

Dec. 22, 1959

H. SHAPIRO
RESONANT UNIT

2,918,636

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FIG. 1.

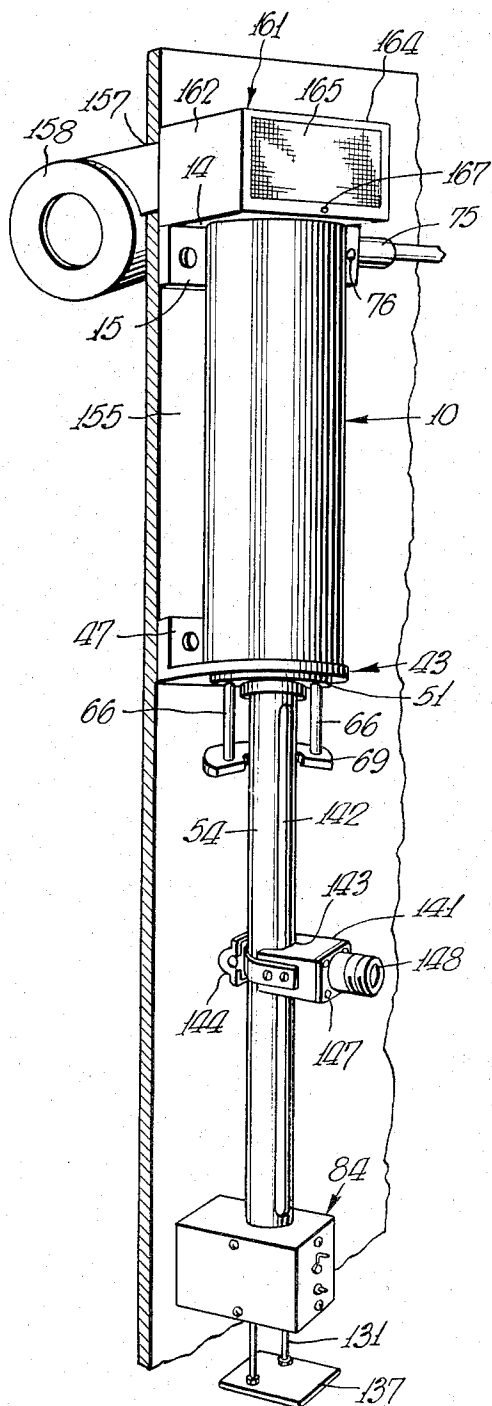
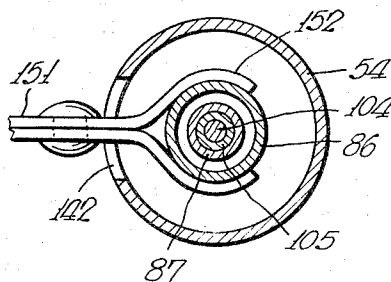


FIG. 6.



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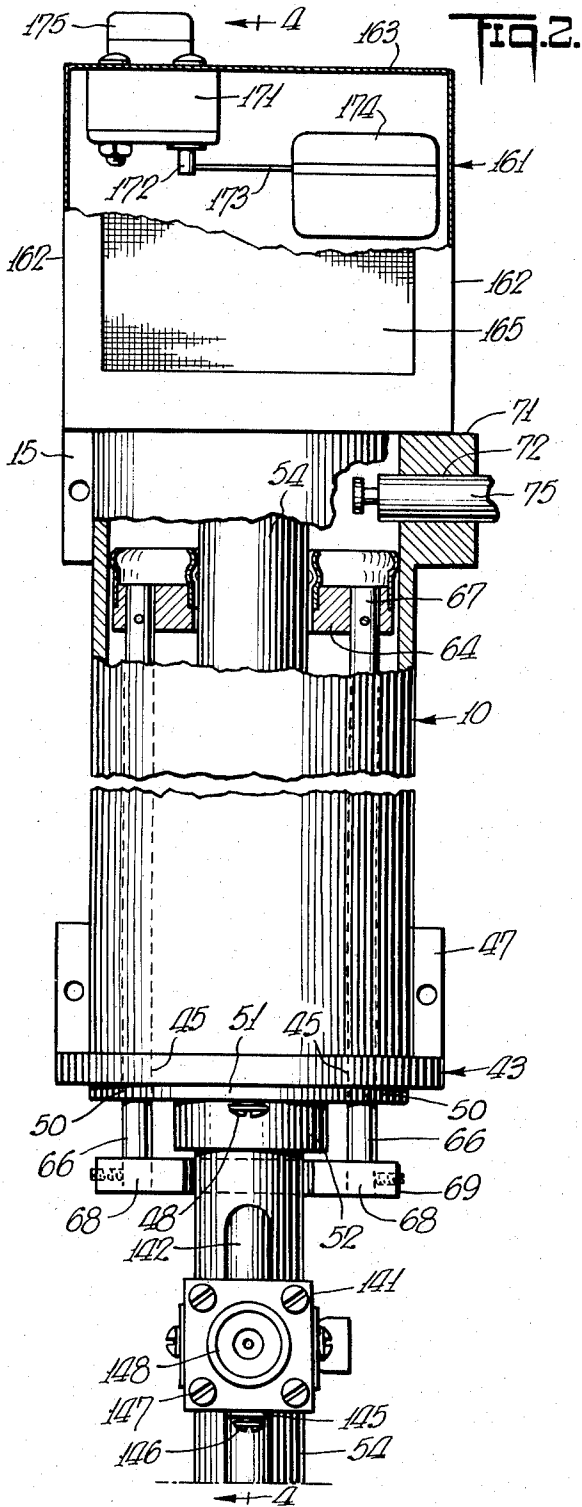
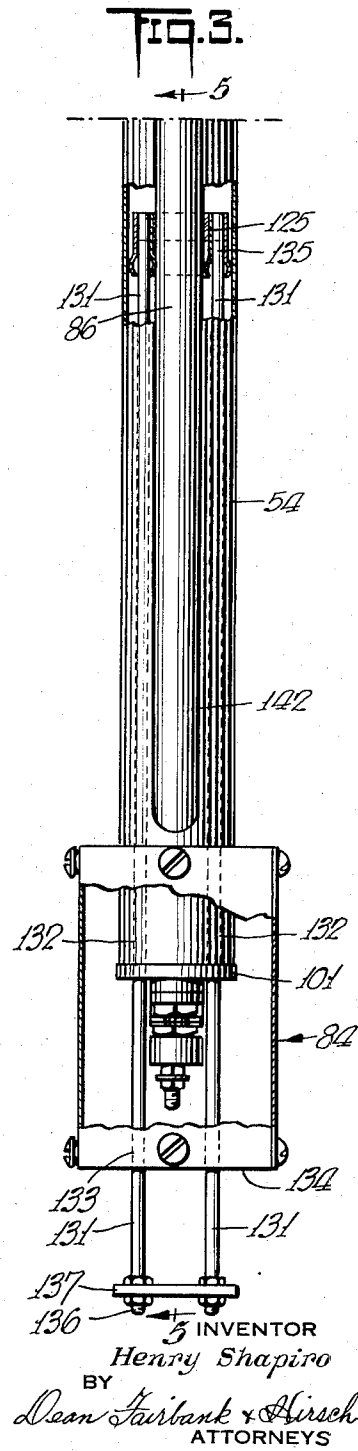
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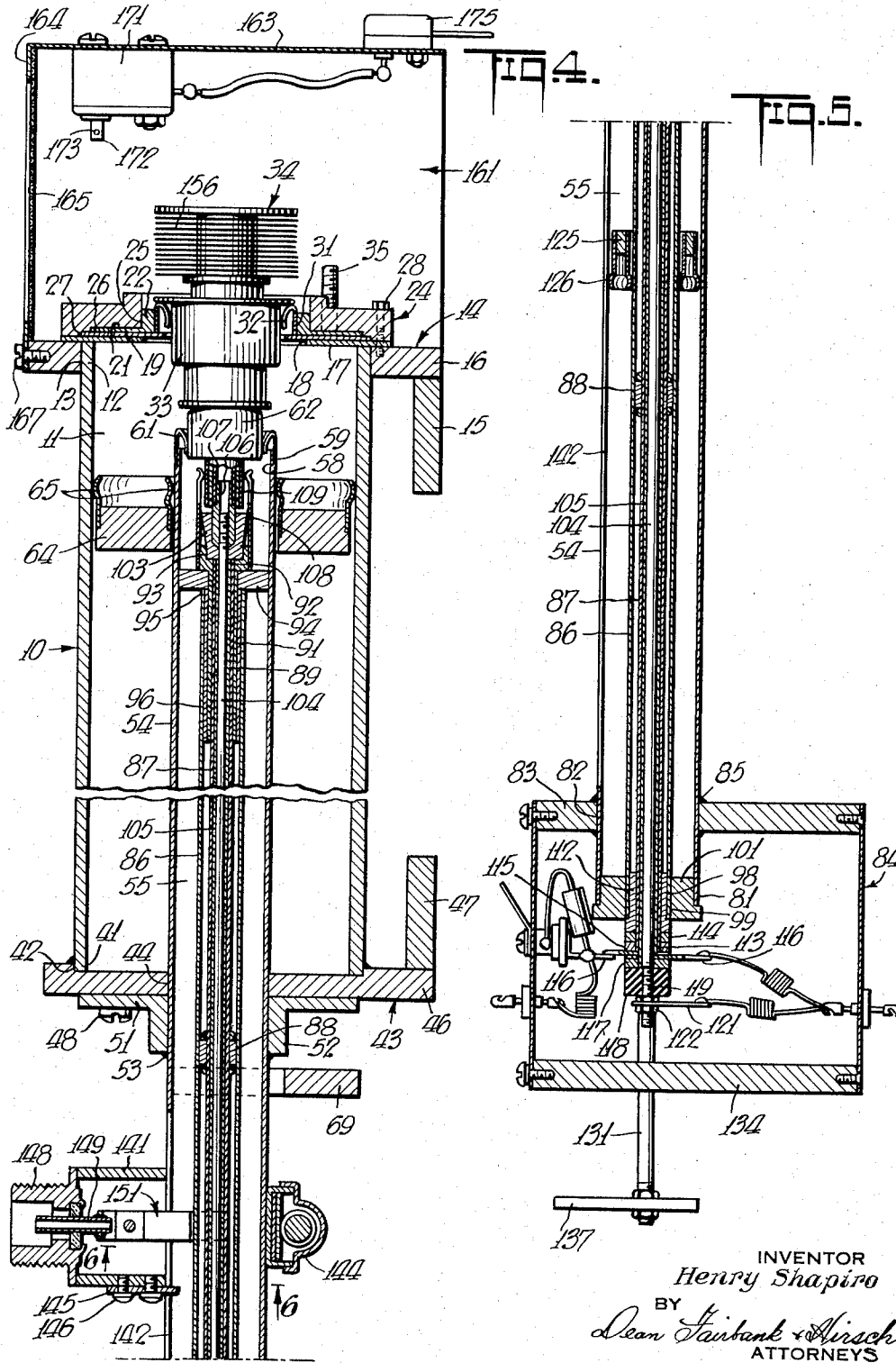
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3 Sheets-Sheet 3



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5 Claims. (Cl. 333—82)

This invention relates to the art of resonant units, more particularly of the tunable cavity type for high frequency transmission.

As conducive to an understanding of the invention, it is noted that where a resonant unit is of the type that includes an anode cavity and a grid-cathode cavity and the input signal to the unit is fed into the grid-cathode cavity, where the resonant unit is made to operate on a given frequency and has a fixed point of feed, due to manufacturing tolerances, it is difficult if not impossible to match the input line to the grid-cathode cavity for optimum transfer of energy and hence losses will occur.

Where the anode and grid-cathode cavities are tunable and such latter cavity is tuned to different frequencies, the location of the point along such cavity into which the input signal should be fed for optimum transfer of energy will vary based on the frequency to which the cavity is tuned.

Where a unit of the above type uses a conventional high frequency electronic tube, generally known in the art as a "Lighthouse" tube and high voltage points on the tube are exposed, there is a likelihood of severe shock and injury to a mechanic servicing the equipment.

Where air is forced against the tube to effect cooling thereof, if flow of such cooling air should stop while high voltages are still applied to the tube, the efficiency of the latter may be impaired or it may be rendered completely inoperative.

It is accordingly among the objects of the invention to provide a resonant unit that has a tunable anode cavity and grid-cathode cavity, that may readily be fabricated and is strong and sturdy and not likely to be deranged, that permits ready adjustment of the point of feed of the input signal into the grid-cathode cavity for most effective match to secure optimum transfer of energy regardless of the frequency to which such cavity is tuned, which permits ready application of a source of cooling air to the electronic tube used in association with the unit with assurance that in the event of discontinuance of flow of such cooling air, power to the tube will be shut off, which provides for complete concealment of the high voltage portions of the tube so that there is no likelihood of injury to a technician servicing the equipment and which also permits ready access to the tube for removal and replacement thereof with assurance that when the tube is exposed, high voltage thereto will be cut off.

According to the invention, these objects are accomplished by the arrangement and combination of elements hereinafter described and particularly recited in the claims.

In the accompanying drawings in which is shown one or more of various possible embodiments of the several features of the invention,

Fig. 1 is a perspective view of the unit mounted for operation,

Figs. 2 and 3 combined show a front view of the unit with parts broken away,

Figs. 4 and 5 combined show a longitudinal sectional

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view of the unit taken along line 4—4 and 5—5 of Figs. 2 and 3, and

Fig. 6 is a transverse sectional view taken along line 6—6 of Fig. 4.

Referring now to the drawings, the device comprises a metal sleeve 10 which defines the outer wall of the anode cavity 11. The upper end 12 of the sleeve 10 extends through and is affixed in a circular opening 13 in top plate 14, the latter having a mounting flange 15 along its rear edge 16.

Positioned on the top plate 14, is a metal disc 17 which has an opening 18 coaxial with opening 13. Positioned on disc 17 is an annular member 19 of insulating material such as mica, the inner diameter of member 19 being less than that of the opening 18 so that it will overlap the periphery of said opening. A second metal disc 21 is positioned on member 19, the disc 21 having a central opening coaxial with openings 13 and 18 and with an annular hub 22 extending outwardly therefrom.

To retain the discs 17 and 21 and insulating member 19 in assembled relation on the top plate 14, a retaining disc 24 of insulating material is provided. As shown in Fig. 4, disc 24 has an outer diameter substantially equal to that of disc 17 and has an opening 25 therethrough coaxial with the opening 13 in plate 14 and of diameter such that hub 22 will fit snugly therein.

The inner face of disc 24 has a recess 26 of diameter such as to accommodate disc 21 and of depth substantially equal to the combined thickness of disc 21 and insulating member 19. In addition, the disc 24 has an annular recess 27 encompassing recess 26 and of diameter such as to accommodate the insulating member 19 to center the latter.

Thus, when screws 28 are inserted through aligned openings in discs 24 and 17 into threaded openings in top plate 14, the discs 17, 21, 24 and insulating member 19 will be securely clamped together and retained on said top plate.

Mounted in the hub 22 of disc 21 is a contact ring 31 having a plurality of resilient contact fingers 32 which are designed to make an effective electric and mechanical connection with the anode ring 33 of a conventional "Lighthouse" tube 34 of the type, for example, put out by General Electric Company, potential being applied to such ring 33 through a terminal 35 extending through disc 24 and connected to disc 21.

As shown in Fig. 4, the lower end 41 of sleeve 11 is seated in a circular recess 42 in a bottom plate 43 and is affixed in said recess as by soldering. The plate 43 has a central opening 44 coaxial with sleeve 10 and a pair of diametrically aligned openings 45 (Fig. 2), the rear edge 46 of plate 43 having a mounting flange 47. Affixed to plate 43 as by screws 48 is a disc 51 which has an outstanding axial hub 52 coaxial with the opening 44 in plate 43 and a pair of openings 50 (Fig. 2) aligned with opening 45.

Extending through hub 52 into sleeve 10 and affixed to the hub as at 53 is a metal sleeve 54 which defines the inner wall of the anode cavity 11 and the outer wall of the grid-cathode cavity 55.

The inner end 58 of sleeve 54 which is positioned adjacent top plate 14 mounts a contact ring 59 which has a plurality of resilient contact fingers 61 designed to make an effective electrical and mechanical connection with the grid ring 62 of tube 34.

Slidably mounted on sleeve 54 in sleeve 10 is a metal plunger 64 by means of which the anode cavity 11 is tuned. The plunger 64 on its inner and outer peripheries has resilient contact fingers 65 which engage the opposed surfaces of sleeves 10 and 54 to provide a good electrical connection and also serve to retain the plunger 64 in set position, the volume of sleeve 11 between plunger 64

and disc 17 defining the active portion of the anode cavity.

To adjust the position of plunger 64 to tune the anode cavity 11, as shown in Fig. 2, a pair of rods 66 are provided which extend through the aligned openings 50, 45, the inner ends 67 of said rods 66 being secured to the plunger 64. The outer ends 68 of rods 66 are affixed to an arcuate adjustment member 69 coaxial with sleeve 54.

In order to tap off energy from the anode cavity 11, a boss 71 is desirably formed integral with sleeve 10 adjacent the upper end 12 thereof. The boss 71 has a bore 72 therethrough leading into the cavity 11 to accommodate a conventional capacitive pickup probe 75 which may be locked in set position as by a set screw 76.

The end 81 (Fig. 5) of sleeve 54 extends through an opening 82 in the wall 83 of a housing 84 and is secured in place as by soldering at 85. Positioned in sleeve 54 coaxial therewith, is a sleeve 86 which defines the inner wall of the grid-cathode cavity and an additional sleeve 87 extends through said sleeve 86, being centered therein by insulating spacers 88. Encompassing the inner end 89 of sleeve 87 is a metal tube 91 which has a hub 92 at its outer end with a recess 93 therein. Encompassing tube 91 and abutting against hub 92 is a collar 94 of insulating material against which the inner end 95 of sleeve 86 abuts, the portion of sleeve 86 encompassing tube 91 being insulated therefrom by insulating material 96. The diameter of collar 94 is such as to center the inner end of sleeve 86 in sleeve 54 and the outer end 98 (Fig. 5) of sleeve 86 extends through the central opening 99 in a plug 101 affixed in the outer end 81 of sleeve 54.

Positioned in the recess 93 of hub 92 is a sleeve 103 of insulating material through which one end of a rod 104 extends, said rod having an insulating coating 105 thereon and extending completely through sleeve 87. The inner end of rod 104 mounts a resilient contact member 106 which is engaged by the inner filament contact sleeve 107 of tube 34 and a resilient contact member 108 is affixed to hub 92 and is engaged by the outer grid-cathode contact sleeve 109 of said tube 34.

The threaded end 113 of sleeve 87 extends through a short insulating sleeve 112 positioned in the end 98 of sleeve 86 and mounts an insulating washer 114 which is clamped against the outer end of insulating sleeve 112 by nut 115. A contact lug 116 which makes electrical connection with the threaded end of sleeve 87 is secured in place by a nut 117. An insulating collar 118 encompasses the threaded outer end 119 of rod 104 and a contact lug 121 is mounted on said threaded end as by nuts 122. Thus, when a source of voltage is applied across lugs 116, 121, the filament of tube 34 will be energized.

Slidably mounted on sleeve 86 is a metal plunger 125 (Fig. 5) by means of which the grid-cathode cavity 55 is tuned. The plunger 125 on its inner and outer peripheries has resilient contact fingers 126 which engage the opposed surfaces of sleeves 54 and 86 to provide a good electrical connection and also serve to retain the plunger 125 in set position, the volume of sleeve 54 between plunger 125 and the inner end of sleeve 86 defining the active portion of the grid-cathode cavity.

To adjust the position of plunger 125 to tune the grid-cathode cavity, as shown in Figs. 1, 3 and 5, a pair of rods 131 are provided which extend through diametrically aligned passageways 132 in plug 101 and through aligned openings 133 in the wall 134 of casing 84. The inner ends 135 of rods 131 are secured to plunger 125 and the outer ends 136 thereof are secured to an adjustment plate 137.

Means are provided to feed energy into the grid-cathode cavity. To this end, as shown in Figs. 1, 2, 4 and 6, a hollow block 141 is mounted on sleeve 54, over an elongated slot 142 therein. The block desirably has an arcuate concavity 143 in its inner surface seated on said sleeve 54 and may be secured in desired position along the length of the slot 142 by a suitable clamp 144. To

prevent rotation of the block with respect to sleeve 54, a bar 145 is affixed as by screws 146 to the side wall of the block and extends into the slot 142.

Mounted on the outer end of the block as by screws 147 is a conventional coaxial cable connector 148 to the central pin 149 of which is connected the cross piece of a substantially U-shaped member 151. The member 151 extends through the block 141 and the free ends 152 thereof are curved to define resilient clamp arms slidably to engage the sleeve 86.

As shown in Fig. 1, the unit is mounted in upright position on a panel 155, with the upper portion of the unit from which the cooling fins 156 of the tube 34 extend, adjacent an opening 157 through said panel. A blower 158 is mounted on the rear of panel 155 to force cooling air through such opening to dissipate the heat radiated from fins 156 to help cool the tube 34.

As the fins 156 are at the same high potential as the anode of the tube 34, means are provided to enclose such fins as well as the adjacent portion of the tube to prevent accidental shock to the technicians. To this end, a rectangular casing 161 is provided, having side walls 162, a top wall 163 and a front wall 164 with a rectangular opening therethrough covered by a screen 165. The front and side walls of the casing fit snugly over the front and side edges of the plate 14 and the casing is secured in position by a screw 167. Thus, the tube 34 will be completely enclosed and the air forced by the blower 158 through opening 157 in panel 155 will pass through the screen 165.

To insure that the plate voltage will be cut off in the event the blower 158 does not operate, a switch 171 is mounted in the casing 161 on the inner surface of the top wall 163 thereof. The control member 172 of switch 171 has an arm 173 connected thereto at one end, the other end of the arm mounting a plate 174 against which the air from the blower will strike. The contacts of the switch are connected to a plug 175 mounted on the top wall 163 of casing 161 near the rear thereof and the plug is adapted to coact with a socket (not shown) mounted on the panel 155 and electrically connected to control the power supply.

In the operation of the device, the input cable is coupled to connector 148 and the output probe 75 mounted in boss 71. When the power supply is turned on, the filament of tube 34 will be energized from lugs 116, 121 and the anode from terminal 35. As the blower 158 will first be energized due to suitably relay circuits (not shown), the air forced through opening 157 will strike plate 174 to actuate switch 171 to permit application of high voltage to terminal 35. In the event the blower is defective, as switch 171 will not be energized, no high voltage will be applied to tube 34. Thus, injury to the tube due to over-heating of the anode is avoided.

In the event the technician desires to remove the tube 34, for example, the casing 161 must first be removed from top plate 14. As a result, the plug 175 will be removed from the socket on the panel 155 to insure that the high voltage supply is cut off.

The point along the grid-cathode cavity where the input line should be connected for most efficient match, varies as the grid-cathode cavity is tuned by plunger 125 to different frequencies. As the block 141 may readily be set to any optimum position along sleeve 54, the point of feed may be adjusted. As a result, the device is capable of use over a wide range of frequencies with optimum transfer of energy and precise tolerances in manufacture are not necessary.

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

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Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A device of the character described tunable over a broad band of frequencies where the maximum frequency is many times the minimum frequency comprising three coaxial metal sleeves, the outermost sleeve being shorter than the other two sleeves, said outermost sleeve and the second sleeve adjacent thereto defining an anode cavity, said second sleeve and the third sleeve defining a grid-cathode cavity, means to tune said cavities, said second sleeve having an elongated longitudinal slot therethrough in the portion thereof extending beyond the outermost sleeve, a slidable member mounted on the portion of said second sleeve extending beyond the outermost sleeve, an input carried by said slidable member, a contact member electrically connected to said input, carried by said slidable member and insulated therefrom and from said second sleeve, said contact member extending through said slot and resiliently and slidably engaging said third sleeve to feed the input signal into the grid-cathode cavity, the lowest operating frequency of said device being determined by the effective maximum length of the anode cavity, the far end of the slot in the second sleeve being at a distance from the inner end of the second sleeve substantially equal to an odd multiple of one quarter wave length which is at least the next larger odd multiple of the number of quarter wave lengths used in the anode circuit.

2. A device of the character described comprising a metal sleeve having a closure member at each end, said closure members having axially aligned openings therethrough and defining the top and bottom of said sleeve, a second sleeve extending through the opening in said bottom closure member into said first sleeve, coaxial therewith and spaced from the top closure member, a third sleeve in said second sleeve, coaxial therewith, said first and second sleeve defining an anode cavity and said second and third sleeve defining a grid-cathode cavity, means to tune said cavities, means slidably mounted on the portion of said second sleeve extending beyond the first sleeve, means carried by said slidably mounted means, electrically insulated from said second sleeve and in slidably electrical contact with said third sleeve, to feed an input signal into said grid-cathode cavity, means on said top closure member to mount an electronic tube, a casing removably mounted on said top closure member about the mount for such tube, said casing having an aperture for passage of air thereinto, a switch mounted on said casing, said switch having a control member

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and a plate carried by said control member in the path of the air through said casing.

3. The combination set forth in claim 2 in which a supporting panel is provided, means to mount said device in upright position on said panel, said panel having an opening aligned with the aperture in said casing, a blower mounted on the rear of said panel to force air through said opening into the casing, an electrical connector on said panel and a complementary electrical connector on said casing adapted to coact with said panel connector, said casing connector being electrically connected to said switch.

4. The combination set forth in claim 2 in which said top closure member comprises a disc affixed to the adjacent end of the first sleeve and having an opening therethrough, a pair of juxtaposed annular members, an insulated annular member between said pair of annular members, means to clamp said pair of annular members, and said insulated member against the outer surface of said disc, a terminal connected to the innermost annular member of said pair, said mounting means for said tube being connected to the inner periphery of the outermost annular member.

5. The combination set forth in claim 2 in which said second sleeve has an elongated slot therethrough, the means slidably mounted on said second sleeve is a substantially rectangular hollow casing having its inner edge curved to correspond to the curvature of said second sleeve and riding thereon, a plate affixed at one end of said casing and extending into said slot to prevent rotation of said casing on said second sleeve, means to lock said casing in fixed position on said sleeve, a coaxial connector member mounted on the outer surface of said casing, said member having a central pin, a contact in said casing member affixed to said pin and having its lower end extending through said slot, said lower end having a pair of curved arms slidably engaging said third sleeve.

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