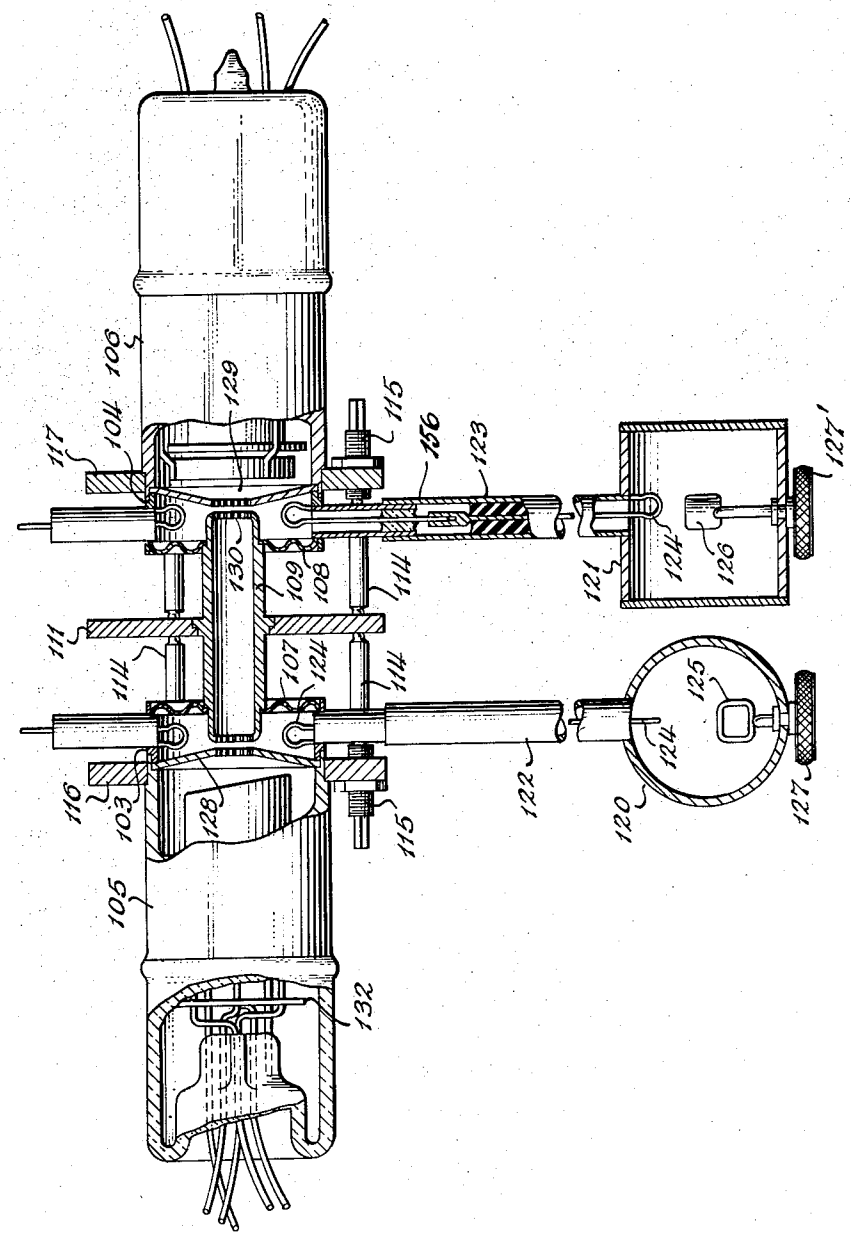
Sept. 9, 1952 W. W. HANSEN ET AL 2,610,307

TUNABLE CAVITY RESONATOR ELECTRON DISCHARGE DEVICE

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TUNABLE CAVITY RESONATOR ELECTRON DISCHARGE DEVICE

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1 Claim. (Cl. 315—6)

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The present invention relates generally to tuning apparatus for high frequency tube structures having enclosed oscillatory circuits or cavity resonators of the type disclosed in Patent No. 2,242,275, issued May 20, 1941, in the name of Russell H. Varian, one of the present inventors. The present application is a division of our copending application Serial No. 457,096 filed September 2, 1942 which issued October 29, 1946 as Patent No. 2,410,063, and which in turn is a division of our Patent No. 2,311,658 issued February 23, 1943 on an application filed July 2, 1940, Serial No. 343,528.

The principal object of the present invention is to provide improved tuning means for varying the resonant frequency of a cavity resonator of such a tube structure, either locally or at some distance from the tube. According to the present invention, such tuning of a cavity resonator is effected by coupling thereto a further tunable cavity resonator by means of a length of high frequency transmission line, such as a coaxial line, and either varying the length of the line or varying the tuning of the tunable resonator, thereby altering the resonant frequency of the resonator which is to be tuned.

Other objects and advantages will become apparent from the present specification taken in connection with the single figure of the accompanying drawing, wherein the invention is embodied in concrete form.

In the drawing, the single figure represents a longitudinal view, partly in cross-section, of a cavity-resonator velocity-modulation or klystron tube to which is coupled the novel tuning apparatus of the present invention. In this figure there is shown a tube structure having a pair of cavity resonators 103, 104 carried by the inner ends of tubular members 105, 106. The inner opposed end walls 107, 108 of resonators 103, 104 are annularly corrugated and flexible and carry a drift-space-providing tube 109. Resonator 104 has a dished wall 129 opposite which is a cathode 150 and modulating and/or focussing electrode 151 in alignment with the resonators 103, 104. Resonator 103 has a similar wall 128 opposite which is a collector or detector structure 153. Resonators 103 and 104 are provided with coupling loops 154 connected to concentric line terminal posts 139 for coupling these resonators to external circuits, to supply or extract energy to or from the resonators, or for tuning, according to the present invention.

A suitable tuning mechanism, such as is described more in detail and claimed in parent

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Patent No. 2,311,658, may be interposed between tube 109 and respective members 105, 106 for flexing the walls 107, 108 to tune the resonators 103, 104. Since this tuning mechanism forms no part of the present invention, it will not be described here but reference is made to the above-mentioned parent patent for a more complete description thereof.

For tuning resonators 103, 104 from a remote or local point, external tuning resonators 120, 121 are used. Resonators 120, 121 are connected by respective concentric lines 122, 123 to the terminals 139 of resonators 103, 104, the loops 124 in the ends of these lines within resonators 120, 121 serving to link the resonator fields of resonators 103, 104 with those of resonators 120, 121 respectively. Tuning resonators 120, 121 are provided with suitable variable impedance means, shown as a loop 125 in resonator 120 and as a plate 126 in resonator 121, both of which are turnable by means of knobs 127, 127'. By turning these knobs, the natural frequency of oscillation or resonant frequency of resonators 120, 121 is varied, thereby effecting a variation in the resonant frequency of the connected resonators 103, 104. The length of the concentric lines 122, 123 is variable depending upon the location of the resonators 120, 121, relative to the tube structure itself.

Further tuning of the resonators 103, 104 may be effected by varying the length of lines 122, 123, as by conventional sliding joints, such as is indicated schematically with respect to line 123 by the reference numeral 156.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

In combination with a high frequency electron discharge tube which includes a cavity resonator, apparatus for adjusting the resonant frequency of said resonator at a point remote from said tube, said apparatus including a second resonator at said remote point having continuously imperforate conductive walls which completely enclose the space within said second resonator except for a single opening which is relatively small with respect to said second resonator; a coaxial transmission line with one end coupled to said first resonator and its other end coupled to said

second resonator through said opening, and means for adjusting the reactance of said second resonator, to thereby vary the resonant frequency of said first resonator.

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