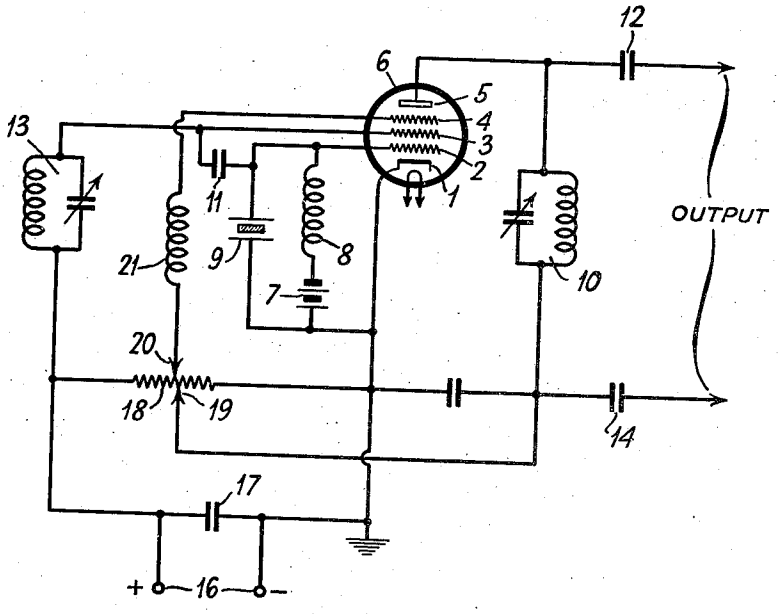
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DYNATRON OSCILLATOR

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DYNATRON OSCILLATOR

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This invention relates to oscillators using the negative resistance characteristics of multi-element tubes. This type of oscillator is commonly known as a "dynatron" oscillator. The circuit arrangements herein disclosed are particularly suitable for use in generating ultra-high frequencies, and also for frequency multiplication, if desired.

It is an object of my invention to provide a system for increasing the output of dynatron oscillators by lowering the plate impedance of the tube itself.

It is a further object of my invention to provide a system which permits oscillations to be set up and maintained at considerably higher frequencies than was heretofore considered possible, except at a sacrifice of utilizable output energy.

My invention is an outgrowth from other inventions in the class of oscillation generators such as illustrated in my Patents Nos. 2,067,365 and 2,067,366 both granted January 12, 1937 and my Patent No. 2,103,655 granted December 28, 1937. Certain improvements over the disclosures of these patents will now be explained in further detail, reference being made to the accompanying drawing the sole figure of which represents a circuit diagram of a preferred embodiment.

It is a well known characteristic of the dynatron oscillator that, when operating at a given frequency, its plate circuit load impedance must be made very high with respect to the tube impedance in order to produce and sustain oscillations of any appreciable amplitude. Since it is quite difficult to build up this load impedance to a proper value when working at frequencies in excess of seven megacycles, it becomes necessary to obtain a proper tube load impedance match by resorting to other expedients than to increase the plate load impedance as far as one would like. I have found that a solution to this problem is very much facilitated by proper design of the suppressor grid circuit so that the suppressor grid receives a potential which is positive with respect to the cathode. I have found, too, that it is quite essential that the suppressor grid be isolated from the cathode for radio frequency currents.

Referring to the drawing wherein the complete circuit arrangement of a preferred embodiment of my invention is shown, the oscillator tube 6 possesses a cathode 1, a control grid 2, a screen grid 3, a suppressor grid 4 and an anode 5. The input circuit connected between the cathode and the control grid preferably includes a grid biasing source 7 and an inductive impedance 8. In shunt with the biasing source and inductance is a piezo-electric device 9 which provides suitable frequency stabilization. The cathode-to-anode circuit includes a parallel-tuned circuit 10 which is resonant to the desired frequency of output, whether it be the fundamental frequency of the oscillator or a frequency harmonically related thereto. A parallel tuned circuit 13 resonant to the fundamental frequency is shown connected between the cathode 1 and the screen grid 3. This circuit is tuned to the fundamental frequency of the oscillations generated. Screen grid potential is supplied from any suitable direct current source the positive and negative terminals of which are indicated at 16. A blocking condenser 17 interconnects the cathode and the high potential side of the screen grid circuit. A potentiometer 18 is provided across the terminals of the source 16 and is arranged with two adjustable taps 19 and 20. Tap 19 is positioned so as to supply a potential to the anode 5 which is intermediate between the potentials of the cathode and the screen grid. The potentiometer tap 20 is adjusted to supply a suitable potential to the suppressor grid 4 which is positive with respect to the cathode. Between the suppressor grid and the potentiometer tap 20 an inductive reactance member 21 is connected. This member serves to isolate the suppressor grid from the cathode for the high frequencies that are generated.

As in the systems of my prior patents above referred to, the oscillator action of the present system is obtained by virtue of the negative resistance characteristic of the tube 6. The tube oscillations are locked in step with those of the piezo-electric crystal 9 and oscillations are built up in the parallel tuned circuit 10 at the harmonic frequency to which it is tuned. The oscillations are sustained by virtue of regenerative action, capacitive feed-back occurring between the screen grid 3 and the control grid 2. If desired, this capacitive feed-back may be augmented by connecting a small capacitor 11 between the screen grid and the control grid, though this is not always desirable in ultra-high frequency work.

The particular embodiment of my invention herein illustrated lends itself to operation at a wide range of frequencies. The plate impedance of the tube 6 is not so great as one might expect it to be for the ultra-high frequencies which the tube is capable of generating. Due to this relatively lower plate impedance the amplitude of the oscillatory output energy is relatively high. This is a particularly desirable feature where frequency multiplication is obtained, since, for the

higher harmonics it will be understood that high power output from such a generator is difficult at best. In this case there is a minimum of reaction between the load circuit impressed across the capacitors 12 and 14 and the fundamental frequency oscillator circuit of the tube.

The particular circuit arrangement as illustrated may readily be modified for use in such circuits as are disclosed in my prior patents above referred to. It is also possible under certain conditions to couple the suppressor grid 4 to either the screen element 3 or the anode 5. Such modifications may be adopted in accordance with the operation frequency and with the particular load requirements imposed upon the oscillator.

I claim:

1. An oscillation generator comprising a discharge tube having a cathode, a control grid, a second grid, a suppressor grid and an anode, a piezo-electric crystal and a tuned circuit regeneratively connecting together said cathode, control grid and second grid, a resonant circuit interconnecting the anode and cathode and arranged to be tuned at times to the fundamental frequency of the oscillations generated and at other times to a harmonic of said fundamental frequency, means for maintaining a positive bias on said suppressor grid with respect to the cathode, means including a high reactive impedance interposed between said suppressor grid and the cathode for isolating said grid at the fundamental frequency of oscillations, and means for maintaining a bias potential on said anode which is positive relative to the cathode and negative relative to said second grid.

2. An oscillation generator and frequency multiplier comprising an electron discharge tube having a cathode, a control grid, a screen grid, a suppressor grid and an anode, a direct current source in circuit between the cathode and the screen grid, means for impressing upon said anode a direct current potential which is intermediate between the potentials of the cathode and screen grid, a resonant circuit connected between the cathode and screen grid, resonating means connected between the cathode and control grid, both the resonant circuit and the resonating means being tuned to the frequency to be generated, means for impressing upon said suppressor grid a positive bias and upon the control grid a negative bias, both with respect to the cathode, means including a highly inductive impedance in circuit between said suppressor grid and the cathode for isolating the suppressor grid at the frequency to be generated, a resonant circuit connected between the anode and cathode and tunable alternatively to the frequency to be generated and to a desired frequency harmonically related thereto.

3. An oscillation generator and frequency multiplier comprising a discharge tube having a cathode, an anode and a plurality of grids arranged progressively between the cathode and anode, a fundamental frequency control circuit including a piezo-electric device between the cathode and the grid adjacent thereto, a circuit resonant to said fundamental frequency and interconnecting the cathode and an intermediate grid, a circuit resonant to a harmonic frequency and interconnecting the cathode and anode, a direct current biasing and operating means having connections to the several electrodes of said tube, said means comprising a direct current source and a potentiometer adapted to render both the anode and the grid adjacent thereto more positive than the cathode, and to maintain said intermediate grid more positive than the anode, thereby to produce dynatron action in said tube, means to isolate the grid adjacent the anode with respect to the high frequency currents traversing the cathode, and means to deliver a harmonic frequency output from the cathode-to-anode circuit.

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