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RADIO FREQUENCY SIGNAL TRANSMITTER ARRANGEMENT

Filed Jan. 13, 1964

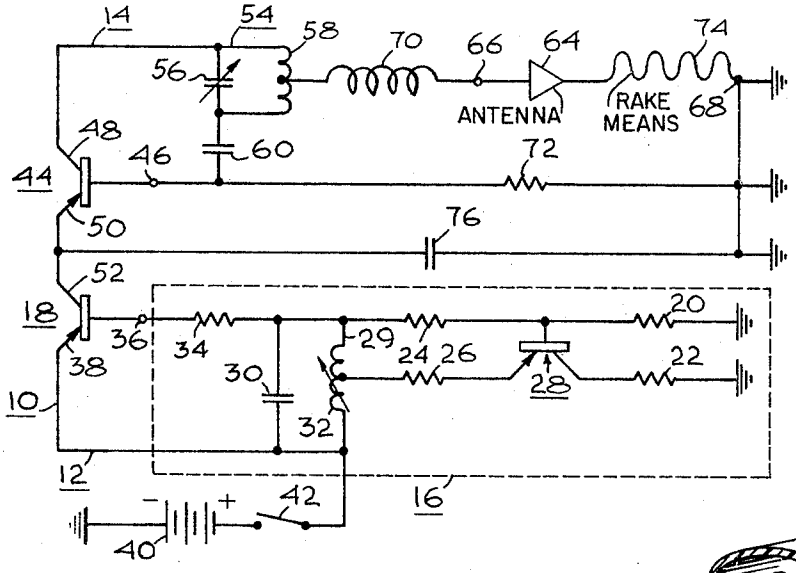


Fig. 1

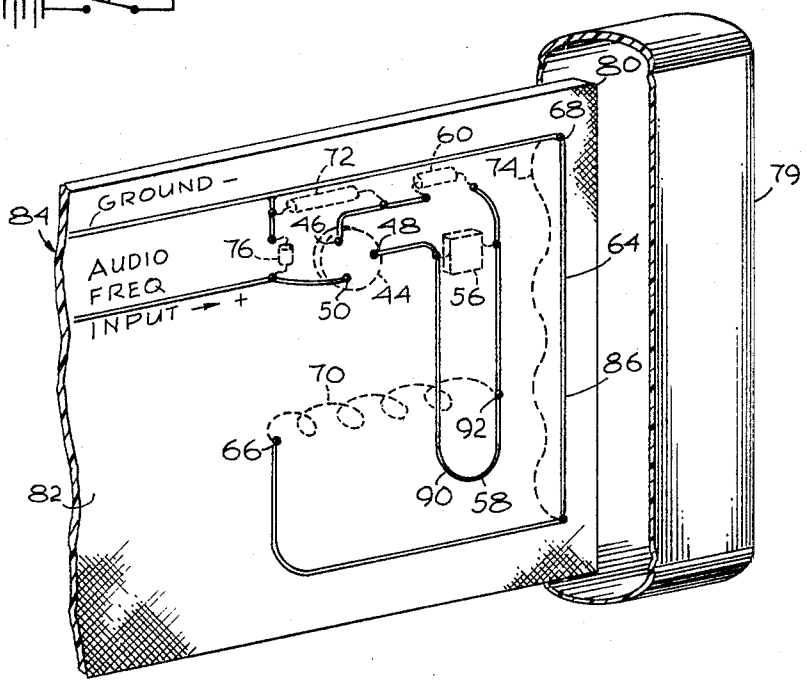


Fig. 3

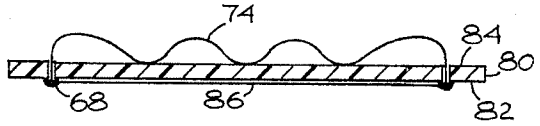


Fig. 4

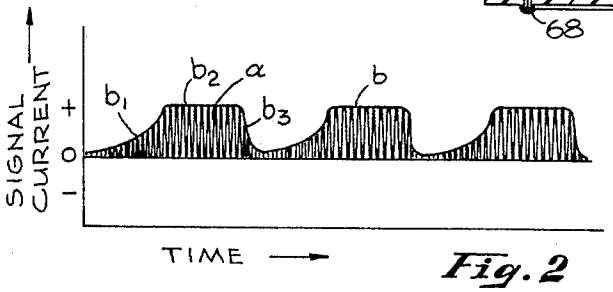


Fig. 2

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RADIO FREQUENCY SIGNAL TRANSMITTER ARRANGEMENT

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This invention relates to the transmitter art and more particularly to an improved compact, low weight, transistorized RF transmitter incorporating an audio frequency amplitude modulation of an RF signal.

In many remotely controlled actuator applications such as automatic garage door openers and the like, it has long been desirable to provide a light-weight, compact radio frequency (RF) signal transmitter. In such an application the transmitter is generally carried in a motor vehicle and transmits a coded signal. A tuned receiver associated with an actuator receives the signal and initiates operation of the actuator to either open or close the garage door. Further, it is often desirable that such transmitters be able to transmit a "coded" RF signal so that a plurality of such actuators may be utilized in a comparatively small geographical area, such as neighboring houses, wherein the radiated signal will selectively initiate operation of only one of many similarly equipped garage doors. Therefore, the transmitter for such an application should be highly stable, that is, very little signal frequency drift over extended periods of time and over a wide range of ambient temperatures.

As the transmitter is generally carried in a motor vehicle, it is preferably light in weight and compact in size. Also, a low cost, readily available power source such, as, for example, standard dry cell batteries, are preferably utilized to provide an integral internal and easily replaceable power source, rather than power the transmitter directly from connections to the motor vehicle battery. In this arrangement, failures of the motor vehicle battery do not prevent operation of the transmitter and initiation of the operation of the actuators may be carried on regardless of motor vehicle battery condition. The transmitter itself, of course, should preferably have a low power drain in order to extend the life of such dry cell batteries.

The transmitter is generally only required to transmit intermittently a signal over comparatively short distances, for example, 300 yards, and thus the radiated power may be comparatively low, for example, on the order of 10 milliwatts. The transmitter should preferably be transistorized so that the power drain is minimal.

To provide the coding of the radiated signal it has been found desirable that the frequency of the radiated RF signal be variable, within limits, such as between 250 and 300 megacycles, and, also, that the radiated signal be amplitude modulated by an audio frequency signal. The frequency of the audio frequency amplitude modulation signal is preferably controllable also and within the range of, for example, 12 to 24 kilocycles. By judicious selection of the particular RF signal frequency and the particular audio signal frequency a comparatively large number of such transmitters may be utilized in a comparatively small geographic area with complete selectivity so that any one transmitter radiates only a signal that initiates operation of a single actuator through reception thereof by a receiver tuned to receive the particular coded, audio frequency amplitude modulated RF signal.

Accordingly, it is an object of applicant's invention to provide an improved transmitter.

It is another object of applicant's invention to provide a highly stable RF transmitter in which the radiated RF signal is audio frequency modulated at a pre-selected audio frequency rate.

It is a further object of applicant's invention to provide a low voltage, low current drain transmitter in which the radiated RF signal may be coded by preselecting a particular RF frequency and amplitude modulating this RF frequency with a pre-selected audio frequency signal.

The above and other objects are achieved, according to one embodiment of applicant's invention, by providing an RF transmitter comprised of substantially two sections: an audio frequency signal generating section and an RF signal generating and transmitting section. Since it is desirable to utilize a comparatively low voltage power supply as, for example, low voltage dry cell batteries, applicant preferably utilizes transistors in his improved RF transmitter to minimize power drain.

In a prefered embodiment of applicant's invention an audio frequency oscillator, such as Hartley oscillator, is coupled between the base and emitter electrodes of an audio frequency switching transistor to provide an audio frequency signal at a pre-selected frequency at the collector electrode thereof. This collector electrode of the audio frequency switching transistor is coupled to the emitter electrode of a power RF oscillator transistor and feeds the audio frequency signal therein. The audio frequency switching transistor and the audio frequency oscillator comprise the audio frequency signal generating portion of applicant's improved RF transmitter.

An RF tank circuit is coupled between the base electrode and the collector electrode of the power RF oscillator transistor and the RF tank circuit includes a tapped inductor and a variable capacitor for controlling the frequency of a generated RF signal. An end fed antenna is connected in series with an inductor to the emitter electrode of the power RF oscillator transistor and the inductor has an impedance which, together with the impedance of the tapped inductor of the RF tank circuit, substantially matches the resistive impedance of the power RF oscillator transistor. The inductor is connected between the input to the antenna and the tapped inductor of the RF tank circuit.

Applicant prefers that the impedance into the end fed antenna be the above described inductance matching the resistive impedance of the power RF oscillator transistor and that it be sufficiently reactive so that changes in the antenna radiation impedance due to, for example, the proximity of foreign objects, do not significantly effect the phase angle of the load presented by the antenna. Thus, the antenna is maintained in the RF signal generating circuit loop and the RF signal generating and transmitting section comprises the above described power RF oscillator transistor, RF tank circuit, end fed antenna, inductor and bias resistor coupled to the power RF oscillator transistor base electrode, and is preferably substantially isolated from the audio frequency signal generating portion of applicant's improved transmitter by a coupling capacitor that is coupled between the antenna termination and the emitter electrode of the power RF oscillator transistor.

Since transistors are basically current controlling devices, the coupling of the audio frequency switching transistor to the power RF oscillator transistor as above described applies a substantially square wave audio frequency amplitude current modulation by the generated audio frequency signal to the generated RF signal so that the antenna radiates a substantially square wave signal.

A low voltage power source such as, for example, a 22½ volt battery, may be utilized to energize the transmitter.

Applicant has found that, in such an arrangement, the radiated RF signal has a comparatively narrow bandwidth. For example, on the order of 100 kilocycles, as compared with the more usual 8 to 10 megacycles in the radiated RF signals from prior art transmitters. This

provides that substantially larger number of actuators dependent upon receipt of such an RF signal for initiating actuation may be utilized in a given geographic area than has heretofore been achieved. Applicant has also found that providing a rake means coupled to the antenna, the radiating area of applicant's transmitter is substantially increased to provide greater area coverage for his radiated signal.

In the preferred form of applicant's invention, applicant utilizes a circuit board to provide connections between the various components of the transmitter and the conductive elements of the circuit board can also provide some of the elements themselves such as, for example, the antenna and the tapped inductor of the RF tank circuit in the RF signal generating and transmitting section of the transmitter.

The above and other embodiments of applicant's invention are more fully described in the following detailed description taken together with the accompanying drawings wherein similar reference characters refer to similar elements throughout and in which:

FIGURE 1 is a schematic diagram of applicant's improved transmitter;

FIGURE 2 is a graphic representation of the signals generated in the embodiment shown in FIGURE 1;

FIGURES 3 and 4 illustrate an embodiment of applicant's invention.

Referring now to FIGURE 1, there is shown a schematic diagram for one embodiment of applicant's invention. As shown thereon a transmitter, generally designated **10**, may be considered to be comprised of two sections: an audio frequency signal generating section **12** and an RF signal generating and radiating section **14**. The audio frequency signal generating section **12** comprises an audio frequency oscillator **16** and an audio frequency switching transistor **18**. In the preferred embodiment of applicant's invention applicant utilizes a Hartley oscillator as the audio frequency oscillation oscillator **16** since the Hartley oscillator is highly degenerate and has a comparatively low power drain.

The well known Hartley oscillator comprises resistors **20**, **22**, **24** and **26** coupled to a transistor **28** as shown in FIGURE 1, an audio frequency tank circuit **29** including a capacitor **30** and variable inductor **32**, and a load resistor **34**. The Hartley oscillator or any other audio frequency oscillator **16** that may be utilized in applicant's invention herein is coupled between the base electrode **36** and the emitter electrode **38** of the audio frequency switching transistor **18** to provide a generated audio frequency signal between the emitter electrode **38** and the collector electrode **52** of the audio frequency switching transistor **18**.

The preselected frequency of the generated audio frequency signal is obtained by varying the inductance of the variable inductor **32** in the audio frequency tank circuit **29**.

In the preferred embodiment of applicant's invention a low voltage power source **40**, such as a 22½ volt dry cell battery, has its plus voltage side connected through a momentary contact switch **42** into the audio frequency signal generating section **12** for connection to the emitter electrode **38** of the audio frequency switching transistor **18**. The negative side of the battery **40** is ground and, therefore, the transistors utilized in the embodiment shown on FIGURE 1 are of the P-N-P type so that correct polarity thereon is maintained. Similarly, if desired, the positive side of the battery **40** may be ground and, in this event, the transistors utilized should be of the N-P-N type for correct polarity.

When utilizing the Hartley oscillator as shown on FIGURE 1, applicant has found that the components thereof preferably have the following values: resistor **20**—220,000 ohms, resistor **22**—10,000 ohms, resistor **24**—4,700 ohms, resistor **26**—1000 ohms, transistor **28**—a Texas Instrument Corporation transistor No. 2N404, or an RCA transistor 2N414, capacitor **30**—.0075 microfarad, inductor **32**—variable 5 to 20 millihenries, and resistance **34**—33,000 ohms. The audio frequency switching transistor **18** is also preferably a Texas Instrument 2N404 or RCA 2N414 transistor. This circuit generates the preferred audio frequency signal between the emitter electrode **30** and collector electrode **52** at the audio frequency switching transistor **18** in the range of 12 to 24 kilocycles, depending upon the particular value of the inductor **32** that is utilized in the audio frequency tank circuit **29**.

In the RF signal generating and transmitting section **14** of the transmitter **10** there is a power RF oscillator transistor **44** having a base electrode **46**, a collector electrode **48**, and an emitter electrode **50**. The emitter electrode **50** of the power RF oscillator transistor **44** is connected to the collector electrode **52** of the audio frequency switching transistor **18**. This feeds the generated audio frequency signal generated in the audio frequency signal generating section **12** into the RF signal generating and transmitting section **14** for modulation of an RF signal generated therein.

An RF tank circuit **54** comprises a parallel connected variable capacitor **56** and tapped inductor **58**, series connected with capacitor **60** between the base electrode **46** and the collector electrode **48** of the power RF oscillator transistor **44**. By varying the capacitance of the variable capacitor **56** the particular RF frequency of the generated RF signal may be selected.

Applicant has found that the reactive impedance of capacitor **60** tends to minimize the phase shift, and resulting frequency shift, of the generated RF signal that occurs due to temperature changes of the power RF oscillator transistor **44** inducing changes in the current gain thereof. Thus, in the preferred embodiment of applicant's invention the capacitor **60** is included for temperature compensation to improve the RF signal frequency stability.

An end fed antenna **64** is provided between the tank circuit **54** and the emitter electrode **50** of the power RF oscillator transistor **44** for radiating an RF signal and has an input terminal **66** and an end terminal **68**. The input terminal **66** of the end fed antenna **64** is coupled by an inductor **70** to the tapped inductor **58** of the RF tank circuit **54**. In the preferred embodiment of applicant's invention the impedance of the inductor **70**, together with the impedance of the tapped inductor **58** substantially matches the resistive impedance of the power RF oscillator transistor **44**.

The output impedance of the power RF oscillator transistor **44** varies somewhat from transistor to transistor. Applicant has found it advantageous in the production of his transmitter **10** to measure the output impedance of the power RF oscillator transistor **44** and provide a fixed inductance value of the tapped inductor **58** in the tank circuit **54**. The exact value of the inductance of the inductor **70** is then selected so that the impedance of power RF oscillator transistor **44** is matched by the sum of the impedance of the tapped inductor **70**. This impedance match tends to provide a more efficient operation of the transmitter **10** in that the radiated power in the signal radiated by the antenna **64** is maximized for a given energy input.

Further, the above described impedance matching of the resistive output impedance of the power RF oscillator transistor **44** by the tapped inductor **58** of the RF tank circuit **54** and the inductor **70** provides a high degree of RF signal stability since changes in the radiating impedance of the antenna **64** are substantially isolated, as regards RF signal phase shift to the RF tank circuit which, if it were present, would tend to vary the frequency of the RF signal from the pre-selected value.

A bias resistor **72** connects the base electrode **46** of the power RF oscillator transistor **44** to ground for direct current biasing and filtering, as described below.

The bias resistor **72** is preferably included to provide this predetermined direct current into the base electrode **46** of power RF oscillator transistor **44** so that the desired radiated power and signal wave shape is achieved.

Thus, an RF signal having a pre-selected frequency determined primarily by the value of the variable capacitor **56** is the RF tank circuit **54** is generated between the emitter electrode **50** and collector electrode **48** of the power RF oscillator transistor **44**. This RF signal is square wave amplitude current modulated by the audio frequency signal applied to the power RF oscillator transistor **44** from the audio frequency switching transistor **18** as described below in more detail in the discussion of FIGURE 2.

If desired, a rake means **74** may be coupled to and made a part of the end fed antenna **64** to provide an increase in the radiating area thereof. By the term "rake" means applicant means an addition to the antenna for the function of increasing the area available for radiation of the square wave current amplitude modulated RF signal. The rake means **74** may take the form of a serpentine type curved electrical conductor coupled to the antenna **64** as shown on FIGURES 3 and 4.

As shown in FIGURE 1, in the preferred embodiment of applicant's invention the antenna **64** is in the loop of the RF signal generating and transmitting portion of the transmitter **10**.

In the preferred embodiment of applicant's invention the power RF oscillator transistor **44** is a 2N2363 transistor such as Texas Instrument Corporation No. T1390. Variable capacitor **56** is a capacitor having a range of 1.5 to 7 micromicrofarads, capacitor **60** is 3.3 micromicrofarads, and inductance **58** is .06 microhenry. The inductance **70** preferably has a value of approximately 0.2 microhenry when utilized with the above described 2N2363 power RF oscillator transistor 44, the exact value depending on the output impedance thereof. Bias resistor **72** has a value of 220,000 ohms.

To substantially isolate the RF signal generating and transmitting section **14** from the audio frequency signal generating section **12** and the power supply **40**, applicant prefers to provide a coupling capacitor **76**, which, for example, might have a value of .001 microfarad, between the end fed antenna **64** end terminal **68** and the connection of the emitter electrode **50** of the power RF oscillator transistor **44** and the collector electrode **52** of the audio frequency switching transistor **18**. This substantially isolates the two sections.

As noted above, transistors are essentially current control devices and thus, in the circuit shown on FIGURE 1, the audio frequency signal applies a substantially square wave current amplitude modulation to the RF signal.

FIGURE 2 is a graph illustrating the current of the output wave form at the radiated signal from antenna **64**.

As shown on FIGURE 2 curve *a* represents the RF signal and curve *b* represents the audio frequency amplitude modulation envelope.

Portion b_1 of curve *b* is the rise time of the audio frequency modulation envelep curve *b* and is determined by the loop gain of the RF signal generating and transmitting section **14** and the "Q" of the RF tank circuit **54**.

The conductive time b_2 of the curve *b* is the conductive time of the power RF oscillator transistor **44** and is determined by the conducting time of the audio frequency switching transistor **18** which feeds the audio frequency signal into the power RF oscillator transistor **44** and provides a substantially flat wave shape illustrated in this portion by the self-limiting action of the diode effect between collector **48** and base **46** of the power RF oscillator transistor **44**, together with the filtering effect of capacitor **60** and bias resistor **72**.

The non-conductive time b_3 of the curve *b* is the non-conductive time of the power RF oscillator transistor **44** and is controlled by the non-conductive time of the audio frequency switching transistor **18**.

As noted above, applicant prefers to provide his transmitter **10** of FIGURE 1 in a compact, low weight configuration. To achieve these objects applicant prefers that the components comprising the transmitter **10** be mounted on a circuit board with conductive elements on the circuit board providing the connection between the components and the circuit board mounted in, for example, a plastic case **79**, of FIGURE 3.

FIGURE 3 illustrates the radio frequency generating and transmitting section **14** as embodied on a circuit board. The circuit board comprises an insulating sheet **80** having a first face **82** on which conductive elements are mounted and an opposite face **84** on which the components are mounted. Contact of the components with the conductive elements is made through the insulating sheet **80** in conventional fashion. FIGURE 3 illustrates the face **82** of the insulating sheet **80** upon which the conductive strips are mounted. The actual components are therefore shown in dotted line as they are on the opposite face **84**. The conductive strip **86** actually comprises the antenna **64**, and, as shown in FIGURE 3, the rake means **74** is coupled thereto intermediate the input terminal **66** and the end terminal **68** of the antenna **64**. This is illustrated in detail on FIGURE 4 which shows the connections of the rake means **74** through the insulating sheet **80** to the conductive element **86** comprising the antenna **64**. It will be appreciated that the serpentine curved rake means **74** is only one shape that the rake means **74** may take. Any other shape electrically conductive member that effectively increases the radiating area of the antenna **64** may be considered a rake means within applicant's invention.

The inductor **58** of the radio frequency tank circuit **54** is also provided by a section of conductive element **90**. Thus, it can be seen that for economy in manufacturing it is preferred that the location **92** of the tap into the tapped inductor **58** be maintained constant so that all circuit boards will have substantially the same configuration. The inductance of the inductor **70** is then varied to achieve the above described matching to the resistive impedance output of the power RF oscillator transistor **44**.

I claim:

1. An improved low power, audio frequency amplitude modulated RF transmitter of the kind having an audio frequency oscillator for applying an audio frequency square wave amplitude current modulation to a radio frequency signal comprising in combination:

a low voltage powered Hartley oscillator;

an audio frequency switching transistor having base, emitter and collector electrodes;

a load resistor coupled to said base electrode of said audio frequency switching transistor, and said Hartley oscillator coupled between said load resistor and said emitter electrode of said audio frequency switching transistor for generating an audio frequency switching transistor for generating an audio frequency signal between said emitter and said collector electrodes of said audio frequency switching transistor;

an RF signal generating and transmitting circuit comprising a power RF oscillator transistor having base, emitter and collector electrodes, a variable capacitance tank circuit coupled between said base electrode and said collector electrode of said power RF oscillator transistor for controlling the frequency of an RF signal, an antenna having an input terminal and an end terminal for radiating an RF signal, an inductor coupled between said tank circuit and said input terminal of said antenna and the inductance of said tank circuit and the inductance of said inductor together matching the impedance of said power RF oscillator transistor, and a bias resistor

coupled to said base electrode of said power RF oscillator transistor, whereby an RF signal is generated between said emitter electrode and said collector electrode of said power RF oscillator transistor;

and said emitter electrode of said power RF oscillator transistor coupled to said collector electrode of said audio frequency switching transistor for receiving said audio frequency modulation signal to square wave current amplitude modulate said RF signal;

a coupling capacitor for isolating said RF signal generating and transmitting circuit from said Hartley oscillator coupled between said end terminal of said antenna and said emitter electrode of said power RF oscillator transistor;

and means for energizing said Hartley oscillator and said RF signal generating and transmitting circuit.

2. The arrangement defined in claim **1** and further comprising a rake means coupled to said antenna for increasing the signal radiating area thereof, and the frequency of said audio frequency signal is in the range of 12 to 24 kilocycles, and the frequency of said RF signal is in the range of 250 to 300 megacycles with a band width of approximately 100 kilocycles.

3. An RF signal transmitter comprising in combination:

an audio frequency switching transistor having base, emitter and collector electrodes;

a power RF oscillator transistor having base, emitter and collector electrodes and the emitter electrode of said power RF oscillator transistor coupled to the collector electrode of said audio frequency switching transistor;

an RF tank circuit having a first preselected inductance, for controlling the frequency of an RF signal, coupled between said base electrode and said collector electrode of said power RF oscillator transistor;

an inductor, an antenna, and a coupling capacitor connected in series between said tank circuit and said emitter electrode of said power RF oscillator transistor, and said inductor having a second preselected inductance and the sum of said first preselected inductance and said second preselected inductance substantially matching the impedance of said power RF oscillator transistor to maintain an inductive coupling into said antenna whereby an RF signal is generated between said emitter and said collector electrodes of said power RF oscillator transistor;

an audio frequency oscillator coupled between said base and said emitter electrode of said audio frequency switching transistor for generating an audio frequency modulation signal between said emitter and said collector electrode of said audio frequency switching transistor;

a bias resistor connected to said base elecrode of said power RF oscillator transistor;

and means for energizing said audio frequency oscillator and said power RF oscillator transistor whereby said RF signal is square wave current amplitude modulated by said audio frequency signal.

4. An RF signal transmitter comprising in combination:

audio frequency signal generating means for generating an audio frequency signal having a first preselected frequency;

RF signal generating means for generating an RF signal having a frequency within a second preselected frequency range different from said first preselected frequency range;

said RF signal generating means comprising a power RF oscillator transistor having base, emitter and collector electrodes for providing said RF signal between said emitter and said collector electrodes of said power RF oscillator transistor;

said audio frequency generating means comprising an audio frequency switching transistor having base, emitter and collector electrodes for providing said audio frequency signal between said emitter and said collector electrodes of said audio frequency switching transistor, and said collector electrode of said audio frequency switching transistor coupled to said emitter electrode of said power RF oscillator transistor to square wave current amplitude modulate said RF signal at said audio frequency;

and an antenna means in said RF signal generating means and coupled to said emitter electrode of said power RF oscillator transistor for transmitting said square wave current modulated RF signal.

5. An RF signal transmitter comprising in combination:

audio frequency generating means for generating an audio frequency signal having a first prselected frequency;

RF signal generating means for generating an RF signal having a frequency within a second preselected frequency range different from said first preselected frequency range;

said RF signal generating means comprising a power RF oscillator transistor having base, emitter and collector electrodes for providing said RF signal between said emitter and said collector electrodes of said power RF oscillator transistor;

said audio frequency signal generating means comprising an audio frequency switching transistor having base, emitter and collector electrodes for providing said audio frequency signal between said emitter and said collector electrodes of said audio frequency switching transistor, and said collector electrode of said audio frequency switching transistor coupled to said emitter electrode of said power RF oscillator transistor to square wave current amplitude modulate said RF signal at said audio frequency;

an antenna means coupled in said RF signal generating means for transmitting said square wave current modulated RF signal;

and a coupling capacitor coupled between said emitter electrode of said power RF oscillator transistor and said antenna means for substantially isolating said audio frequency generating means from said RF signal generating means.

6. The arrangement defined in claim **3** wherein the said RF tank circuit comprises a parallel connected variable capacitor and a tapped inductor having said first preselected inductance, and a temperature compensating capacitor, and said parallel connected variable capacitor and tapped inductor connected in series with said temperature compensating capacitor between said base electrode and said collector electrode of said power RF oscillating transistor.

7. An RF signal transmitter comprising in combination:

a power RF oscillator transistor having base, emitter and collector electrodes;

a tank circuit comprising a variable capacitor and a tapped inductor having a first preselected inductance connected in parallel and a temperature compensating capacitor connected in series with said parallel connected variable capacitor and tapped inductor between said base electrode and said collector electrode of said power RF oscillator transistor for controlling the frequency of an RF signal;

an antenna having an input connection and an end connection;

an inductor having a second preselected inductance coupled to said input connection of said antenna and to said tapped inductor of said tank circuit and the sum of said first preselected inductance and said second preselected inductance providing an impedance substantially matching the impedance of said power RF oscillator transistor;

a bias resistor coupled to said base electrode of said power RF oscillator transistor to provide a predetermined direct current into the base electrode of said power RF oscillator transistor whereby an RF signal is generated at a preselected frequency between said emitter electrode and said collector electrode of said power RF oscillator transistor;

means for generating an audio frequency signal, said means connected to said emitter electrode of said power RF oscillator transistor for providing said audio frequency signal therein to modulate said RF signal;

and a coupling capacitor coupled between said antenna end terminal and said emitter electrode of said power RF oscillator transistor for substantially isolating said means from said power RF oscillator transistor.

8. In combination:

an audio frequency oscillator;

an audio frequency switching transistor having base, emitter and collector electrodes and said audio frequency oscillator coupled between said base and said emitter electrodes for generating an audio frequency modulation signal between said emitter and said collector electrodes of said audio frequency switching transistor;

a power RF oscillator transistor having an emitter electrode connected to said collector electrode of said audio frequency switching transistor for receiving said audio frequency signal, and a base and a collector electrode;

a tank circuit for controlling the frequency of an RF signal, said tank circuit comprising a variable capacitor and a tapped inductor connected in parallel, and a first side thereof connected to said collector electrode of said power RF oscillator transistor, and a temperature compensating capacitor connected between said base electrode of said power RF oscillator transistor and said tank circuit, and said tapped inductor having a first preselected inductance;

an antenna for transmitting an RF signal and having an input connection and an end connection;

an inductor having a second pre-selected inductance and the sum of said first preselected inductance and said second preselected inductance substantially matching the impedance of said power RF oscillator transistor, and said inductor connected between said tapped inductor of said tank circuit and said input terminal of said antenna;

and a bias resistor coupled to said base electrode of said power RF oscillator transistor whereby an RF signal is generated between said emitter and said collector electrodes of said power RF oscillator transistor and said RF signal is square wave current amplitude modulated by said audio frequency signal.

9. In combination:

an audio frequency oscillator;

an audio frequency switching transistor having base, emitter and collector electrodes and said audio frequency oscillator coupled between said base and said emitter electrodes of said audio frequency switching transistor for generating an audio frequency signal between said emitter electrode and said collector electrode of said audio frequency switching transistor;

and an RF generating and transmitting circuit comprising a power RF oscillator transistor having base, emitter and collector electrodes and said emitter electrode of said power RF oscillator transistor connected to said collector electrode of said audio frequency switching transistor for receiving said audio frequency signal therein, and means connected between said base electrode and said collector electrode of said power RF oscillator transistor for providing an RF signal between said emitter electrode and said collector electrode of said power RF oscillator transistor whereby said audio frequency signal square wave current amplitude modulates said RF signal, and means for radiating said amplitude modulated RF signal.

10. A transmitter comprising in combination:

an audio frequency oscillator;

an audio frequency switching transistor having base, emitter and collector electrodes and said audio frequency oscillator coupled between said base and said emitter electrodes of said audio frequency switching transistor for generating an audio frequency modulation signal having a preselected frequency between said emitter and said collector electrodes of said audio frequency switching transistor;

a power RF oscillator transistor having base, emitter and collector electrodes, said emitter electrode of said power RF oscillator transistor coupled to said collector electrode of said audio frequency switching transistor;

an end fed antenna having an input terminal and an end terminal for radiating an RF signal;

a tank circuit having a first preselected inductance for controlling the frequency of an RF signal, coupled between said collector and said base electrodes of said power RF oscillator transistor, an inductor having a second preselected inductance and the sum of said first and said second preselected inductances substantially matching the impedance of said power RF oscillator transistor, and said inductor coupled between said tank circuit and said input terminal of said antenna for feeding an RF signal into said antenna, a bias resistor coupled to said base electrode of said power RF oscillator transistor, and a rake means coupled to said antenna for increasing the radiation transmission area thereof, whereby an RF signal is generated between said emitter and said collector electrodes of said power RF oscillator transistor;

a coupling capacitor coupled to the end terminal of said antenna and said emitter electrode of said power RF oscillator transistor for substantially isolating said audio frequency oscillator;

and a low voltage power source for energizing said audio frequency oscillator whereby said RF signal is square wave current modulated by said audio frequency signal.

11. The arrangement defined in claim 10 wherein said RF signal is radiated by said antenna at approximately 10 milowatts, said audio frequency signal has a frequency within the range of 12 to 24 kilocycles and said RF signal has a frequency within the range of 250 to 300 megacycles and a band width of approximately 100 kilocycles.

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