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TUNABLE REFLEX KLYSTRON HAVING MEANS TO VARY THE SPACING BETWEEN THE FIRST AND SECOND GRIDS

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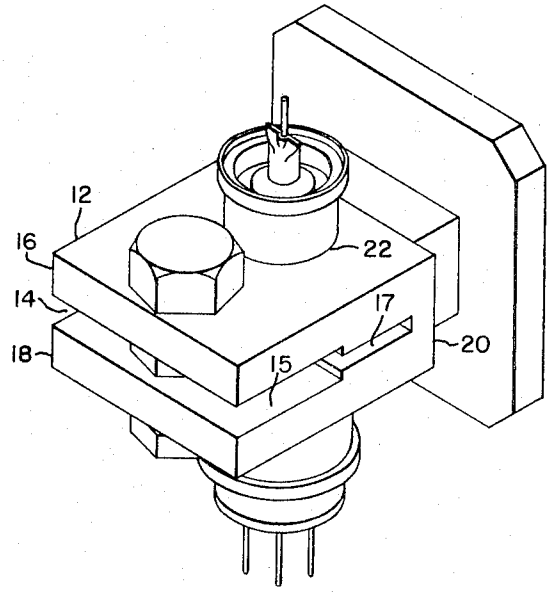

Fig. 1.

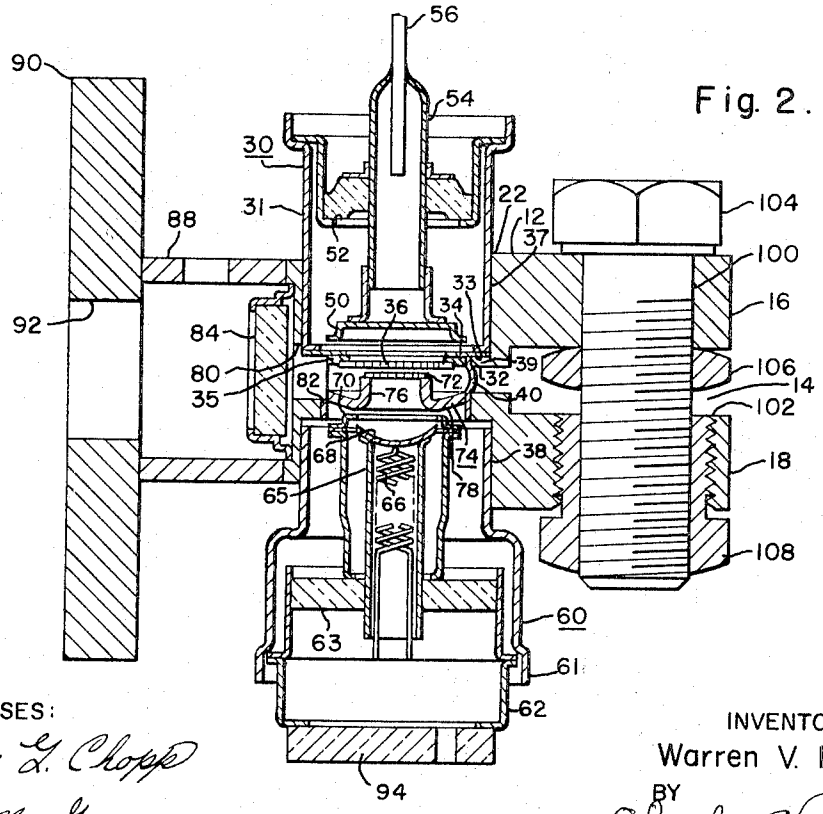

Fig. 2.

WITNESSES:

John L. Clopp

Leon M. Garman

INVENTOR

Warren V. Hoxie

BY

Charles F. Renz

ATTORNEY

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TUNABLE REFLEX KLYSTRON HAVING MEANS TO VARY THE SPACING BETWEEN THE FIRST AND SECOND GRIDS

Warren V. Hoxie, Elmira, N.Y., assignor to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

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ABSTRACT OF THE DISCLOSURE

This invention is directed to a tunable reflex klystron. A U-shaped body portion is provided having a slot therein perpendicular to the axis of the tube, a first and second grid are secured respectively to the upper and lower legs of the U-shaped body portion and a deformable wall connects the two leg members. Flexure of the leg members varies the spacings of the first and second grid, permitting tuning of the klystron.

This invention relates to an electron emissive device and more particularly to a device of the reflex klystron type.

Reflex klystron tubes employ several different kinds of tuning arrangements. The more general method of tuning these devices is by varying the spacing or gap between a cathode grid and a reflector grid within the klystron device. One particular method that is now utilized is by varying this gap by distorting the klystron body by pressure applied in a direction perpendicular to the axis of the tube. One of the grids is provided with a header in contact with the body. The deformation of the body in turn distorts the grid header causing the grid to shift position and vary the gap. It is found that this particular method of tuning the klystron has mechanical problems in assuring that the movement of the grid will be in the proper direction and in the critical design of the header utilized in supporting the movable grid element.

It is accordingly the general object of this invention to provide a new and improved tunable electron emission device.

It is another object to provide an improved tunable reflex klystron device.

It is a more particular object to provide an improved tunable reflex klystron device providing an output window and a single tuning screw for providing tuning thereof.

Briefly, the present invention accomplishes the above cited objects by providing a U-shaped body member including a bore through the leg portions of said U-shaped member and provided with a flexible body liner member between the leg portions and perpendicular thereto. An output window is provided through the base portion of the body member and mechanical means are provided for flexing the leg portions and a portion of body liner to vary the spacing between grid members located respectively in the two leg portions.

Further objects and advantages of the invention will become apparent as the following description proceeds and features of novelty which characterize the invention will be pointed out in particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawings in which:

FIG. 1 is a perspective view of a reflex klystron representing one embodiment of the invention; and

FIG. 2 is a sectional view of the reflex klystron illustrated in FIG. 1.

Referring now to FIGS. 1 and 2, there is shown a preferred embodiment of the invention incorporated in a reflex klystron. The klystron comprises a main or resonator body **12** made from a large block of suitable material such as iron. The body **12** is a relatively flat rectangular block and in one specific embodiment is 1.06 inches by .940 inch by .50 inch. A centrally located groove **14** cut into the body **12** as illustrated provides an upper leg portion **16** and a lower leg portion **18** and a base portion **20**. The groove **14** as illustrated in FIG. 1 is wider at the extremity of the legs **16** and **18** so as to provide a wider groove portion **15**, about .188 inch, and a narrower groove portion **17**, about .062 inch. The sides of the groove **14** are parallel to the upper and lower surfaces of the body **12**.

A multi-diameter bore **22**, about .432 inch in diameter, is provided through the body **14** and is positioned such that it is confined within the groove section **17** and is adjacent the base portion **20**. The bore **22** is perpendicular to the upper and lower surfaces of the body **12**.

Fixedly secured within the upper leg portion **16** is a repeller assembly **30** including a repeller cup member **31** of a suitable material such as iron. The repeller cup **31** is brazed within a first diameter portion **37** of the bore **22** and seated on the projection **33** of a smaller diameter portion **39** within the bore **22** with an annular washer or spacer **34** provided therebetween. An annular grid header **35** is secured to the lower surface of the washer **34** of a suitable material such as iron. A tubular body liner **40** is brazed into the smaller diameter portion **39** of leg **16** and the portion **39** of leg **18**. The body liner **40** is of iron and has an outside diameter of .350 inch and inside diameter of .317 inch. The member **40** provides a flexible connecting means between the upper leg portion **16** and the lower portion **18** and forms a part of the evacuated wall of the reflex klystron. A grid member **36** of a suitable material such as copper is brazed to the header **35**. The grid **36** may be referred to as the repeller grid since it is the grid that is positioned closest to the repeller electrode. The repeller grid header **35** is also brazed about its outer periphery to the tubular member **40**. A repeller button **50** is provided within the repeller cup assembly **30** and is secured to the repeller cup **31** by a suitable header means **52** which supports the repeller stem **54** and also provides a vacuum tight seal between the repeller stem **54** and the repeller cup **31**. A lead-in for the repeller is provided by means of the wire **56** of a suitable material such as nickel which is electrically and physically connected to the repeller stem **54**.

A cathode assembly **60** is positioned and fixedly secured to the lower leg portion **18**. The cathode assembly **60** consists of a cathode support cup **61** which extends into the bore **22** and is secured to section **38** by brazing thereto. A cathode support assembly **62** is supported within the cup **61** by a suitable header **63** and provides support for the cathode **65** which includes a heater **66** and a cathode button **68**. In addition the cathode support provides support for a focus electrode **70**. Leads for the electrodes are sealed through a header **94**.

Positioned between the cathode button **68** and the repeller grid **36** is a cathode grid **72**. The cathode grid **72** is positioned adjacent to the repeller grid **36** and is supported therein by a header member **74** which includes a tubular portion **76** with the grid mesh attached to one end of the tubular portion **76** adjacent the repeller grid and an out-turned flange **78** on the opposite end of the tubular member **76** which has its periphery secured to the liner **40** by a suitable technique such as brazing. The header member **74** is secured to the liner **40** within the section **38** of the bore **22** of leg **18**. In this manner, the envelope of the klystron between the repeller grid and the cathode grid is the thin walled flexible liner **40**.

An opening 82 is provided in the liner 40 and an aligned opening 80 in the base portion 20 of the body 16 for coupling of energy out the cavity resonator region defined between the two grids 36 and 72 and the region between these two grids defined by the two headers 35 and 74 and the liner 40. A suitable ceramic window 84 is provided across the output opening 80 and is vacuum sealed to the base portion 20. A rectangular wave guide 88 and flange 90 with opening 92 is provided for coupling electromagnetic energy out the tube through the window 84.

The tuning mechanism for flexing the leg members 16 and 18 is mounted at the extremities thereof. Threaded openings 100 and 102 respectively are provided in the upper and lower legs 16 and 18 as illustrated in FIG. 2. A threaded bracket bolt 104 is threaded into the upper opening 100 and a jam nut 106 locks the bolt 104 to the upper leg 16. The bracket bolt 104 is also secured within the lower leg 18 by internal threads provided upon a differential tuning screw 108 with the external thread of the differential tuning screw 108 threaded to the threads provided within the opening 102 in leg 18, and the internal threads of the screw 108 threaded to the bolt 104. The total turns per inch of the external thread on the differential tuning screw 108 is 32 and the turns per inch of the internal portion of the differential tuning screw 108 is 28.

In the tuning of the device to change the oscillation frequency of the tube, the mechanics of tuning are as follows. The bracket bolt 104 is securely locked to the upper leg portion 16 by the lock or jam nut 106. Turning of the differential screw member 108 in a counterclockwise direction results in flexing the two legs 16 and 18 toward each other. As this pressure is applied to the legs of the body, the thin flexible wall 40 is deformed on the side remote from the base portion 20 as indicated in FIG. 2. This deformation in the wall 40 moves grid 72 closer to the grid 36. As the gap between the grids decreases, the capacitance therebetween decreases, causing the frquency of the device to increase. By turning the differential screw 108 in a clockwise direction the frequency may, of course, be lowered if the wall is under deformation prior to movement. The flexure of the legs 16 and 18 has no effect on the window 84 mounted in the base portion and, therefore, there is no danger of cracking this seal during the tuning operation. It has been found that a reflex klystron of a frequency of operation of 14,000 megacycles is capable of being tuned over a range of 1800 megacycles with the above system.

While there have been shown and described what are at present considered to be the preferred embodiments of the invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention be limited to the specific arrangement shown and described and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

I claim as my invention:

1. A reflex klystron device comprising a U-shaped body member including a base portion and first and second leg portions, said first leg portion having an opening therein to provide a first thick wall envelope section, a cathode and a first grid electrode secured within said opening of said first leg portion, said second leg portion having an opening therein to provide a second thick wall envelope section and aligned with said first opening, a repeller electrode and a second grid electrode secured within said second opening, a third envelope section connecting said first and second envelope sections and having a thin wall portion secured to said first and second leg members, and means mounted on said leg portions to apply force to said legs for distorting said thin wall portion and thereby vary the spacing between said first grid electrode and said second grid electrode.

2. A reflex klystron device comprising a U-shaped body member including a base portion and first and second leg portions, said first leg portion having an opening therein to provide a first thick wall envelope section, a first grid electrode secured within said opening of said first leg portion, said second leg portion having an opening therein to provide a second thick wall envelope section and aligned with said first opening, a second grid electrode secured within said second opening, a third envelope section connecting said first and second sections and having a thin wall portion secured to said first and second leg members, and means mounted on the extremities of said leg portions to apply force to said legs substantially parallel to the axis of said envelope section to distort said thin wall section and vary the spacing between said first grid electrode and said second grid electrode.

3. A reflex klystron device comprising a U-shaped body member including a base portion and a first and second leg portion, said first leg portion having an opening therein to define a first thick wall envelope section, a cathode and a first electrode secured within said first envelope section, said second leg portion having an opening therein to define a second thick wall envelope section and aligned with said first opening, a repeller electrode and a second electrode secured within said second envelope section, a third envelope section connecting said first and second envelope sections and having a thin wall portion secured to said first and second leg members, said base portion and said third envelope section having an opening with a window therein for transmission of energy from said envelope defined by said third envelope section, and means mounted on said leg portions to apply force to said legs for distorting said thin wall portion and thereby vary the spacing between said first electrode and said second electrode without distorting said window.

4. A klystron device comprising a U-shaped body member to provide a base portion and first and second leg portions, said first leg portion having an opening therein to provide a thick wall first envelope portion and including a cathode and a first grid secured therein, said second leg portion having an opening therein to provide a thick wall second envelope portion aligned with said first opening and including a repeller electrode and a second grid electrode mounted within said opening, a third envelope portion connecting said first and second envelope portions and including at least a thin wall deformable portion connecting said first and second openings and secured to said first and second leg members, a differential tuning screw assembly threadedly engaged through apertures provided in the extremities of said leg portions and remote from said base portion with respect to said envelope openings to provide means for applying force to said leg portions and vary the spacing between said leg portions and distort said third envelope portion between said leg portions and thereby vary the spacing between said first and second grid electrodes.

5. A reflux klystron device comprising a U-shaped body member to provide a base portion and a first and second leg portion, said first leg portion having an opening therein to provide a thick wall first envelope portion and including a cathode and a first grid secured therein, said second leg portion having an opening therein to provide a thick wall second envelope portion aligned with said first opening and including a repeller electrode and a second grid electrode mounted within said opening, a third envelope portion connecting said first and second envelope portions and including a thin wall section connecting said first and second openings and secured to said first and second leg members, a window secured to said base portion closing an opening in said base portion for transmission of energy from said klystron device, a tuning screw assembly engaging apertures provided in the extremities of said leg portions and remote from said base portion with respect to said envelope openings to flex said leg portions and distort said thin wall section

of said third envelope portion between said leg portions and thereby vary the spacing between said first and second grid electrodes.

6. A klystron device comprising a U-shaped body member to provide a base portion and a first and second leg portion, said first leg portion having an opening therein to provide a thick wall first envelope portion and including a cathode and a first grid secured therein, said second leg portion having an opening therein to provide a thick wall second envelope portion aligned with said first opening and including a repeller electrode and a second grid electrode mounted within said opening, a third envelope portion connecting said first and second envelope portions connecting said first and second openings and including a thin wall section secured to said first and second leg members, means provided in

leg portions and remote from said base portion with respect to said envelope openings to flex said leg portions and distort a portion of said thin wall section of said third envelope portion between said leg portions and thereby vary the spacing between said first and second grid electrodes.

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HERMAN KARL SAALBACH, *Primary Examiner.*

ELI LIEBERMAN, P. L. GENSLER, *Examiners.*