

Similar reference characters denote corresponding features of the invention consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present device incorporates a phenomenon known as harmonics in its operation to trigger the resonant characteristics of target cells or organisms. A harmonic is a multiple of the original (fundamental) frequencies of wave functions. For example, a second harmonic of 100 cycles is 200 cycles or Hz while a third harmonic would be 300 cycles.

The invention employs square shaped wave functions which are made up of an infinite number of the odd numbered harmonics fundamental frequency. That is, a square wave is constructed from sine waves using the third, fifth, seventh and so on, harmonics of the fundamental frequencies. For example, a 1000 cycle fundamental output square wave contains sine waves of 3000 Hz, 5000 Hz, 7000 Hz, and all other odd numbered harmonics.

The invention employs an amplitude modulated (AM) radio wave which comprises three waves, the primary wave and two side bands which are the sum and difference of the radio wave and the modulated audio wave. For example, a 1000 cycle audio wave on a 1,000,000 cycle radio wave produces two side bands; one, the lower side band at 999,000 cycles, and two, the upper side band at 1,001,000 cycles. The separation between the upper and lower side bands is what is known as the bandwidth. In this example, the bandwidth is 2000 cycles. The harmonics that make up the audio frequency square wave will produce the bandwidth of the transmitted electromagnetic wave, which will play an important part in the construction and operation of the present invention.

The side bands are important in that they contain all of the square waves generated. The side bands contain only one third of the power of the total electromagnetic energy generated and transmitted, while the carrier wave retains the other two thirds of the power transmitted. All of the harmonics that make up the square wave also will produce side bands of their own. Further, a linear amplifier will produce harmonics of the primary input radio wave generated by the transmitter used in the present invention. These harmonics of the radio wave also will act as a carrier of all the harmonics of the square wave and produce another set of side bands, thus resulting in literally hundreds of radio and audio frequencies produced by and introduced into a plasma tube antenna, discussed below. The effects of the device are dependent upon the properly applied audio frequency. It is the audio frequency that determines the formation of side bands, and the ability to produce resonant interaction between the device and the selected tissues or microorganisms. Therefore with the proper audio frequency resonant effects occur, and with the incorrect audio frequency, there are no effects.

Referring to FIG. 1, the device includes a low power radio frequency transmitter **10** generating radio waves having a radio frequency and a radio function. The radio frequency utilized generally is in the 2 to 33 MHz range. It has been found that certain radio frequencies may produce deeper tissue penetration with the device than other radio frequencies. The FCC has set aside certain frequencies for use with industrial, scientific and medical (ISM) devices. The most commonly used of these is located at 27.12 MHz. The allocated bandwidth by the FCC at 27.12 MHz is + or -163,000 cycles or a total of 326,000 cycles. It is to the

devices advantage to utilize all this available allocated bandwidth in its operation.

The primary low power radio frequency transmitter must be Amplitude Modulated preferably on a frequency of 27.12 MHz. The simplest method to generate the necessary 27.12 AM radio wave is to utilize a standard Citizen Band (CB) radio set to operate on channel **14**. CB radios generally include audio filters that limit the audio frequency response to a range of 300 to 2500 cycles. This frequency limitation effectively inhibits and clips off the harmonics in the square wave. To overcome this frequency limitation, modifications are made to the CB radio that widens its bandwidth. Further, the modulation limiter of the CB radio is bypassed allowing the CB radio to over-modulate. Over-modulation produces a pulsed radio wave. When the radio wave is modulated with an audio signal, the audio wave will therefore be pulsed too. The effects of pulsed radio frequency energy on tissues is well known. The unique effect generated by the modified CB radio is that the pulse width and duration varies directly with the modulated audio frequency square wave. The higher the audio frequency modulated, the shorter and more frequent the output pulse of radio energy.

The invention also employs an audio frequency oscillator **12** generating audio waves having an audio frequency and an audio function. The audio frequency oscillator **12** must provide for square wave output and should be adjustable in multiple range steps for frequency. Preferably, the quality of the square wave is quite high, being less than 0.1% distorted. The square wave should have a rise time of less than 20 nanoseconds, the faster the rise time the better. The audio frequency oscillator may be connected to the AM transmitter directly or to the microphone **14** of the transmitter.

One way to deliver optimum voltage output to the microphone is to listen to the output of the CB unit on another CB and set the output voltage to produce a clear signal. A second way is to set the output of the square wave generator to below 0.2 volt, then set the plasma tube antenna **16** to near maximum brightness by increasing or decreasing the voltage out of the frequency generator. Once set for one frequency, the voltage output should be correct for all audio frequencies. A third way is to employ a wide band oscilloscope to set the voltage output to the microphone at its optimum level.

Ideally, the radio frequency transmitter delivers a pulsed wide band width radio wave with a pulse rate and width varying with the applied audio frequency. Also, the radio frequency amplifier should deliver power in an amount that increases as the audio frequency increases.

Stability in audio frequency output may not be necessary toward optimum usage of the invention. Recent investigation has shown that frequency instability may be more effective. Toward this end, the invention may include means for presetting the degree of drift or sweep across a certain set amount of audio frequencies.

Where a high powered AM radio transmitter is used, the invention includes the use of a wide band width linear radio frequency amplifier. A wide bandwidth linear amplifier is necessary in order to properly amplify the side bands generated by the primary radio frequency generator. Preferably the linear radio frequency amplifier has no harmonic suppression and will generate its own radio frequency band harmonic signals. The linear amplifier receives and amplifies the output radio wave from the primary transmitter. From the amount of amplification produced by the linear amplifier, a power multiplication factor can be determined. This power multiplication factor in a 200 watt output linear

amplifier being driven by a 4 watt output CB radio is equal to 50. The power multiplication factor is important in giving power to the side bands generated by the input audio square wave. For example, a harmonically generated side band of the fundamental square wave audio frequency may have only one-half watt of power as it leaves the CB radio. After passing through the linear amplifier this same side band now has 25 watts of power.

Between the radio frequency transmitter and the radio frequency amplifier, the invention employs a discrete length of coaxial wire **20**. The length chosen is crucial in that the invention is most effective where transmission occurs with a minimum of standing wave ratio. Standing wave ratio is a measure of the power absorbed by the antenna relative to the power reflected back to the radio frequency amplifier. The ideal ratio is 1:1, however anything below 2:1 is good. A standing wave ratio that is too high will destroy the amplifier as well as the transmitter. Ideally, the cable length should be 18 feet or $\frac{1}{2}$ wavelength long. The use of an 18 foot or $\frac{1}{2}$ wavelength cable between the primary radio transmitter and the linear amplifier has been found to facilitate the creation of a gas plasma within the plasma tube.

The invention also includes an antenna tuner **22**. The antenna tuner matches the output of the radio frequency amplifier to the plasma tube **16** to insure that the maximum power is transmitted to the tube. The tuner receives the output from the radio frequency amplifier and supplies it via the wire terminals of the antenna tuner to the antenna leads of the plasma tube.

In order for the antenna tuner to function, it must be set on the lowest inductance regardless of the type of tube or gas used. Once the plasma lights in the plasma antenna, the standing wave ratio will approach infinity briefly until the plasma begins absorbing the power. At that point, the tuner knobs may be used to bring the standing wave ratio to a minimum. If the plasma does not light, input to the transmitter should be ceased temporarily to prevent damage to the primary radio frequency transmitter and linear amplifier.

Optionally, the invention may employ an external balun **24**, an impedance matching transformer used in some antenna tuners. The balun plays an important role in the full generation of the plasma waves of interest. A balun is rated by its ability to match dissimilar circuits. For example, a 4:1 balun will match a 75 ohm to a 300 ohm circuit. The size and type of balun has a direct effect on the strength and field density of the wave produced by the device. It has been found that certain baluns containing a large toroid can produce local fields that are physically difficult to tolerate for more than a few minutes at a time. The invention may also use a reverberator in communication with the audio frequency oscillator.

The invention employs a second length of coaxial cable **26** interposed between the radio frequency amplifier and antenna tuner. Ideally, the cable should be 18 feet or $\frac{1}{2}$ wavelength long. The use of said 18 foot or $\frac{1}{2}$ wavelength long cable tends to orient the output wave from the plasma tube fore and aft rather than laterally relative to the plasma tube.

The antenna tuner delivers energy to the antenna via approximately four feet of antenna wire **28**. The standing wave ratio should be maintained under 2:1 to prevent damage to the electronics.

The invention employs a plasma tube **16** as an antenna. The antenna **16** generates an output signal. A plasma tube antenna allows exposure of the entire subject, or a room full of subjects at one time.

Any of three types of glass may be used: First, common leaded glass found in any neon tube shop; second, quartz; and third, borosilicate (pyrex). Leaded glass is the easiest to work, is of the lowest cost and fastest to fabricate. Leaded glass is not ideally suited for the present invention because it is not very strong and tends to obstruct ultraviolet light.

Quartz glass is very strong, passes the entire light spectrum and has high heat resistance. Unfortunately, quartz is very expensive and generally does not accept internal electrodes. Bombardment, or purification of a finished quartz tube by heating it with flame or electrical current while evacuating it, is quite difficult without internal electrodes. Pyrex, on the other hand, does accept metal inserts of kovar or tungsten.

The tube may be filled with any noble gas (Argon, Helium, Neon, Xenon or Krypton). Argon, Helium and Neon give off ultraviolet radiations when excited by high voltage electricity. In order to fully utilize the spectrum of these gases, unleaded glass must be used. Diluting the primary gas with another gas reduces the amount of voltage necessary to create lighting of the plasma, commonly known as Penning affect. Experimentation with a mixture of about 98% Helium and 2% Argon has shown to be a very easily lightable mixture.

Table 1, below, contains a number of spectral lines and their position in the infrared, visible and ultraviolet regions for the noble gases.

TABLE I

GAS	Number of Spectral Lines			
	TOTAL	VISIBLE	>7050 (IR)	<3950 (UV)
Argon	3	164	110	109
Helium	129	26	47	57
Krypton	260	77	130	53
Neon	439	82	153	204
Xenon	309	130	132	47
Mercury ¹	195	41	32	122

¹Mercury is not a noble gas.

Visible light generally exists between 3950 and 7050 angstroms. Accordingly, Neon provides comparatively little visible strength yet it is the brightest of the noble gases in the visible region when excited by radio frequencies.

Below, Table 2 shows the range of spectral lines for each of the gases.

TABLE II

GAS	Range of Spectral Lines	
	RANGE	
Argon	487 to 23,966	
Helium	231 to 40,478	
Krypton	729 to 40,685	
Neon	352 to 33,834	
Xenon	740 to 39,955	
Mercury ¹	893 to 36,303	

¹Mercury, when added to the above gases, may decrease the power necessary to initiate the lighting of the plasma.

Table II shows the range within the spectrum occupied by each gas. It is well known that a shorter wavelength, in Angstroms, will provide for a more powerful spectral wave. Between 100 and 1000 angstroms, the wave has enough power to produce photoionization of O₂, O, N₂, and N. Between 1000 and 3000 angstroms, the spectral wave has enough power to photodissociate O₂ and O₃. Generally,

germicidal ultraviolet radiation occurs between 2200 and 2950 angstroms. The most effective transmission commonly used being 2537 angstroms.

Table III, below, lists the typical amount of germicidal energy necessary to destroy common microorganisms. Significantly, all of the gases of interest produce spectral lines far below the 2537 angstrom level. These spectral lines can be of use only if utilizing either quartz or more silicate glass for the plasma tube.

TABLE III

Germicidal Energy	
BACTERIAL ORGANISM	UV ENERGY (uw-sec/cm ²)
<i>B. Anthracis</i> (Anthrax)	4520
<i>Salmonella Enteritidis</i> (Food Poisoning)	4000
<i>C. Diphtheriae</i> (Diphtheria)	3370
<i>E. Coli</i> (Food Poisoning)	3000
<i>N. Catarrhalis</i> (Sinus Infection)	4400
<i>P. Aeruginosa</i> (Various Infections)	5500
Dysentery Bacilli	2200
<i>Staph. Aureus</i> (Various Infections)	2600
<i>Strep. Viridans</i> (Various Infections)	2000

Utilizing the linear amplifier of the present invention, the plasma tube may produce approximately 125,000,000 microwatts of power entering the plasma tube, the actual power being modulated by the light waves being unknown. The result in transmitted power, measured especially in the UV region, at this time, is not directly ascertainable. The light energy given off may be measured with various well known instruments, but the measurement does not truly indicate the power of the UV wave.

Table IV below, shows the total sum strength of the spectral electromagnetic light waves emitted by each type of gas in the UV, visible and infrared bands. The table also shows the number of spectral lines having a strength of 1000 or more. Spectral line strength is relative and compared to the standardized weakest observable line, which is 1.

TABLE IV

Electromagnetic Light Wave Strength		
GAS + # LINES > 1000	EM BAND STRENGTH	TOTAL FOR GAS
Helium # Lines = 5	UV 4843	11,901
	Visible 1416	
	IR 5742	
Krypton # Lines = 45	UV 12,370	151,290
	Visible 38,910	
	IR 100,010	
Mercury # Lines = 9	UV 38,761	55,371
	Visible 9950	
	IR 6660	
Xenon # Lines = 46	UV 12,370	168,326
	Visible 55,040	
	IR 93,329	
Neon # Lines = 86	UV 30,526	266,823
	Visible 6712	
	IR 212,795	
Argon # Lines = 32	UV 17,015	418,460
	Visible 33,549	
	IR 382,837	

Other gases, that have not been examined due to toxicity and/or chemical reactivity, include Fluorine, Bromine and Chlorine. Each gas has certain aspects which are very appealing for use. For example, Bromine has nearly 10 times the UV output of Mercury, 9 times the visible output over

Xenon and about 2.5 times the IR output of Argon. Due to the chemical reactivity of these gases, they should never be used in a tube with an internal electrode, probably only in a quartz tube with ultraviolet shielding.

The internal electrodes of the plasma tube may vary quite a bit. If using standard or common Neon sign tubing, cold cathode type electrodes with flexible woven connecting leads for power input should be used. Electrodes with solid copper connecting leads will quickly break the wire lead. The two internal electrodes are known as a cathode and an anode. The anode in this unit should be a piece of round barstock with a sloping face on it, attached to the tube. The cathode may be a piece of the same round barstock except that it generally has a flat face perpendicular to the anode support. The anode has an angle on its face between 17° and 22°. The greater the anode angle, the more energy required for a particle to leave the face of the anode parallel to the cathode face. The narrower the anode face angle, the less energy that is needed for a particle to leave the anode face parallel to the cathode face. As a result, the main beam comes out of the tube at a glancing angle, instead of at 90°, therefore the subject being treated will have to be positioned accordingly.

The cathode may be formed with a point in the center of it to better disperse the radio frequency energy. The cathode may be nothing more than a pointed tip at the end of the support rod. The cathode also may be round and flat faced with multiple sharp needles projecting outward toward to anode. As a rule, the anode and cathode should not be placed nearer than 1 cm. apart, preferably around 2.5 cm. apart. This is exemplified in FIG. 5. The tube 16 is shown containing anode 30 and cathode 32. The anode 30 has a flat angled face 34. The cathode 32 has a flat face 36 with a plurality of sharp needles 38 projecting therefrom.

The anode and cathode should be constructed from non-porous, heat-tolerant material, such as steel, stainless steel, tungsten, kovar, tantalum or nickel/chrome-plated brass. Porous metals, such as silver, gold, brass, tin, aluminum and copper, trap small amounts of gases and impurities that may leak into the tube over time and contaminate it. Further, the electrodes do become quite hot under the influence of radio frequency, thus some metals may melt, destroying the tube.

If a tube without electrodes is used to practice the invention, the tube must be wrapped with a flat braided wire. This is best seen in FIGS. 2, 3 and 4. Referring to FIG. 4, the tube should be wrapped with approximately one turn of wire before two automotive hose clamps 40 are mounted on the tube, securing the wire thereto. Preferably, on a 16-inch long tube, the clamps should be located approximately 12 inches apart. Another method would be to attached the wire to the electrodes at the end of the tube. This method is not recommended because of the difficulty in lighting the gas.

Referring to FIG. 2, wrapping the tube with a spiral of wire is possible, but care must be taken in doing so. This method may produce a condition in which the plasma tends to twist and distort and in some cases, not light. If not done properly, too much current density prevents plasma. Argon-filled tubes seem to work well with this method.

A focused metallic reflector behind the tube tends to help direct the light waves and intensify some of the devices effects.

The precise nature of a plasma wave, the energy produced in a plasma tube, is not clear. One theory has it that the radio wave, with its attached or modulated audio wave, is attached to the light generated in the plasma tube. Possibly, the light waves are modulated onto the radio-audio waves. Yet

another theory is that an entirely new form of energy is created which has properties common to sound, light and radio waves, but also properties which are not common.

Within the plasma tube, the audio frequency is spread about longitudinally, the light travels in longitudinal waves and the radio waves are disbursed vertically or horizontally from a standard antenna. The vector interface of these three forms of vibration in cellular structures may be a contributing factor in the device's ability to cause the devitalization of small organisms. The heterodyning occurring within the plasma tube also may account for literally thousands of different frequencies.

Although the above has been directed primarily toward eradication of malignant cells, the device also may be employed for other beneficial purposes. During development of the present device, it was observed that insects were irritated by the transmitted waves. Although sustained large doses transmitted waves may be lethal to human beings, experimentation with frequency and power levels should result in a device that is harmless to humans, yet annoying to insects such that they are driven from an area, such as a house or farmer's field. The output signal of the present device may be directed toward an insect population to drive them from a location.

The present invention is not intended to be limited to the embodiments described above, but to encompass any and all embodiments within the scope of the following claims.

I claim:

- 1. A resonant frequency therapy device comprising:
 - an audio frequency oscillator generating audio waves having an audio frequency;
 - a radio frequency transmitter generating radio waves having a radio frequency, said radio frequency transmitter receiving and modulating said audio waves from audio frequency oscillator with said radio waves, defining radio-audio waves having a radio-audio frequency;
 - a radio frequency linear amplifier receiving and amplifying said radio-audio waves from said radio frequency transmitter, defining amplified radio-audio waves having an amplified radio-audio frequency;
 - an antenna tuner receiving said amplified radio-audio waves from said radio frequency amplifier and generating a tuned signal; and
 - an antenna receiving said tuned signal from said antenna tuner and transmitting an output signal and wherein said antenna is a plasma tube.
- 2. A resonant frequency therapy device as recited in claim 1, wherein said audio frequency oscillator is a square wave oscillator.
- 3. A resonant frequency therapy device as recited in claim 1, wherein said radio frequency transmitter generates amplitude modulated radio waves.
- 4. A resonant frequency therapy device as recited in claim 1, wherein said radio frequency transmitter generates pulsed radio waves.
- 5. A resonant frequency therapy device as recited in claim 1, wherein said antenna tuner further comprises a current-balancing balun.
- 6. A resonant frequency therapy device as recited in claim 1, further comprising a tuned length coaxial cable for

conveying said radio-audio waves from said radio frequency transmitter to said radio frequency amplifier.

7. A resonant frequency therapy device as recited in claim 1, further comprising a tuned length coaxial cable for conveying said amplified radio-audio waves from said radio frequency amplifier to said antenna tuner.

8. A resonant frequency therapy device as recited in claim 1, further comprising a reverberator in communication with said audio frequency oscillator.

- 9. A resonant frequency therapy device comprising:
 - an audio frequency oscillator generating audio waves having an audio frequency;
 - a radio frequency transmitter generating radio waves having a radio frequency, said radio frequency transmitter receiving and modulating said audio waves from audio frequency oscillator with said radio waves, defining radio-audio waves having a radio-audio frequency and a wavelength;
 - a radio frequency linear amplifier receiving and amplifying said radio-audio waves from said radio frequency transmitter, defining amplified radio-audio waves having an amplified radio-audio frequency;
 - an antenna tuner receiving said amplified radio-audio waves from said radio frequency amplifier and generating a tuned signal; and
 - an antenna receiving said tuned signal from said antenna tuner and transmitting an output signal and a tuned length of coaxial cable for conveying said amplified radio-audio waves from said radio frequency amplifier to said antenna tuner, said tuned length coaxial cable being one half the length of said wavelength of said radio-audio waves and wherein said antenna is a plasma tube.

- 10. A resonant frequency therapy device comprising:
 - an audio frequency oscillator generating audio waves having an audio frequency;
 - a radio frequency transmitter generating radio waves having a radio frequency, said radio frequency transmitter receiving and modulating said audio waves from audio frequency oscillator with said radio waves, defining radio-audio waves having a radio-audio frequency;
 - a radio frequency linear amplifier receiving and amplifying said radio-audio waves from said radio frequency transmitter, defining amplified radio-audio waves having an amplified radio-audio frequency;
 - an antenna tuner receiving said amplified radio-audio waves from said radio frequency amplifier and generating a tuned signal; and
 - an antenna having a varying impedance receiving said tuned signal from said antenna tuner and transmitting an output signal and a tuned length of coaxial cable for conveying said amplified radio-audio waves from said radio frequency amplifier to said antenna tuner, said antenna tuner generating a tuned signal by matching the varying impedance of the antenna and wherein the antenna is a plasma tube.

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