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[54] SIGNAL TRANSMITTER

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[58] **Field of Search**.....325/115, 116, 124, 153, 160, 325/178, 176, 133, 154; 343/860, 894; 331/47

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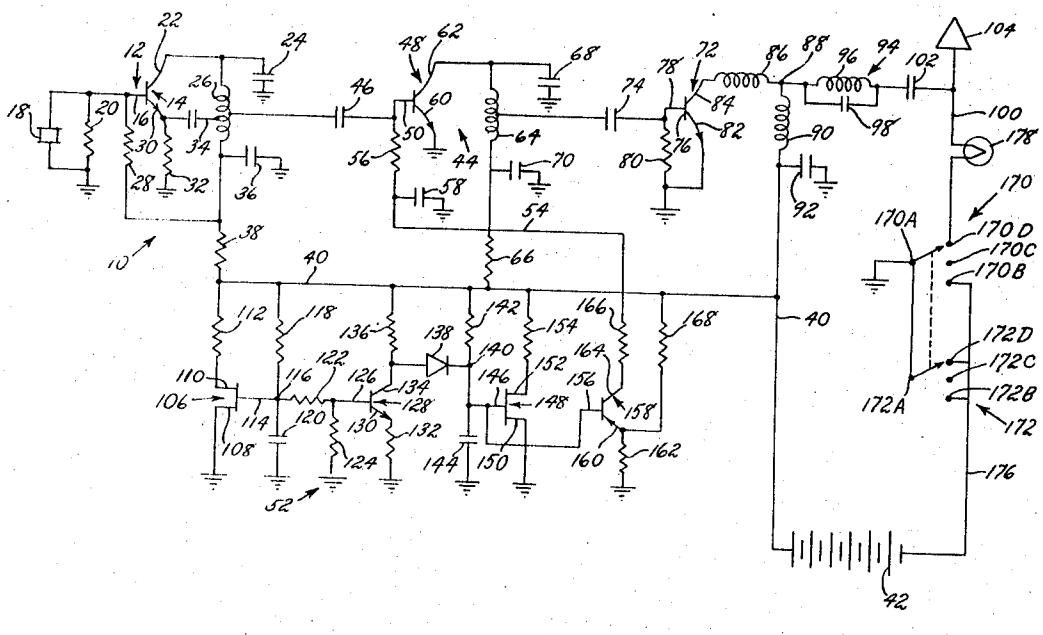
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[57] **ABSTRACT**

A signal transmitter for transmitting the international distress signal which includes a generator for simultaneously producing the military and civil distress signals having the appropriate frequencies. An antenna is provided which is tuned to a frequency intermediate the military and civil signal frequencies. An impedance matching network is connected between the antenna and the generator which is adapted to produce the conjugate impedance of the antenna at the military and civil signal frequencies so that the signals are transmitted with substantially maximum power.

11 Claims, 2 Drawing Figures



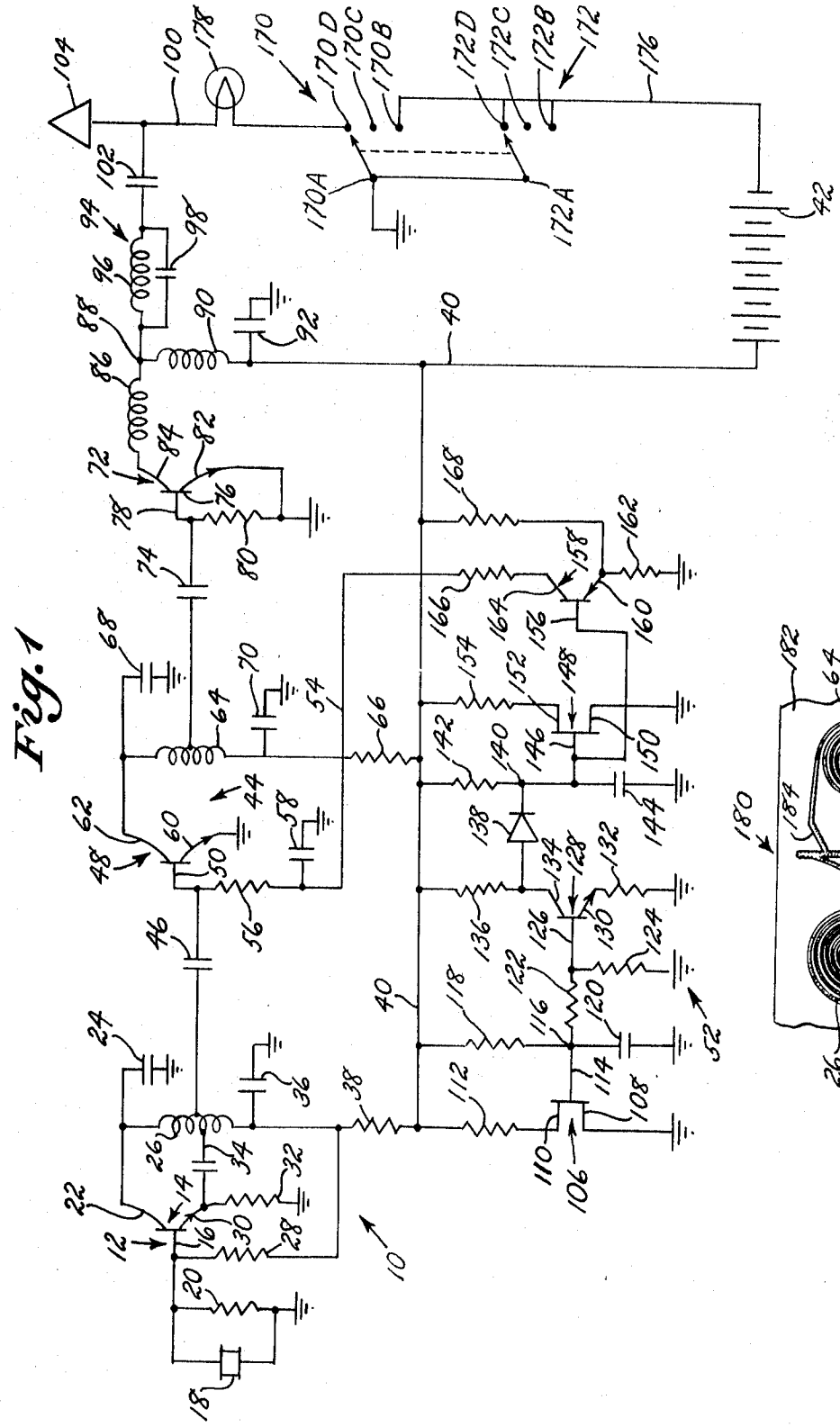


Fig. 1

Fig. 2

SIGNAL TRANSMITTER

This invention relates generally to a signal transmitter and, more particularly, pertains to a transmitter for generating and broadcasting a distress signal.

As is well known to fliers, sailors, servicemen, adventurists and the like, the international emergency distress signal is a wobbling tone which may be transmitted at a military carrier frequency of 243 MHz or a civil carrier frequency of 121.5 MHz. Presently, there are a number of commercially available signal transmitters which are specifically designed for use by the above-noted classes of people or, for that matter, any person likely to encounter sudden emergency conditions. However, these devices suffer from a number of various drawbacks which seriously limit their overall usefullness.

For example, one particular disadvantage is that many such transmitters do not have a separate power supply and consequently draw power from the power source which drives the vehicle in which they are travelling. Accordingly, if this power source is destroyed, as in a crash or the like, the transmitter is rendered useless. Even if the power source remains intact, these types of transmitters have been found to deplete such power sources within 10–15 minutes of continuous use. When it is taken into consideration that it normally takes approximately 55 minutes to locate an emergency or distress signal transmitter, it becomes obvious that the use of such transmitters as emergency devices is, at best, questionable.

Other types of distress signal transmitters are portable to the extent that they incorporate self-contained power supplies; however, these transmitters similarly have drawbacks associated with their use. Thus, in practice it has been that the shelf-life of the portable power supply is relatively short. Hence, when the transmitter is called upon to perform it may only produce a signal for an insufficiently short interval of time. Even if the power supply has a long shelf-life but has not been renewed at proper intervals, the same result will be obtained. Since present portable transmitters of the type under consideration do not incorporate any means to notify the operator that the power source is depleted, the person in distress usually falsely relies upon the transmitter, to his detriment.

Other problems associated with prior art distress signal transmitters of the aforementioned types arise because variable elements are utilized in the tuned circuits incorporated in the transmitter. As a result, tuning procedures are necessary to initially tune the transmitters to the desired carrier frequency thereby increasing the overall cost of such devices in terms of both the cost of such elements and the labor involved in such critical tuning procedures.

Accordingly, a general object of the present invention is to provide an improved emergency or distress signal transmitter.

A more specific object of the invention is to provide portable distress signal transmitter having a self-contained long-life power supply.

A further object of this aspect of the present invention is the provision of a signal generator having a built-in test apparatus to quickly notify the operator as to whether the transmitter is operable or inoperable.

Another object of this invention resides in the novel details of the circuitry which provide a transmitter of the type described which does not utilize variable elements in the tuned circuits thereby eliminating the problems and added costs which are associated with such elements.

A further object of the invention is to provide a reliable and inexpensive transmitter which broadcasts the international distress signal at both military and civil carrier frequencies simultaneously.

Accordingly, a distress signal transmitter constructed according to the present invention comprises signal generator means for generating first and second signals wherein the second signal has a higher frequency than the first signal. An antenna is provided which has a wavelength appropriate for the transmission of a signal having a wavelength intermediate the wavelength of said first and second signals. Impedance matching means is connected between the signal generator means and the antenna for producing the respective conjugate impedances of said antenna at said first and second signals.

Other features and advantages of the present invention will become more apparent from a consideration of the following detailed description when taken in conjunction with the accompanying drawing, in which:

FIG. 1 is a schematic circuit wiring diagram of a distress signal transmitter constructed according to the present invention; and

FIG. 2 is a bottom plan view of a printed circuit board illustrating coils which may be used in the circuit of FIG. 1.

As noted hereinabove, the signal transmitter of the present invention is operable to broadcast the international distress or emergency signal on the military carrier frequency of 243.0 MHz and the civil carrier frequency of 121.5 MHz. These carrier frequencies are amplitude modulated with a signal which sweeps through a range of from 300 Hz to 1,000 Hz at a 2–3 Hz rate to produce the wobbling tone which is indicative of the emergency signal.

Accordingly, a transmitter constructed according to the present invention is designated generally by the reference numeral **10** in FIG. 1 and includes a grounded base crystal oscillator transistor stage **12**. More specifically, the stage **12** includes a transistor **14** having a base electrode **16** connected to ground through a crystal **18**. A resistor **20** is connected in parallel with the crystal **18**. Connected to the collector electrode **22** of the transistor **14** is one end of a tuned or tank circuit comprising a capacitor **24** and an inductor **26**. The other end of the capacitor **24** is connected to ground and the other end of the inductor **26** is returned to the base electrode **16** via a resistor **28**. The emitter electrode **30** of the transistor **14** is connected to ground through a resistor **32** and to a tap on the inductor **26** through a capacitor **34**. Connected to the junction of the inductor **26** and the resistor **28** is a by-pass capacitor **36**. Also connected to this junction is one end of a resistor **38**, the other end of which is connected to a power lead **40** which, in turn, is connected to the positive terminal of a biasing source **42**. As shown in FIG. 1, the source **42** may comprise a battery pack.

In the example under consideration, the oscillator stage **12** is tuned to and produces a 60.750 MHz signal. This signal is applied to a high efficiency frequency doubler stage **44** through a coupling capacitor **46**, one end of which is connected to an appropriate tap on the inductor **26**.

More particularly, the stage **44** includes a transistor **48**, the base electrode **50** of which is connected to the other end of the capacitor **46**. Additionally, the electrode **50** is connected to a modulating circuit, which is designated generally by the reference numeral **52** and is described in detail below, by a lead **54** through a resistor **56**. A by-pass capacitor **58** is connected between the end of the resistor **56** remote from the electrode **50** and ground. The emitter electrode **60** of the transistor **48** is connected to ground. The collector electrode **62** of the transistor **48** is connected to the power lead **40** through a series circuit comprising an inductor **64** and a resistor **66**. A tuning capacitor **68** is connected between the electrode **62** and ground and, together with the inductor **64**, forms a tuned or tank circuit. A by-pass capacitor **70** is connected between the junction of resistor **66** and inductor **64** and ground.

The output signal of the stage **44** is applied to another frequency doubler stage **72** through a coupling capacitor **74** having one end connected to an appropriate tap on the inductor **64**. As noted above, in the example under consideration, the oscillator stage produces a signal having a frequency of 60.750 MHz. Hence, the frequency of the signal appearing at the output of the stage **48** will be 121.5 MHz. In other words the tuned circuit comprising the inductor **64** and the capacitor **68** is tuned to 121.5 MHz.

The stage **72** includes a transistor **76**, the base electrode **78** of which is connected to the other end of the capacitor **74** and to ground through a resistor **80**. The emitter electrode **82** of

the transistor **76** is connected to ground and the collector electrode **84** thereof is connected to one end of an inductor **86**. The other end of the inductor **86** is connected to a junction **88** to which is connected one end of another inductor **90**. The other end of the inductor **90** is connected to the power lead **40** and to one end of a by-pass capacitor **92**, the other end of which is connected to ground.

While no physical tuning capacitor per se is used to tune the inductors **86** and **90**, use is made of the collector-to-emitter capacitance (i.e., the varactor effect of the transistor **76**) to produce the desired signal. Moreover, the parameters of the stage **72** are chosen so that the signal of fundamental frequency (i.e., the frequency of the input signal) and the second harmonic signal appearing between the junction **88** and ground have equal amplitudes. Thus, in the specific example under consideration, two substantially equal amplitude signals will appear between the junction **88** and ground; one signal having a frequency of 121.5 MHz, and the other signal having a frequency of 243 MHz.

Connected to the junction **88** is one end of a signal trap **94** comprising an inductor **96** and a capacitor **98** connected in parallel therewith. The other end of the trap **94** is connected to an antenna lead **100** through a coupling capacitor **102**. The lead **100** is connected to a telescoping dipole antenna **104**.

In practice the trap **94** is tuned to reject the third harmonic of the oscillator frequency or, in the circuit under consideration, the trap **94** rejects signals having frequencies of approximately 180.0 MHz but passes the 121.5 MHz and 243 MHz signals to the antenna **104** via the capacitor **102** and the lead **100**. It will now be obvious that the circuit thus far described simultaneously produces the military emergency carrier frequency signal of 243 MHz and the civil emergency carrier frequency signal of 121.5 MHz and transmits the same via the antenna **104**.

Since it is desirable to transmit or broadcast both of the above signals with substantially full power, a feature of the invention is to provide a novel impedance matching arrangement at both of the aforementioned frequencies. Thus, the antenna **104**, when extended, is selected to be slightly short at the wavelength corresponding to the signal of 121.5 MHz. Hence, the antenna **104** appears to have a capacitive reactance at 121.5 MHz and an inductive reactance at 243.0 MHz. However, the trap **94** is tuned to 180 MHz. Hence, the trap **94** exhibits an inductive reactance at 121.5 MHz and a capacitive reactance at 243 MHz. Thus, in view of the fact that the impedances of the antenna **104** and the trap **94** are the conjugate of each other at the two frequencies of interest, the antenna is matched to the circuit and the two carrier signals are broadcast with substantially no attenuation due to mismatching.

The modulating circuit **52** is adapted to amplitude modulate the 121.5 MHz and 243 MHz signals at a 2–3 Hz rate with a signal which sweeps from 300 Hz to 1,000 Hz. Accordingly, the modulating circuit **52** includes a unijunction transistor **106** the first base electrode **108** of which is connected to ground and the second base electrode **110** of which is connected to the power lead **40** through a resistor **112**. The emitter electrode **114** of the transistor **106** is connected to the junction **116** of a resistor **118** and a capacitor **120**. The other end of the capacitor **120** is connected to ground and the other end of the resistor **118** is connected to the lead **40**.

The operation of unijunction transistor **106** is conventional. Thus, the potential across the capacitor **120** begins to increase until the triggering potential of the transistor **106** is reached at which point the transistor conducts and the capacitor **120** discharges therethrough. Accordingly, a sawtooth waveform is generated across the capacitor **120** and the parameters are chosen so that this sawtooth potential has a frequency of approximately 3 Hz.

Connected between the junction **116** and ground is a voltage divider network comprising the serially connected resistors **122** and **124**. The base electrode **126** of a transistor **128** of a phase inverter stage is connected to the junction of the resistors **122** and **124**. The emitter electrode **130** of the transistor **128** is connected to ground through a resistor **132** and the collector electrode **134** thereof is connected to the power lead **40** through a resistor **136**.

The anode electrode of a diode **138** is connected to the collector electrode **134** of the transistor **128** and the cathode electrode thereof is connected to the junction **140** of an RC circuit comprising a resistor **142** connected between the lead **40** and the junction **140**, and a capacitor **144** connected between the junction and ground.

Also connected to the junction **140** is the emitter electrode **146** of a unijunction transistor **148**. The first base electrode **150** of the transistor **148** is connected to ground and the second base electrode **152** is connected to the lead **40** through a resistor **154**. The signal appearing between electrode **146** and ground sweeps between 1,000 and 300 Hz at a 3 Hz rate.

To be more specific, the conduction of the phase inverter stage or transistor **128** will vary at substantially a 3 Hz rate under control of the sawtooth signal appearing at the junction **116**. When the transistor **128** is fully conducting the capacitor **144** charges through the resistor **142** until the triggering potential of the unijunction transistor **148** is reached. The elements are chosen so that the signal produced occurs at a 300 Hz rate for this condition of the transistor **128**. However, when the transistor **128** is in cut-off, the diode **138** is biased to conduct thereby connecting the resistor **136** in parallel with the resistor **142** to change the effective resistance and, therefore, the time constant of the charging circuit. For this condition of the circuit the elements are chosen so that the signal appearing across the capacitor **144** occurs at a 1,000 Hz rate. For intermediate values of conduction of the transistor **128** the effective resistance in series with the capacitor **144** will vary accordingly. Hence, the signal appearing on the electrode **146** of the unijunction transistor **148** will sweep from 300 to 1,000 Hz at the 3 Hz rate.

Connected to the electrode **146** is the base electrode **156** of a transistor **158**. The emitter electrode **160** of the transistor **158** is connected to ground through a resistor **162** and the collector electrode **164** is connected to the lead **54** through a resistor **166**. Additionally, the electrode **160** is connected to the lead **40** through a resistor **168**.

In operation, the transistor **158** operates as a switch which opens and closes at a rate determined by the waveform on the base electrode **156**. Thus, when the transistor **158** is conducting, the resistor **56**, which is in the base circuit of the frequency doubler stage **44**, is essentially connected to ground. However, when the transistor **158** is in cut-off the end of the resistor **56** remote from the electrode **50** is floating thereby causing the transistor **48** to cease conducting. Thus, the action of the transistor **158** is to amplitude modulate the signal applied to the stage **44** from the oscillator stage **12**. Hence, the output 121.5 MHz and the 243 MHz signals will be amplitude modulated by a signal which sweeps through a frequency band of from 300 Hz to 1,000 Hz at approximately a 3 Hz rate.

The operation of the transmitter **10** is controlled by a pair of ganged single-pole triple throw switches **170** and **172**. To be more specific, the respective armatures **170A** and **172A** of the switches **170** and **172** are connected together and to ground by a lead **174**. The terminals **172B**, **172D** and **170B** of the respective switches are connected together and to the negative terminal of the source **42** by a lead **176**. The terminals **172C** and **170C** are unconnected while the terminal **170D** of the switch **170** is connected to the antenna lead **100** through a test lamp **178**.

Under normal circumstances the armatures **170A** and **172A** of the respective switches **170** and **172** will be in contact with the terminals **170C** and **172C**, respectively. When it is desired to operate the transmitter the telescoping antenna **104** is pulled out to its required length and the ganged switches are operated to the lower position so that the respective armatures engage the contacts **170B** and **172B**. Thus, the negative terminal of the source **42** will be grounded through the lead **176** and the respective switches to complete the circuit between

the energy source **42** and the appropriate elements. Accordingly, the transmitter **10** will broadcast the necessary distress signals on both the military and civil frequency bands in the manner described above.

As noted above, a feature of the present invention is to provide means for quickly and easily determining whether the transmitter **10** is operational without the need to broadcast false distress signals. Thus, when it is desired to test the transmitter the switches **170**, **172** are operated to connect the armatures **170A**, **172** to the respective terminals **170D**, **172D**. At this time the telescoping antenna **104** is left in the collapsed position. The source **42** will be grounded through the lead **176** and the switch **172** so that the distress signals will be generated. However, the collapsed antenna **104** will limit the broadcast of the signals to a relatively small range.

Additionally, the test lamp **178** will be connected between the antenna lead **100** and ground via the switch **170**. Hence, the output distress signals similarly will be applied to the lamp **178**. Since the output signals are AM carrier signals, the lamp **178** will flicker at a rate determined by the modulated envelope of the carrier wave. Accordingly, when the operator observes such flickering he is aware that the transmitter is operating properly. However, if the flickering is absent the operator is made aware that the device is faulty and should be replaced or repaired before embarking on the potentially hazardous journey.

It is to be noted that the circuit of FIG. **1** utilizes solid state devices which consume minimum power. Hence, the source **42** may comprise an alkaline battery which ideally has a relatively long shelf-like to ensure proper operation of the transmitter **10** for a relatively long period of time. Additionally, the low power drain of the elements contributes to the long duration of signal broadcasting of the transmitter when it is operational.

It is further to be noted that the circuit of FIG. **1** does not use any variable tuning elements in the tuned circuits. To be more specific, use is made of the depletion capacitance of the transistors to eliminate the need for variable tuning elements and their consequent time consuming critical adjustments. For example, the elements **26** and **24** comprising the tuned circuit in the oscillator stage **12** are chosen so that the circuit resonates at the desired frequency. However, as a result of stray and wiring capacities, or tolerance variations in the components and the like, the circuit may resonate of at a slightly different frequency than 60.750 MHz. If the tuned circuit is off resonance, the current through the transistor **14** will decrease thereby changing the width of the depletion layer in the transistor and, hence, the junction or depletion capacitance exhibited by the transistor. Thus, the capacitance of the transistor changes automatically until resonance is obtained thereby eliminating the need for variable elements.

A further feature of the present invention is the provision of a printed circuit board on which the elements comprising the circuit of FIG. **1** are mounted and on which the inductor components are printed thereby eliminating the need for inductor elements and their consequent cost. Thus, as shown in FIG. **2**, a printed circuit board **180** is provided which includes an insulating board **182**. Printed on the underside of the board **182** are conductors **184** representing the various circuit connections. Also printed on the undersurface of the board **182** are coils such as coils **26** and **64** which are, in effect, inductors having the proper inductance, Q, etc. for their intended purpose. (It is to be noted that many conductors **184** and other circuit elements have not been shown in FIG. **2** in the interests of clarity.) The actual printing is performed in the conventional manner. Accordingly, as noted above, the need for physical inductors is eliminated.

Thus, a distress or an emergency signal transmitter has been disclosed which simultaneously broadcasts on both military and civil frequencies which is simple to fabricate and which is efficient and reliable in operation.

While a preferred embodiment of the invention has been shown and described herein it will become obvious that numerous ommissions, changes and additions may be made in such embodiment without departing from the spirit and scope of the present invention.

What is claimed is:

1. A signal transmitter comprising signal generator means for simultaneously generating a first and a second signal wherein the second signal has a higher frequency than said first signal, an antenna having a wave length corresponding to the wave length of a signal intermediate the wave lengths of said first and second signals, and a fixed frequency impedance matching means between said signal generator means and said antenna for producing the respective conjugate impedances of said antenna at said first and second signals.

2. A signal transmitter as in claim **1**, in which said impedance matching means includes means tuned to reject a signal having a frequency intermediate the frequency of said first and second signals.

3. A signal transmitter as in claim **1**, in which said signal generator comprising means for generating a fundamental frequency signal, the second harmonic of said fundamental frequency signal which corresponds to said first signal, and the fourth harmonic of said fundamental frequency signal which corresponds to said second signal; and said impedance matching means comprises a parallel inductor and capacitor circuit which is tuned to reject the third harmonic of said fundamental frequency signal.

4. A signal transmitter as in claim **1**, and test means selectively connectable with said antenna and responsive to the amplitude modulation of said first and second signals for indicating such amplitude modulation.

5. A signal transmitter as in claim **4**, in which said test means comprises a lamp, and a switch for connecting said lamp with said antenna.

6. A signal transmitter as in claim **1**, in which said signal generator means comprises carrier frequency generating means for simultaneously producing first and second carrier frequency signals, said carrier frequency generating means including a frequency doubler stage operable to produce a fundamental and a second harmonic signal of substantially equal amplitudes whereby said second carrier frequency signal is twice the frequency of but substantially equal in amplitude to said first carrier frequency signal.

7. A signal transmitter as in claim **6**, in which said frequency doubler stage includes a plurality of inductors, said inductors comprising a plurality of coils printed on a printed circuit board.

8. A signal transmitter as in claim **6**, in which said signal generator means further comprises modulating means for modulating said first and second carrier frequency signals to produce said first and second signals, said modulating means being operable to modulate said first and second carrier frequency signals with a modulating signal which sweeps between a third and a fourth frequency at a predetermined rate.

9. A signal transmitter as in claim **8**, in which said modulating means includes first signal means for producing a signal which varies at said predetermined rate, second signal means for producing a signal which sweeps between said third and fourth frequencies, and connecting means for connecting said first signal means with said second signal means to control the operation of said second signal means at a rate determined by said first signal means signal.

10. A signal transmitter as in claim **9**, in which said second signal means comprises a capacitor, discharging means connected in parallel with said capacitor for discharging said capacitor when the potential across said capacitor reaches a preselected value, a first charging resistor connected between said capacitor and a charging source for causing said capacitor to charge at a selected rate, a second charging resistor, and switch means responsive to said first signal means signal for selectively connecting said second resistor in parallel with said first resistor to change the charging rate of said capacitor.

11. A signal transmitter as in claim **10**, in which said switch means comprises a semiconductor diode.

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