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RESONATOR FOR VELOCITY MODULATION TUBES

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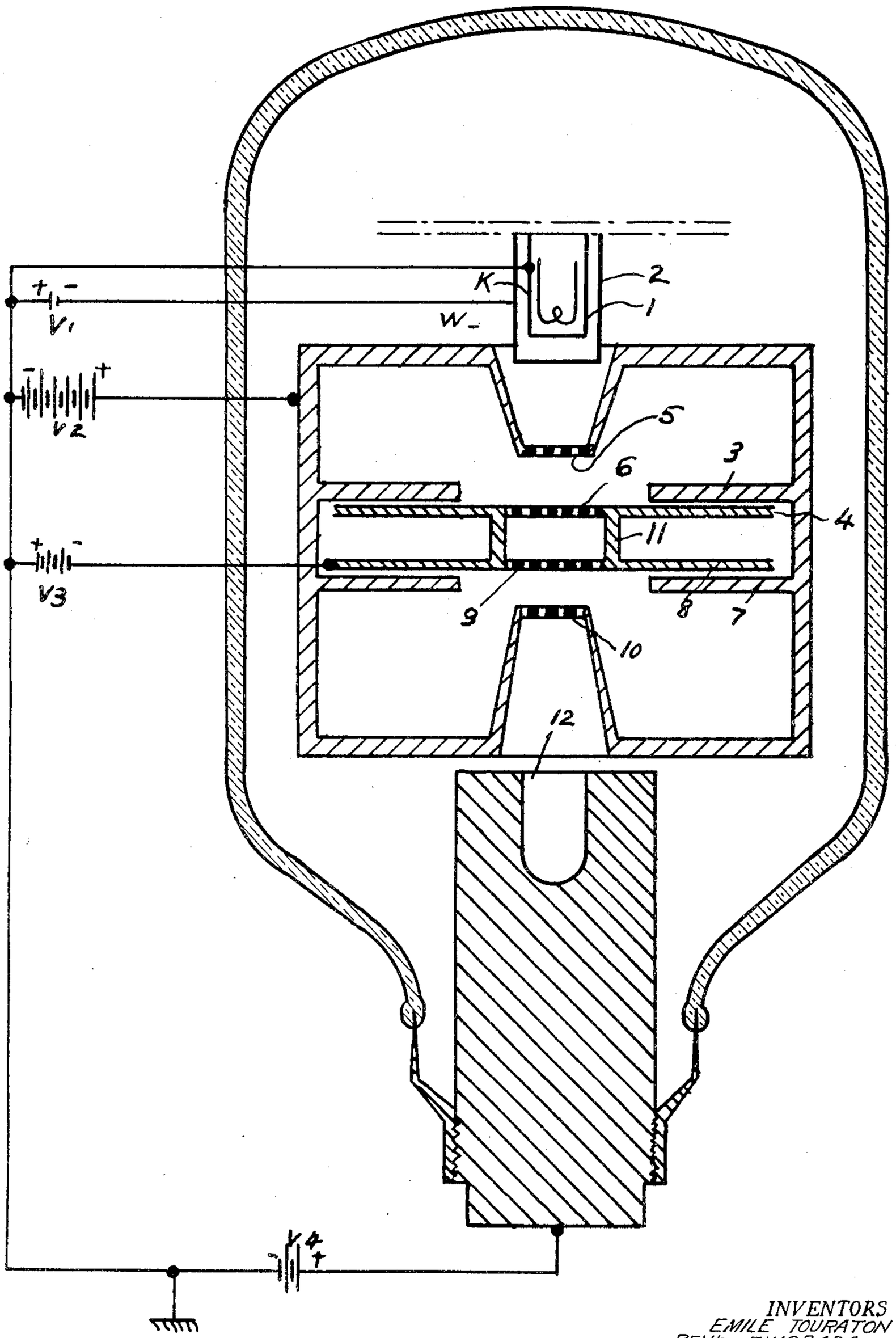

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RESONATOR FOR VELOCITY MODULATION TUBES

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9 Claims. (Cl. 315—6)

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The present invention relates to a resonator for velocity modulation tubes.

It is customary in the art for the mean velocity of the electrons to be constant throughout the path of travel of the beam. In the patent application filed by the applicants on December 17, 1945, under the title "Velocity modulation tubes with variable mean velocity," a description is given of devices that vary this velocity while permitting an increase of the gain in power by improving the grouping, and an increase of the band width by lessening the capacity of the modulation and pick-up resonators.

One of the objects of the present invention is to improve the mean velocity variation tubes.

According to certain features of the present invention, in a velocity modulation or pick-up resonator comprises a cavity provided with a single flat grid associated to a second grid located in front of it, the second grid being coupled by capacitance to the resonant cavity. The resonant circuit is then formed by the cavity and the associated grid integral with an independent electrode that can be brought to a constant potential different from that of the resonating cavity.

Other objects and features of the invention will be found upon reading the following description of one example of embodiment given with reference to the appended drawing of which the single figure illustrates a tube of this kind intended for use as amplifier.

The selected example of embodiment is a velocity modulation tube with variable mean velocity.

As shown in the figure, a tube of this kind comprises:

(*a*) An electron gun consisting of a cathode **1** and a Wehnelt cylinder **2**,

(*b*) A modulation resonator **3** comprising a single grid **5**,

(*c*) A pick-up resonator **7** provided with a grid **10**,

(*d*) An intermediate electrode **11** joining a disc **4** provided with a grid **6** to a disc **8** provided with a grid **9**; the drift space is comprised between the two grids **6** and **9**.

(*e*) A target **12** shown schematically.

The modulation resonant circuit consists of two parts, one of them integral with the first grid **5**, and the other integral with the second grid **6**; these two parts are connected by a capacitance formed by **3** and **4**.

Similarly, the pick-up resonant circuit consists of two parts, one of them integral with the first grid **9**, and the other integral with the second

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grid **10**; these two parts are connected by a capacitance formed by **8** and **7**.

Owing to the braking of the electrons in the modulation space **5**—**6**, the electrons are grouped at low velocity in the drift space within electrode **11**. Owing to their braking in the modulation space and their re-acceleration in the pick-up space, the electrons pass through the modulation, drift and pick-up spaces with variable mean velocity. The transit time of the electrons in these spaces is the time that would be taken to traverse them by electrons having a constant velocity equal to the arithmetic mean of the velocities at the level of the grids that limit these spaces.

The mean speed of the electrons in the modulation and pick-up spaces may be very high, while the velocity of the electrons in the drift space is low. The electrons are braked at the output of the pick-up resonator so as to reach at a reduced velocity the target **12** brought to a low potential **V4**. The carrying out of these conditions, which forms one of the objects of the abovementioned patent application by the applicants, makes it possible to increase either the gain in power or the band width.

By the use of the device according to the features of the invention, it has become possible to eliminate the junction zones, the modulation space, or the pick-up space in which the velocity of the electrons is high, and also the drift space in which the speed of the electrons is low.

The electrons that issue from grounded cathode **1** are accelerated by part **3** of the modulation resonator brought to a high constant potential **V2** and focussed by the Wehnelt cylinder **2** brought to a constant potential V**1** in such a way as to form a cylindrical beam. They are then braked in the space comprised between grids **5** and **6**, the intermediate electrode **11** being brought to a low constant potential V**3**. The electrons are at the same time modulated in velocity in the modulation space, comprised between grids **5** and **6**.

They become grouped at low speed in the drift space comprised between grids **6** and **9**.

They are then re-accelerated by part **7** of the pick-up resonator brought to a high constant potential V**2**. The groups of electrons formed in the drift space rapidly traverse the pick-up space comprised between grids **9** and **10**. They are partially braked by the high frequency field of the pick-up resonator which they excite. After having traversed grid **10**, they are braked once

more and at a low speed they reach the target 10 brought to a low constant potential V4.

In order to avoid the coupling of the modulation and pick-up circuits, use may be made of the following device described by way of example. Parts 3 and 7 of the modulation and pick-up resonators are joined. The discs 3 and 4 on the one hand, and 7 and 8 on the other, constitute two capacitances as great as possible. In series with these capacitances there is inserted the very high impedance presented by a closed quarter wave-length radial circuit formed by discs 4 and 8 and the body of electrode 11.

Although the present invention has been described for one example of embodiment, it is evident that it is by no means limited thereto, and that the same is capable of numerous variants and modifications without departing from its scope.

It is to be noted that the modulation circuit alone may consist of a cavity provided with a grid and associated to another grid integral with an independent electrode brought to a different potential. Similarly, the pick-up resonant circuit alone may comprise features of the invention, and finally, the central electrode that comprises the two grids may be replaced by two or more electrodes.

What we claim is:

1. A velocity modulation device comprising a container, means therein for producing an electron beam, first and second cavity resonators separated by a drift space and serially arranged for passage therethrough of said beam, said beam exciting oscillations in said resonators, two grids positioned in the path of said beam between said resonators defining said drift space, said grids being capacitively coupled to said resonators and provided with a quarter wavelength circuit to present high impedance for decoupling the oscillations in said resonators.

2. A velocity modulation device according to claim 1, wherein said grids comprise a quarter wave-length line at the operating frequency of the device interconnecting the said cavity resonators.

3. A velocity modulation device according to claim 1 wherein said circuit includes a transmission line of a quarter wavelength at the operating frequency of the device serially interconnecting the said capacitive couplings of the said grids.

4. A velocity modulation device according to claim 3, wherein said grids have extension discs included in said capacitive couplings, and means interconnecting said discs, said means and said discs defining said quarter wavelength line.

5. A velocity modulation device comprising means including an electron gun and a collector electrode for producing an electron beam within a container, two cavity resonators each having two grids, the four grids being located successively in the beam path, the inner two grids having radially extended portions providing capacitive couplings to their respective resonators, thereby permitting separate direct voltage energization of said inner and other grids and enabling a variable mean velocity of electrons in said path.

6. A velocity modulation device according to claim 5, wherein said inner grids are conductively interconnected to provide a quarter wavelength radial circuit to present high impedance for decoupling the said circuits of said resonators at the operating frequency of the device.

7. A velocity modulation device comprising a container having spaced inwardly disposed walls defining with the other walls of the container first and second cavity resonator chambers with an intermediate chamber therebetween, means for producing an electron beam coaxially of the three chambers, an electrode disposed in said intermediate chamber comprising a tubular member having spaced grids therein to define a drift space and a pair of spaced outwardly disposed plates capacitively coupled with said inwardly disposed walls, the tubular member and plates of said electrode comprising a closed quarter wavelength circuit thereby presenting a high impedance in series with the capacitance of the aforementioned wall-plate coupling and means for energizing said container and said electrode independently of each other.

8. A velocity modulation device comprising a container having spaced inwardly disposed walls defining with the other walls of the container first and second cavity resonator chambers with an intermediate chamber therebetween, means for producing an electron beam coaxially of the three chambers, an electrode disposed in said intermediate chamber and means capacitively coupling said electrode with said inwardly disposed walls and forming in conjunction with said electrode a closed quarter wavelength circuit in series with the capacitance of the aforementioned wall-plate coupling.

9. A velocity modulation device comprising a container having a pair of spaced walls therein defining with the other walls of the container first and second cavity resonator chambers with an intermediate chamber therebetween, means for producing an electron beam coaxially of the three chambers, an electrode disposed in said intermediate chamber and having an opening therethrough for passage of said electron beam, and said electrode having a pair of spaced plates capacitively coupled with said pair of walls, said plates being disposed in parallel relation to provide a quarter wavelength circuit in series with the capacitance of the aforementioned wall-plate coupling.

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