

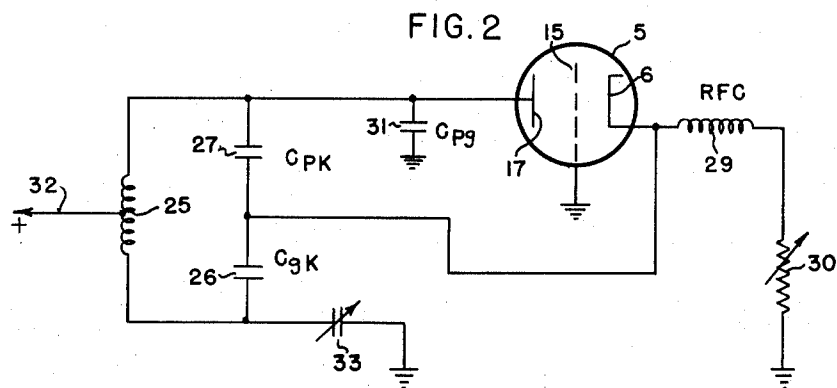
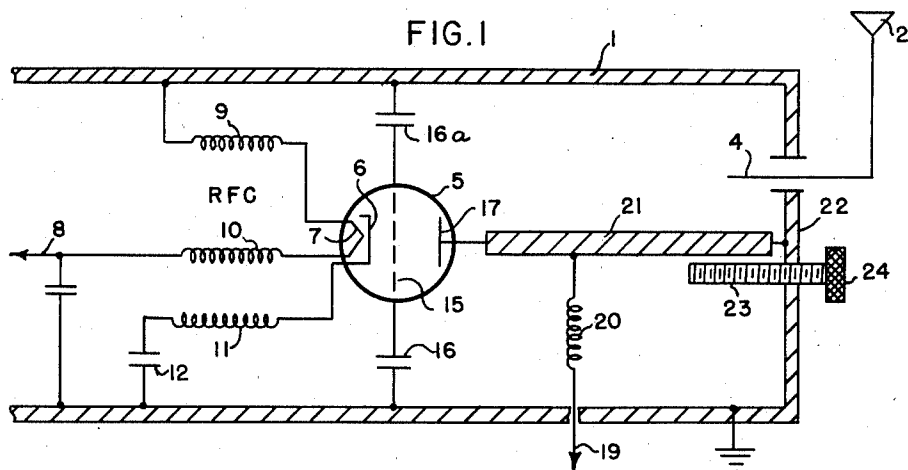
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TUNABLE CAVITY OSCILLATOR

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## UNITED STATES PATENT OFFICE

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## TUNABLE CAVITY OSCILLATOR

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1 Claim. (Cl. 250—36)

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This invention relates to tunable cavity oscillators, and particularly to such an oscillator utilizing tube capacities for feedback.

Resonant cavity oscillators are well known in the art for producing comparatively high power outputs at micro-wave frequencies. When such an oscillator must be tunable, there has been a difficulty in that a second tuned circuit has been required to maintain feedback, and this second circuit must be tracked with the first frequency controlling element.

The present invention makes use of the tube capacities to produce feedback, and thus provides a simple cavity oscillator which will operate over a wide range of frequencies, without the complications of adding another tunable circuit.

The invention is illustrated in the drawing, in which:

Fig. 1 shows a schematic circuit diagram of a preferred embodiment of my invention; and

Fig. 2 shows an equivalent circuit diagram of the embodiment of Fig. 1.

The oscillator illustrated in the the drawing may be used in a pulse type radio communication system, and accordingly, the circuit is shown as adapted to pulse modulation.

A coaxial line type resonant cavity 1 is coupled to an antenna 2 by a probe 4. The effective length of cavity 1 is one-half wavelength at the operating frequency of the oscillator, this length being controllable by means of a tuning element hereinafter described. At the opposite end of cavity 1 is disposed an evacuated triode 5 having a heater type cathode 6 made emissive by a heater element 7 fed through a heater lead 8. Radio frequency chokes 9 and 10 prevent the flow of high frequency current through the cathode heater element 7. The cathode 6 is connected through radio frequency choke 11 and capacitance 12 to the outer conductor of the coaxial line cavity 1.

Grid 15 has two terminals, as shown, the terminals being connected through capacitances 16 and 16a to the outer cavity conductor 6. Anode 17 is provided with suitable potential through an external lead 19 connected to a choke 20 disposed within the cavity 1. Choke 20 in turn is connected to a rod 21 which constitutes the inner conductor of the coaxial line, and is disposed axially of the cavity 1. The rod 21 is connected to the anode 17 at one end, and to the end wall 22 of the cavity at the opposite end.

The frequency of oscillation is controlled by a tuning plug 23 passing threadably through end wall 22 and adjusted by such means as a knob

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24. Plug 23 is disposed parallel to and closely adjacent rod 21, and the capacitative effect therebetween is directly proportional to the length of the plug portion extending into the cavity.

The manner in which the elements cooperate to function as a circuit capable of oscillation in the modes described will be considered, using the schematic showing of Fig. 2.

The circuit of Fig. 1 may be shown to be the equivalent of that of Fig. 2. The inductance of the cavity 1 may be considered as a lumped inductance 25; the grid to cathode capacity or  $C_{gk}$  as a capacitance 26; the plate to cathode capacity or  $C_{pk}$  as a capacitance 27; the plate to grid capacity or  $C_{pg}$  as a capacitance 31, and the relation between tuning plug 23 and rod 21 as a variable capacitance 33. The common point between capacitances 26 and 27 is returned to cathode 6. Cathode 6 is isolated from ground by radio frequency choke 29 and variable resistance 30. Grid 15 is grounded, and the anode potential is applied at 32 through the inductance 25.

The circuit as shown in Fig. 2 will be seen to be that of the well known Colpitts oscillator. The effective feedback will depend on the capacity-voltage dividing network  $C_{gk}$  (26) and  $C_{pk}$  (27). Cathode potential will be independent of frequency since neither the grid-cathode nor the plate-cathode capacitance is associated with any inductance. Feedback control is not necessary, since excessive regeneration produces grid-cathode current that forces the voltage of the cathode closer to that of the grid. Frequency control over the desired range is effected simply through the variable capacitance 33, which in the embodiment of Fig. 1 is the tuning plug 23. No outside tuned circuit is required to maintain feedback, with the attendant difficulties of frequency control.

The invention thus provides simple circuit means for receiving and transmitting micro-waves over a considerable range of frequencies.

What is claimed is:

An ultra-high frequency oscillator comprising a hollow conductive cylinder providing a resonant cavity, an electron discharge tube within said cavity, said tube including a cathode, grid and anode, means providing a high impedance to ultra-high frequency oscillations connecting said cathode to said cylinder, means providing a low impedance to ultra-high frequency oscillations connecting said grid to said cylinder, a conductive rod connected to said anode, said rod being con-

centrically enclosed by said cylinder, an end wall for said cylinder, and a single tuning control for adjusting the frequency of said oscillator comprising a longitudinally adjustable conductive member mounted in said end wall and extending into said cylinder adjacent to but spaced from said conductive rod, thereby being capacitively coupled to said conductive rod.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number    | Name       | Date           |
|-----------|------------|----------------|
| 2,285,662 | Hutcheson  | June 9, 1942   |
| 2,408,355 | Turner     | Sept. 24, 1946 |
| 2,411,424 | Gurewitsch | Nov. 19, 1946  |