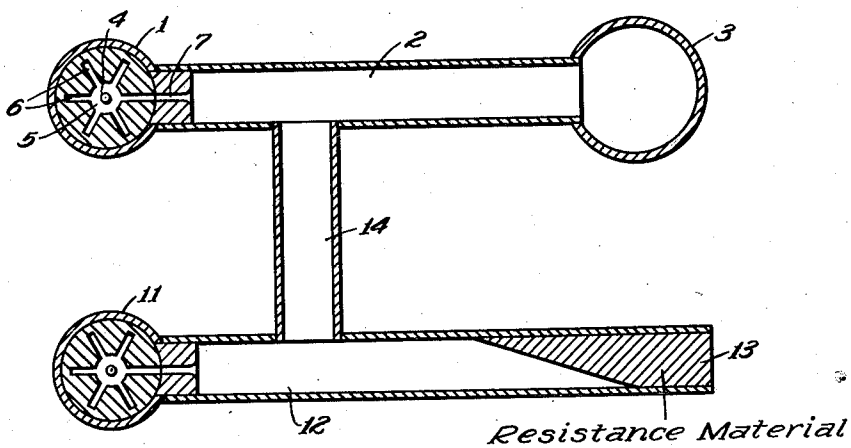


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OSCILLATOR MODE SUPPRESSION

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WITNESSES:

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OSCILLATOR MODE SUPPRESSION

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Our invention relates to generators of electrical oscillations and, in particular, relates to an arrangement adapted for use in generating pulsed electrical oscillations of ultra high frequency.

Generators of ultra high frequency oscillations, of which the magnetron may be taken as an example, embody, as part of their structure, chambers or cavities which tend to resonate at the frequency of the electrical vibrations being generated. However, as is well known, such resonant cavities are capable of vibrating in a number of different modes of vibration, with a corresponding range of different frequencies; and the same is true of the wave guide and resonator systems through the agency of which they supply power to load devices. Since the generators are thus capable of oscillating at a number of different frequencies, it is sometimes difficult to induce generation at a particular one of these frequencies which may be desired, inasmuch as substantial energy is involved in vibration in any mode, and the amount of such energy is considerably greater in the case of some modes than in the case of others. Difficulty thus arises in inducing the oscillation generator to build up the mode of vibration which may be desired in any particular case. Factors which determine the rate of building up energy in the respective modes include the size of the cathode, for example, in magnetrons, the operating voltage and current, the type of electric field pattern readily realizable in the tube and connected transmission systems, and the noise level which usually furnishes the initiating vibratory energy. By adjusting one or more of these to give a high conversion efficiency for the desired mode of vibration, it is in many cases possible to enforce such mode. However, in other cases such adjustments are either more or less ineffective or interpose difficulties of an undesirable character in a particular practical application of the generator. Where, as is now frequently the case, it is desired to employ such generators for sending out energy in the form of successive pulses of short duration, separated from each other in time, it is obvious that the necessity for building up the desired mode of vibration exists each time a new pulse is generated, and that the difficulties above described are particularly acute in the case of such uses.

One object of our invention is, accordingly, to provide an arrangement which enforces a particular desired mode of oscillation on an ultra high frequency generator system.

Another object of our invention is to provide an arrangement in which the desired mode of

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vibration is forced to build up in an oscillation generator by injecting power at the frequency corresponding to the desired mode from an external source into the generator system.

Still another object of our invention is to materially shorten the time required for causing a generator of ultra high frequency vibrations to build up its energy in the desired mode of vibration to a level sufficient to insure maintenance of that vibration mode when connected to a work device.

Still another object of our invention is to provide an improved form of generator for ultra high frequency electrical vibrations.

A still further object of our invention is to provide a novel type of ultra high frequency generator employing the magnetron principle of generation.

Other objects of our invention will become apparent upon reading the following description, taken in connection with the drawing in which the single figure is a schematic view, partly in cross-section, of an oscillation generator system embodying the principles of our invention.

Referring in detail to the drawing, an ultra short wave generator 1, which is shown for the purposes of illustration as of the magnetron type, is connected to an output channel shown as a wave guide 2 leading to a resonating cavity 3 or other type of work device. The generator 1 comprises a central electron-emissive filament 4 positioned in the axis of an anode having the general form of a cylinder with a central chamber 5 from which radial cavities 6 having closed peripheral end walls project. High frequency generators of this type are well known in the art under the term "magnetron," and it is believed that more detailed description is unnecessary here. The wave guide 2 projects from one side of the magnetron 1 and has a duct or passage 7 opening out of one of the radial cavities 6 at its radially-outward end to permit electromagnetic waves generated within the oscillator 1 to be propagated out into the wave guide 2.

In accordance with our invention, we provide a second generator 11 of high frequency oscillations capable of operating at the same frequency as the mode of vibration desired to be derived from the generator 1. The generator 11 may be of any suitable type for this purpose, but to illustrate the principles of our invention, we show it as a second magnetron, although for some purposes such a generator as a Klystron may be equally or more desirable. The generator 11 is connected to transmit energy into a second chan-

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nel 12, which may be another wave guide, provided at its remote end with a load device 13 capable of absorbing energy of the type generated by the oscillator 11. For some purposes, it may be desirable to make the load device 13 adjustable.

The wave guide 2 and the wave guide 12 are connected to each other through a duct 14 which is of such dimensions as to couple the two wave guides to each other loosely. In fact, so loose may be this coupling that only a fraction of the order of 0.0001 of the power flowing through the wave guide 2 will be transmitted through the duct 14 to wave guide 12. Since the major part of the build-up time of the vibration energy in a magnetron takes place at very low power levels, the flow of an extremely small amount of power through the duct 14 from the generator 11 will be sufficient to determine the frequency and mode of vibration at which the generator 11 will build up at the beginning of each pulse.

In one species of our invention the generator 11 is operated continuously at the frequency corresponding to the mode of vibration desired from oscillator 1 and is, accordingly, in a condition to transmit through the duct 14 an amount of power sufficient to build up the desired mode of vibration in the oscillating generator 1 at the beginning of each pulse-period in which power is switched on to the latter to cause the generation of a pulse of vibratory energy to be initiated. Because of the looseness of the coupling provided by the duct 14, the initiation or cessation of flow of power from generator 1 through the wave guide 2 to the load 3 will cause no deleterious interference with the oscillation of the generator 11.

For certain purposes it may be desirable that the oscillation generator 11 shall not be of the continuously operating type, but it may be switched into operation periodically; and when this is done, it is desirable that the switching operation to energize the generator 11 should take place a fraction, such as $\frac{1}{2}$, of a pulse duration earlier than the switching in of energizing power to the generator 11. It will be obvious that the load 13 will waste almost none of the energy produced by the generator 1 by reason of the loose coupling above mentioned as existing through the duct 14.

While we have described the duct 14 as loosely coupling the wave guides 2 and 12, it may be desirable when the generator 11 is of low power output, as present day Klystron oscillators are, to make this coupling fairly tight, designing the coupling to suit the relative power of the oscillators 1 and 11. It may be desirable, where this coupling is not very loose, to interpose a TR switch of conventional type in the duct 14 to cut off power flow through the duct from wave guide 2 to wave guide 12 as soon as the oscillations induced in wave guide 2 by oscillator 1 have reached a considerable strength. An application, Serial No. 480,991, now Patent No. 2,525,468, of Daniel Alpert for Ultra High Frequency Tubes, filed March 29, 1943, shows a TR switch such as is referred to.

We claim as our invention:

1. In combination with a first oscillation generator of a type capable of oscillating in a number of different frequency modes, a transmission system connected to the output thereof, a second oscillation generator connected to a load, and a coupling between said second generator and said first generator providing a relatively loose coupling therebetween.

2. In combination with a first oscillation gen-

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erator of a type capable of oscillating in a number of different frequency modes and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a transmission system connected to the output thereof, a second oscillation generator connected to an adjustable load, and a coupling between said second generator and said first generator providing a relatively loose coupling therebetween.

3. In combination with a first high frequency oscillation generator provided with means for causing it to generate energy in successive spaced pulses, a transmission channel conducting energy from said generator to a load device, a second oscillation generator capable of operating at a frequency the same as that at which the first said oscillation generator is desired to act, means for causing said second oscillation generator to transmit energy in pulses having the same periodicity as those which said first generator produces, means for causing the respective pulses generated by said second generator to be initiated shortly prior to the initiation of each pulse in said first generator, a load device connected through a second transmission channel to said second generator, and means for loosely coupling said first transmission channel and said second transmission channel.

4. In combination with a first oscillation generator of the magnetron type, a transmission system connected to the output thereof, a second oscillation generator connected to a load, and a coupling between said second generator and said first generator providing a loose coupling therebetween.

5. In combination with a first oscillation generator of the magnetron type and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a wave guide transmission system connected to the output thereof, a second oscillation generator connected to a load, and a coupling between said second generator and said first generator providing a coupling therebetween.

6. In combination with a first oscillation generator of the magnetron type and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a transmission system connected to the output thereof, a second oscillation generator provided with means for causing it to operate with substantial continuity connected to an adjustable load, and a coupling between said second generator and said first generator providing a loose coupling therebetween.

7. In combination with a first oscillation generator of a type capable of oscillating in a number of different frequency modes and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a wave guide transmission system connected to the output thereof, a second oscillation generator provided with means for causing it to operate with substantial continuity connected to an adjustable load, and a coupling between said second generator and said first generator and providing a loose coupling therebetween.

8. In combination with a first oscillation generator of a type capable of oscillating in a number of different frequency modes and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a wave guide transmission system connected to the output means for causing it to operate with sub-

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stantial continuity connected to a load, and a coupling between said second generator and said first generator and providing a loose coupling therebetween.

9. In combination with a first oscillation generator of the magnetron type and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a wave guide transmission system connected to the output thereof, a second oscillation generator connected to a load, and a coupling between said second generator and said first generator providing a loose coupling therebetween.

10. In combination with a first oscillation generator of the magnetron type and means for causing it to generate energy in successive pulses separated by periods of substantially zero energy, a wave guide transmission system connected to the output thereof, a second oscillation generator provided with means for causing it to operate with substantial continuity connected to a load, and a coupling between said second generator and said

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first generator providing a loose coupling therebetween.

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