March 19, 1935. J. N. WHITAKER 1,995,164

OSCILLATION GENERATION

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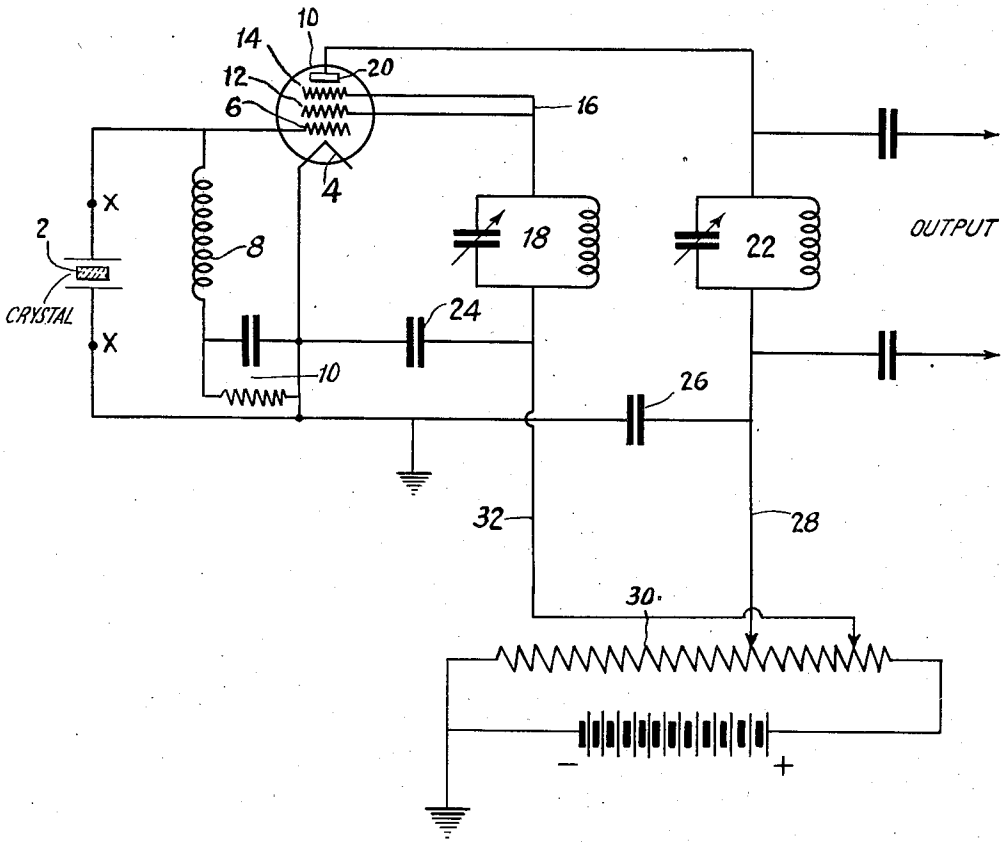

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OSCILLATION GENERATION

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5 Claims. (Cl. 250—36)

In my copending application Serial Number 599,946, filed March 19, 1932, I have disclosed an oscillation generator utilizing negative resistance action of a multi-electrode tube for producing high frequency oscillations and utilizing regenerative action between other electrodes of the same tube for producing frequency stabilizing oscillations. My present invention presents an improvement thereover in that the power output of the oscillations in the negative resistance portion of the system is materially enhanced.

According to my present invention, in order to increase the negative resistance output of an electron discharge device, I connect together a plurality of the electrodes which otherwise would be subjected to different operating potentials. I have discovered that by so doing, there is an improved negative resistance or "dynatron" output even though, as far as I am aware, the tubes were not intended for negative resistance action.

I shall describe my present invention more fully with the aid of the accompanying drawing which is a wiring diagram of a circuit incorporating my latest contribution to the art.

In greater detail, the fundamental frequency controlling element of the system shown in the drawing is a piezo-electric crystal 2 which is connected between the cathode 4 and the first grid, control, or cold electrode 6 adjacent the cathode. For biasing purposes a choke coil 8 in series with the grid leak condenser arrangement 10 is also connected between the grid 6 and cathode 4.

The second and third grid electrodes 12, 14 of the vacuum tube or electron discharge device 10 are directly connected together by the connection 16, and between them and the cathode there is connected a tunable circuit 18 tuned to the fundamental frequency of the piezo-electric element 2. The grid electrode 12 would normally be the screen grid and may be termed an intermediate grid. The grid 14 would normally be the suppressor grid of the tube 10 and would normally be adjacent the anode 20 of tube 10. Between the anode or plate 20 and the cathode there is connected a second tunable circuit 22. The lower ends of the tuned circuits 18, 22 are connected to ground for high frequency currents by the action of by-passing condensers 24, 26. Plate 20 is maintained through lead 28 at a lower positive potential with respect to the cathode 4 than the combined electrodes 12, 14 which are maintained at a higher positive potential with respect to the cathode by the application of a voltage from potentiometer 30 through lead 32.

Oscillations are set up in the tuned circuit 18 by virtue of regenerative action, feedback occurring through the interelectrode capacity existing between the grid 6 and the grids 12, 14.

Oscillations at the same or preferably a harmonic frequency or sub-harmonic frequency, are set up in circuit 22 by virtue of negative resistance or "dynatron" action as described more fully in my copending application already referred to. I have found, by connecting the grids 12, 14 together, that there is a substantial increase in power at the harmonic frequencies in circuit 22, which of course should be tuned to the desired harmonic of circuit 18 or to the fundamental frequency of the crystal 2. Moreover, if desired, circuit 22 may be tuned to the same frequency as the crystal 2 or to some sub-harmonic.

It is not necessary that the crystal be used, for any constant frequency controlling wave may replace the crystal. For example, the crystal may be removed and at the points X, a constant frequency wave from any form of oscillator or oscillator followed by frequency multipliers may be impressed. Or, the crystal 2 may be replaced by a parallel tuned circuit in which case the cathode 4, grid 6 and circuit 18 would act as the regenerative oscillator of the tuned grid, tuned plate type, feedback occurring as before by virtue of interelectrode capacity within the tube.

If a controlling frequency source is connected to the points XX indicated on the drawing, circuit 18 may be tuned to the same, to a multiple, or to some sub-multiple of the controlling frequency, and similarly circuit 22 may be tuned to the same frequency as the controlling frequency applied to points X or to some harmonic thereof, or to some sub-harmonic thereof, it being understood further that circuits 18 and 22 may be tuned simultaneously to the same or different frequencies.

Also, it is to be clearly understood that my present invention is applicable to many other circuits such as any one of those disclosed in my copending application already referred to. Consequently, I do not intend to be limited by what I have illustrated in the drawing, but my present invention is to be given the full width, scope and depth indicated by the appended claims.

Having thus described my invention, what I claim is:

1. An oscillation generating system comprising a tube having an anode electrode, a grid adjacent the anode, a cathode electrode, a grid adjacent the cathode and a grid intermediate said grids, an oscillatory circuit connected between

the grid adjacent the cathode and the cathode, short circuiting means connecting directly together the intermediate grid and the grid adjacent the anode, an oscillatory circuit connected between the grids connected together and said cathode, and an oscillatory circuit connected between said anode and cathode.

2. Apparatus as claimed in the preceding claim wherein said anode is maintained at a positive potential with respect to said cathode and in which the grids short circuited together are maintained at a higher positive potential with respect to said cathode.

3. Apparatus as claimed in claim 1 characterized by the fact that the grids short circuited together are maintained at a positive potential with respect to said cathode and being characterized by the fact that means are provided for maintaining said anode at a lesser positive potential with respect to said cathode, and being further characterized by the fact that the oscillatory circuit connected between said anode and said cathode is tuned to a harmonic of the frequency of the oscillatory circuit between the grid adjacent said cathode and said cathode.

4. An oscillation generator comprising a vacuum tube having an anode, a cathode, a control grid, a screen grid and a suppressor grid, a piezo-electric crystal connected between the control grid and cathode, means short circuiting together said screen grid and said suppressor grid, a tuned circuit connected between the grids connected together and said cathode, a tuned circuit connected between said anode and cathode, means for maintaining said anode at a positive potential with respect to said cathode, and means for maintaining suppressor and screen grids at a higher positive potential with respect to said cathode.

5. Apparatus as claimed in the preceding claim characterized by the fact that the circuit connected between said anode and cathode is tuned to a harmonic of the operating frequency of said piezo-electric crystal.

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