claim:

1. A radio control system for actuating any selected one of a plurality of mechanisms from a remote location, comprising, in combination: a master unit at said remote location including: a transmitter; arming means for generating a coded electrical arming signal; and a plurality of individual command means for respectively generating command signals upon actuation; a switch having a switch wiper arm connected to said transmitter and including: a center contact constituting an "off" terminal, an arming contact connected to said arming means and

positioned adjacent to said center contact, and a command contact following said first arming contact and connected to said plurality of command means; and a slave unit connected to said plurality of mechanisms, said slave unit including: a receiver; a timing control switch means; an arming discriminator circuit connected between said receiver and timing control switch means for passing only said arming signal to said switch means to actuate the same; a gating circuit connected to said switch means and adapted to be opened by said switch means for a given period of time when said switch means is actuated; a plurality of command signal discriminators connected between said receiver and said gating circuit and adapted respectively to pass a corresponding one of said command signals received in said receiver; and a plurality of switches connected to the output of said gating circuit and responsive respectively to signals passed thereto from a corresponding one of said command signal discriminators to operate one of said plurality of said mechanisms, whereby movement of said switch wiping arm in said master unit from said "off" terminal to said command contact causes said arm to make momentary contact with said arming contact to transmit said arming signal and actuate said timing control switch means to open said gating circuit in said slave unit, and whereby actuation of the selected one of said command means passes its generated command signal to said transmitter through said command contact to be received and passed by the corresponding command signal discriminator and through said gate to the connected switch to actuate the mechanism connected thereto.

2. A radio control system according to claim 1, in which said master unit further includes interrogating means for generating an interrogating signal and a receiver for receiving an interrogation response signal from said slave unit; said switch including an additional arming contact connected to said arming means and positioned on the opposite side of said center contact from said first mentioned arming contact; an interrogating contact successively following said additional arming contact and connected to said interrogating means; and a receiver contact successively following said interrogating contact; a plurality of interrogation response signal discriminating circuits having indicators connected to their outputs; and a second switch wiping arm ganged for movement with

said first mentioned switch wiping arm to connect said receiver to said interrogation response signal discriminating circuits when said first mentioned switch arm is moved to said receiver contact; said slave unit further including: an interrogating signal discriminating circuit; an additional gating circuit connected to said timing control switch means for operation thereby for passing said interrogating signal; an interrogation control means responsive to said interrogating signal from said additional gating circuit for successively generating, in time, conditioning signals; a transmitter; a plurality of coincidence circuits connected to receive signals respectively in response to actuation of said mechanisms and to receive said conditioning signals successively in time, said coincidence circuits passing signals only when both a conditioning signal and signal in response to actuation of a mechanism are received simultaneously; and a plurality of interrogation response signal generators connected between the outputs of said coincidence circuits and said transmitter, whereby movement of said switch arm in said master unit from said "off" contact to said receiver contact causes momentary contact with said additional arming contact and then with said interrogating contact to open said additional gating circuit and pass said interrogating signal to said interrogation control means in said slave unit, and whereby only that particular mechanism operated will cause a particular interrogation response signal to be transmitted back to said receiver in said master unit and corresponding interrogation response signal discriminating circuit to energize the corresponding indicator in said master unit indicating actuation of the mechanism.

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