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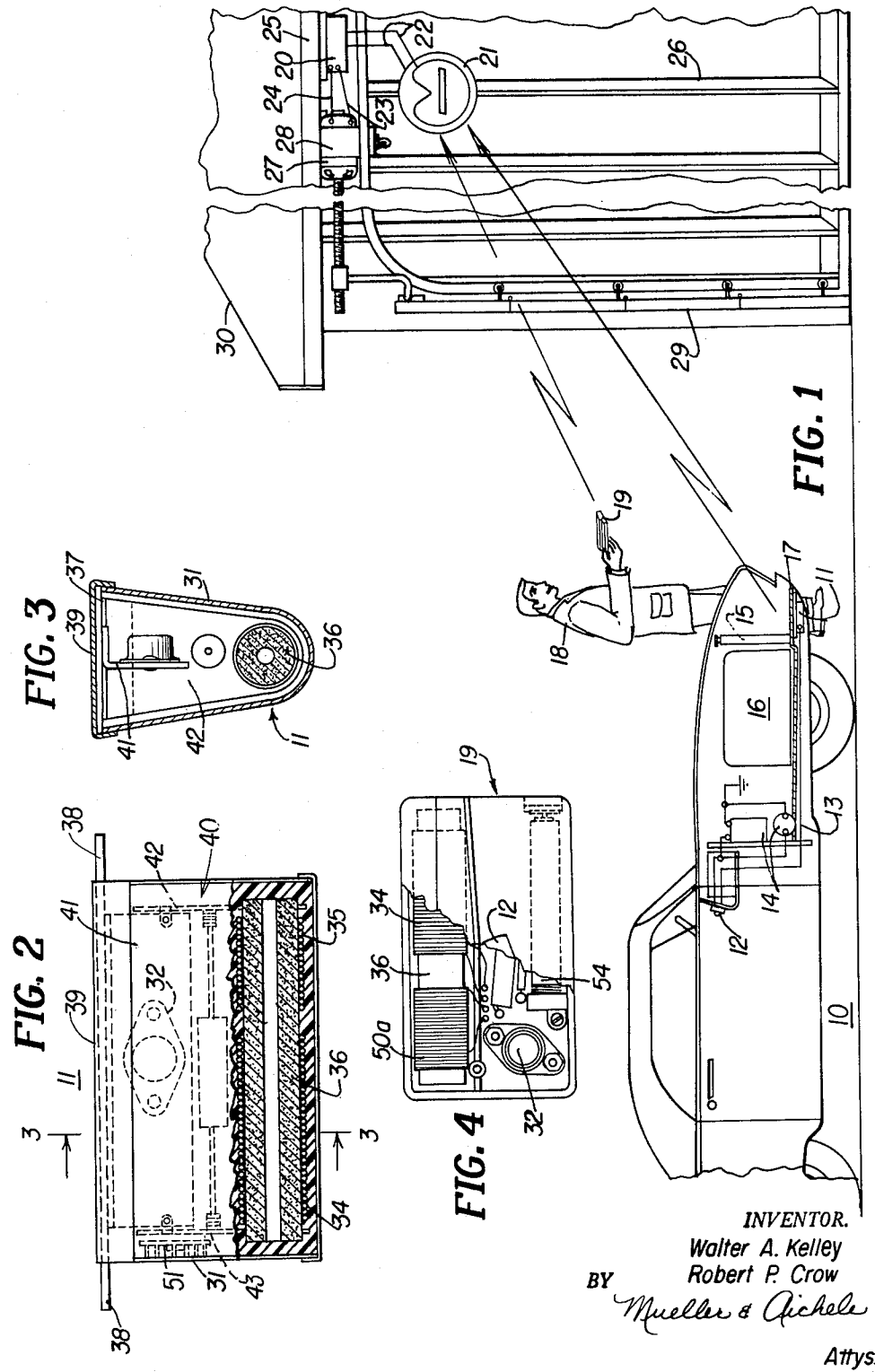
R. P. CROW ETAL

3,233,239

INDUCTION FIELD TRANSMITTER

Filed July 17, 1961

2 Sheets-Sheet 1



Feb. 1, 1966

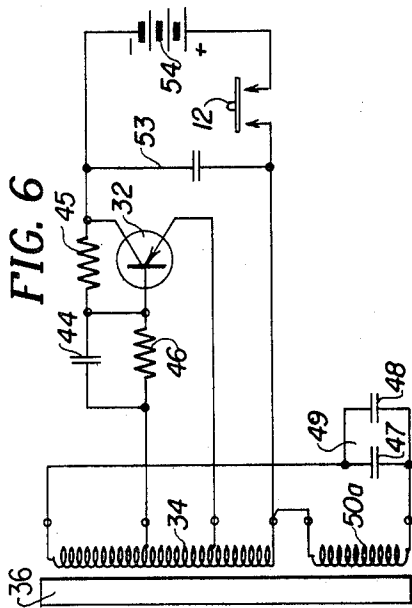
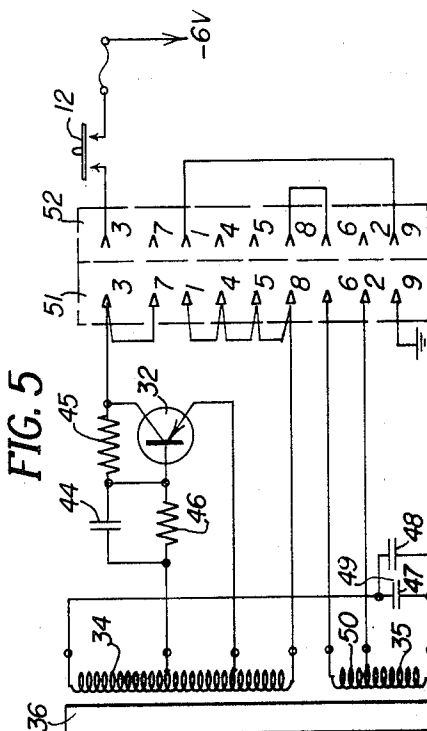
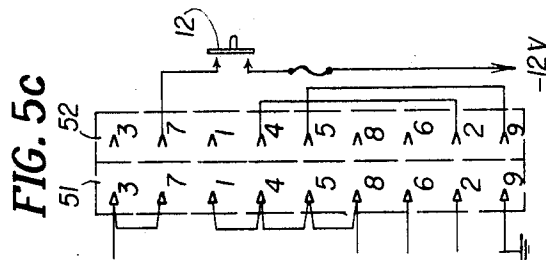
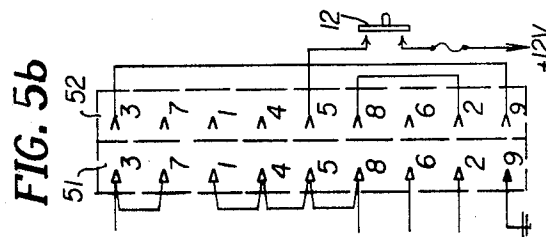
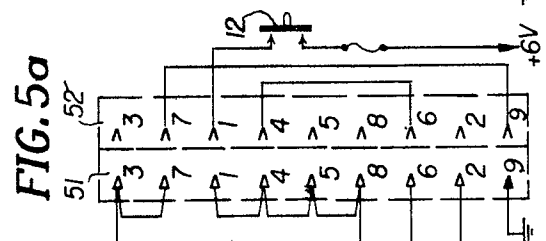
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INDUCTION FIELD TRANSMITTER

Filed July 17, 1961

2 Sheets-Sheet 2



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INDUCTION FIELD TRANSMITTER

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Filed July 17, 1961, Ser. No. 124,596

3 Claims. (Cl. 343—225)

This invention relates in general to remote control devices and, more particularly, to a transistorized remote induction control system including portable and/or mobile transmitters and a fixed receiver which may be used to control a mechanism such as a garage door.

Many types of remote control systems are presently known, ranging from relatively simple devices incorporating a sensing unit which responds as a vehicle passes a fixed point, e.g., an "electric eye," to the more elaborate systems which incorporate special coding arrangements included within radio transmitting and receiving apparatus. The former offers little or no security of operation and is relatively inflexible and inconvenient. The latter, while providing adequate versatility and a certain measure of security in operation, has the disadvantages of circuit complexity, substantial expense, and usually requires an FCC operating license. Still other types of systems require the installation of special loop antennas, such as an antenna of considerable size to be installed beneath the driveway in a garage door control system. The majority of those remote control systems employing the medium of radiant energy fields do not afford sufficient protection from false operation on spurious signals and/or random noise.

Accordingly, it is an object of the present invention to provide an improved remote control system operating at a relatively low frequency within an inductive field such that operation is permitted without a license.

Another object of the invention is to provide a new and improved remote control system for general use which requires minimum standby and operating power, and which is highly reliable in operation being insensitive to spurious signals and random noise.

A further object of the present invention is to provide a remote control system including a light weight, compact and completely self-contained portable transmitter unit that can be installed within a vehicle or hand carried by an individual.

Still another object of the present invention is to provide a remote control system including a mobile transmitter unit with a self-contained inductive loop antenna which can be readily installed on an automobile or like vehicle, and which is compatible with any plus or minus ground, 6 or 12 volt vehicular electrical system.

A feature of the present invention is the provision of a transistorized remote control system including a receiver having a reflex action circuit including a differential detector network for developing a direct current control voltage in response to a received alternating current signal, and which is of the correct polarity and level only if the received signal is within certain predescribed frequency limits. The D-C. control voltage is fed back to the input of the receiver to control the amplification of the receiver signal by automatic gain control action. The D-C. control voltage is amplified by reflex action in the transistor stages to supply the operating current for actuating a relay of the controlled device.

Another feature of the present invention is the provision of a remote control receiver including a diode limiting circuit for limiting the amplitude of on-frequency signals to a predetermined level of strength to prevent distortion from tripping-out the actuating relay. Distortion developed on excessively strong signals may appear as harmonics and therefore as off-frequency signals.

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Without such limiting action, the actuating relay may trip-out on such distortion under certain conditions.

A further feature of the present invention is the provision of a mobile transmitter unit including a transistor oscillator which is insulated from ground allowing operation from either ground polarity. Further a transformer is included having a winding with taps for connecting different numbers of turns whereby the same relative inductance, and thereby the same operating frequency, may be maintained on either six or twelve volt vehicular electrical systems.

The invention is illustrated in the drawings in which:

FIG. 1 illustrates the remote induction control system including a transmitter installed on an automobile, a hand held transmitter, and a receiver for operating a garage door operator mechanism;

FIG. 2 is a view partly broken away showing the mobile transmitter unit of the system of FIG. 1;

FIG. 3 is a cross section view along the lines 3—3 of FIG. 2;

FIG. 4 shows the portable transmitter;

FIG. 5 is a circuit diagram for the mobile transmitter unit of FIG. 2;

FIGS. 5a, 5b and 5c show alternate connections for the connecting plug of the transmitter of FIG. 5, and

FIG. 6 is a circuit diagram for the portable transmitter unit of FIG. 4.

The invention consists of a remote induction control system including a mobile transmitter unit which may be conveniently mounted in an automobile, truck, or like vehicle and is compatible with any vehicular electrical system whether plus or minus ground, six or twelve volts. A portable transmitter may also be used which can be either hand-carried or installed on or adjacent to the dashboard of a vehicle, and which operates from a self-contained battery. The components of the transmitter are mounted within a housing and are encapsulated in a molded composition which provides effective protection from tampering and against the effects of shock and vibration, and/or adverse weather conditions. Upon actuation of the transmitter an inductive field is generated which, if within operating range, is induced in the receiver antenna to initiate the operation of a remotely controlled mechanism such as a garage door operator. The receiver circuit may include three stages of A-C. amplification coupled in cascade and connected to a differential detector network which is frequency selective and produces a control voltage when the received signal is within predetermined frequency limits. The control voltage is applied to the first two stages by a reflex connection and is amplified therein and applied from the second stage to an operating relay which actuates the door operator mechanism to open or close the garage door. The control voltage developed in the differential detector will be of the correct polarity to provide the required D-C. current output at the second stage to operate the actuating relay when a signal of the predetermined frequency is received. The desired signal may vary over a wide range of amplitudes and still result in the actuation of the relay. This control voltage further determines the overall amplification of the receiver stages by automatic gain control action thereby providing stability over a wide range of amplitudes of the received signal. This control voltage provides increased gain within a predetermined bandwidth and reduced gain outside of the desired bandwidth. The receiver includes a limiting circuit which reduces excessively strong on-frequency signals to prevent tripping-out of the actuating relay due to excessive distortion in the form of harmonics.

FIG. 1 illustrates the remote induction control system wherein a mobile transmitter 11 is mounted on an automobile 10 and a receiver 20 and inductive loop antenna

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21 are provided in a garage 30. The receiver 20 controls the motor 27 of a door operator mechanism 28 to open or close the door 29 in response to signals from the transmitter 11. A hand transmitter 19, held by a person 18, is also shown in FIG. 1 and illustrates the fact that a plurality of transmitters may be used in a system having a single receiver.

The transmitter 11 is mounted on the automobile in a relatively unobstructed location, preferably under the splash pan 17 between the radiator 15 and the bumper. The transmitter is connected by an electrical lead 13 through the dashboard mounted switch 12 to the battery-generator voltage source 14 of the automobile. A ground connection is provided to the frame of the automobile, and adequate fusing is provided for protection against wiring shorts.

The receiver 20 may be mounted on a ceiling joist 25 in the garage, and is connected by a lead 23 to a power supply receptacle in the door operator mechanism 28. The starting circuit for the motor 27 of the operator mechanism is connected to the receiver 20 by lead 24. The receiver 20 is provided with an inductive loop antenna unit 21. This antenna may be mounted on a vertical joist such as 26, or at any other convenient location. The antenna 21 is connected to the receiver 20 by the lead 22. The details of the construction of the door operator mechanism are believed to be unimportant to the invention and thus are not described herein. Operator mechanisms of various construction are available and may be used with the system of the present invention.

Transmitter

Construction of the mobile transmitter unit 11 is shown in greater detail in FIGS. 2 and 3. The transmitter is provided with a metal mounting base 39 which has flanges 38 with apertures for receiving mounting bolts or screws. Mounting base 39 is received in a housing 31. Attached to the mounting base is a metal supporting frame 40 consisting of a center plate 41 and end plates 42 and 43. The various components of the transmitter are attached to this frame. The frame 40 and mounting base 39 may also provide a ground return for the transmitter circuit, or a ground lead extending to the outside of a unit may be provided. Frame 40 and the attached components are completely encapsulated in a shock resistant casing of a tough and durable molded material such as filled polyester rosin. The antenna in transmitter 11 consists of a single core rod 36, preferably of ferrite, on which coils 34 and 35 are wound. The desired frequency is obtained by physically spacing coils 34 and 35 with respect to one another on the core rod 36 before encapsulation.

A circuit diagram for the transmitter unit 11 of FIG. 2 is shown in FIG. 5. Transmitter 11 includes a transistor 32 coupled to the antenna core 36 by coils 34 and 35. Capacitors 47 and 48 are connected across the coils 34 and 35, which are connected in series to form a tank circuit 49 whose resonant frequency may be in the frequency range of 17 to 30 kilocycles. Power is applied through switch 12, and terminal 3 on socket 51 and plug 52 to transistor 32. Resistors 45 and 46 form a voltage divider arrangement which biases the base negatively with respect to the emitter, and biases the collector negatively with respect to the base. Capacitor 44 bypasses signal frequencies.

When the switch 12 is closed, oscillations occur in tank circuit 49, which is in resonance and results in a resonant rise in current. Compatibility of the mobile transmitter with either plus or minus, 6 or 12 volt vehicular electrical systems is provided in the arrangement whereby a portion of coil 35, identified as numeral 50, is not used in twelve volt operation, to maintain the same relative inductance, and thereby the same operating frequency as produced in six volt operation with the coil portion 50 remaining in series with coil 35. This adding or omitting of coil part 50 is accomplished by the manner in which the connector 52 of complementary connectors 51-52 is connected to the vehicular electrical system.

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Connectors 51 and 52 are shown in FIG. 5 with suitable jumpers for compatibility with a positive grounded six volt vehicular electrical system. FIG. 5a shows the proper connections for negative ground 6 volt operation. FIG. 5b shows the proper connections for negative ground, 12 volt operation, and FIG. 5c shows the connections for positive ground, 12 volt operation.

The plus or minus ground compatibility is further accomplished by the insertion of a mica washer between the transistor 32 and the mounting frame 40 which effectively isolates the transistor from true ground but allows sufficient heat conduction therethrough for reliable operation.

A circuit diagram for the portable transmitter 19 is shown in FIG. 6. With the exception that it operates from a self-contained battery 54, the portable transmitter is identical in electrical operation to the mobile transmitter 11, and it is therefore considered unnecessary to describe this circuit in detail herein. The same reference numbers are used as in the circuit of FIG. 5. Since the circuit operates from a single battery voltage, it is not necessary to provide a tap on coil 50a as on coil 50 of FIG. 5.

Thus it can be seen that a simple but highly reliable remote control system is provided consisting of a fixed receiver and one or more mobile transmitters operating within a closed induction field for optimum protection from false operation on spurious signals and random noise as well as on excessively strong on-frequency signals. Further, the transmitters may be provided as convenient hand-carried units operating from a self-contained battery source or as units for installation in a vehicle and adaptable for operation from its electrical system, whether positive or negative ground polarity, six or twelve volt power level.

We claim:

1. A transmitter for generating an induction field including in combination; antenna means including a coil wound on a core of ferromagnetic material, capacitor means coupled to said coil and forming a resonant circuit therewith, transistor means coupled to said resonant circuit to form an oscillator, said oscillator producing an alternating current signal having a frequency dependent upon the inductance of said coil, direct current voltage supply means capable of having different voltages coupled to said coil and said transistor means to furnish energy to said oscillator, said different voltages applied to said coil causing the inductance of said coil to change, said coil having a plurality of taps thereon for selective connection to said supply means, said taps being located on said coil so that the inductance of the connected portion of said coil has substantially the same effective value with different supply voltages applied thereto, whereby the frequency of said oscillator means is maintained at a predetermined frequency.

2. A transmitter for generating an induction field including in combination; antenna means including coil means wound on a core of ferromagnetic material, capacitor means coupled to said coil means and forming a resonant circuit therewith, transistor means coupled to said resonant circuit to form an oscillator, said oscillator producing an alternating current signal having a frequency dependent upon the inductance of said coil means, direct current voltage supply means adapted to provide different voltages coupled to said coil means and said transistor means to furnish energy to said oscillator, said different voltages applied to said coil means causing the effective inductance of said coil means to change, said coil means having a plurality of sections with terminals thereon for selective connection to said supply means, said terminals being located on said coil means so that the inductance of the connected portion of said coil means has substantially the same effective value with different supply voltages applied thereto, whereby the

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frequency of said oscillator means is maintained substantially at a predetermined frequency.

3. A transmitter for generating an induction field including in combination; antenna means including coil means having a plurality of winding sections wound on a core of ferromagnetic material, capacitor means coupled to said coil means and forming a resonant circuit therewith, transistor means coupled to said resonant circuit to form an oscillator, said oscillator producing an alternating current signal having a frequency dependent upon the inductance of said coil means, connector means having a first portion with conductors connected to said winding sections and to said transistor and a second portion having conductors adapted to engage said conductors of said first portion and apply a direct current operating potential thereto, said sections of said coil means being connected through said connector means in accordance with the supply potential applied thereto, so that the inductance of the connected portion of said coil means

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has substantially the same effective value with different supply voltages applied thereto, whereby the frequency of said oscillator means is maintained substantially at a predetermined frequency.

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