Aug. 2, 1949. A. DANZIGER 2,477,581

ULTRA HIGH FREQUENCY OSCILLATOR

Filed June 24, 1943 2 Sheets-Sheet 1

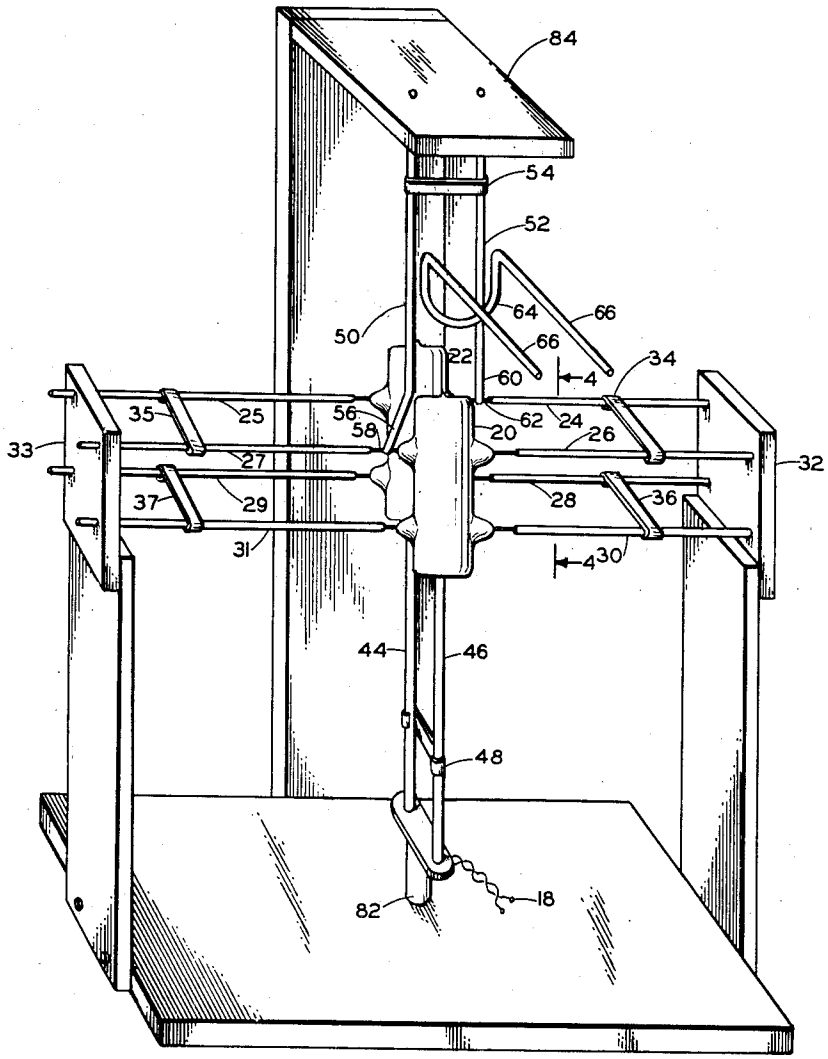


FIG.1.

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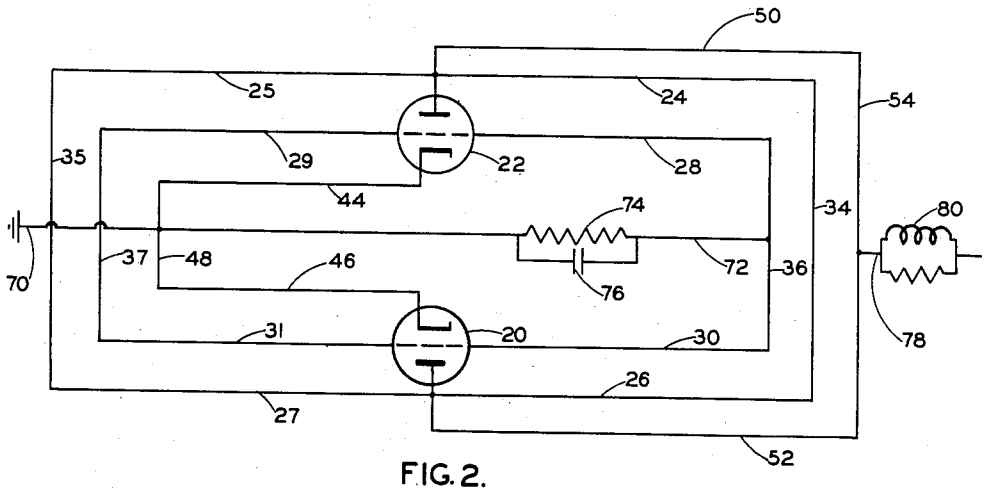


FIG. 2.

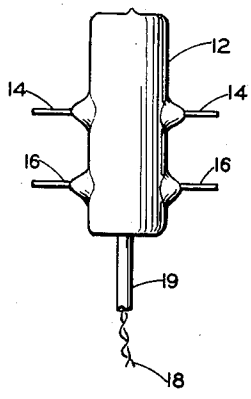


FIG. 3.

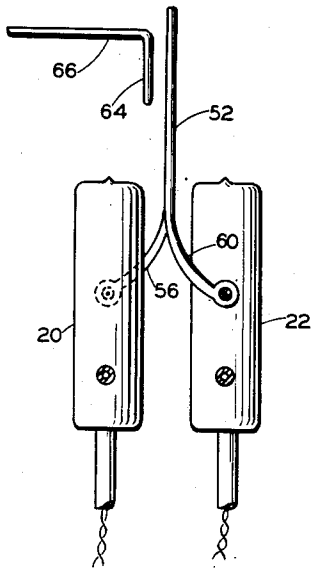


FIG. 4.

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2,477,581

UNITED STATES PATENT OFFICE

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ULTRA HIGH FREQUENCY OSCILLATOR

Albert Danziger, Bradley Beach, N. J.

Application June 24, 1943, Serial No. 492,023

6 Claims. (Cl. 250—36)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to oscillators, particularly for the generation of ultrahigh frequency power.

The primary object of the invention is to improve oscillators. A more particular object is to devise a U. H. F. oscillator using standard vacuum tubes of the type having diametrically-opposed pins supporting the anode, and a second pair of diametrically-opposed pins spaced from the first pins for supporting the grid. A further object is to provide a U. H. F. oscillator in which the resonant circuits are for the most part simple pipes or tubing, yet which are adjustable, either to vary frequency, or to obtain optimum power output at a desired frequency. Still another object is to provide such an oscillator in which two tubes are connected in push-pull by circuits which are symmetrical with respect to coordinate axes.

To the accomplishment of the foregoing general objects, and other more specific objects which will hereinafter appear, my invention resides in the oscillator elements and their relation one to the other as hereinafter are more particularly described in the specification and sought to be defined in the claims. The specification is accompanied by drawings in which

Figure 1 is a perspective view of an oscillator embodying features of my invention;

Figure 2 is a wiring diagram explanatory of the invention;

Figure 3 illustrates the type of tube employed in the oscillator of Figure 1; and

Figure 4 is a fragmentary section taken approximately in the plane of the line 4—4 of Figure 1.

Referring to the drawing, and more particularly to Figure 3, the tube comprises an envelope 12 having diametrically opposed pins 14 which support the anode, and another pair of diametically opposed pins 16, spaced from the pins 14, for supporting the grid. The cathode has three lead-ins (not shown), which come through the bottom of the tube. Two of these are for heater current supply, while the third is a cathode connection which leads to the midpoint of the filament, the cathode in the present tube being of the oxide-coated filamentary type. It will be understood, however, that the cathode may also be of the indirectly heated type, in which case, the third lead-in is connected to the cathode itself. In either case, the two heater lead-ins are connected to a pair of conductors 18, while the third lead-in is connected to a tube or pipe 19, through which the conductors 18 may pass.

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Referring now to Figure 1, I provide two tubes 20 and 22, which are operated in push-pull, said tubes being disposed in collateral relation, with the pins of both tubes in parallel planes. Four pipes 24, 26, 28, and 30 extend in parallel relation from the four pins at one side of the tubes, said pipes forming a continuation of the pins. In the specific structure here disclosed, the ends of the pipes are received in an insulation member 32, preferably made of polystyrene. A shorting bar 34 is slidably carried on anode pipes 24, 26, and another shorting bar 36 is slidably carried on grid pipes 28, 30. These complete an anode-to-anode loop and a grid-to-grid loop. Some advantages of this arrangement are the facility with which the loops may be tuned; accurate frequency control; and good frequency stability.

I prefer to make the anode and grid circuits perfectly symmetrical with respect to the transverse as well as the longitudinal axis. For this purpose the opposite anode and grid pins of the tubes are similarly provided with four pipes 25, 27, 29, 31 forming apparent continuations of the pins. These pipes are similarly supported at their outer ends in an insulation plate 33, and are similarly tunable by means of adjustable shorting bars 35 and 37.

Although the oscillator can be held in other positions, it is convenient to speak of the tubes 20 and 22 as being upright with the anode and grid loops extending horizontally therefrom. With that position in mind it may be said that the cathodes are connected by a pair of vertical pipes 44 and 46, forming a cathode to cathode loop which is completed and made adjustable by means of a slidable shorting bar 48. The twisted heater leads 18 from each of the tubes come out at the bottom ends of pipes 44 and 46, and are connected together and to a suitable filament power supply source.

The complete oscillator further includes an output circuit made up of vertical pipes 50 and 52 and an adjustable shorting bar 54. The pipe 50 is offset forwardly at 56 for connection to the left-hand anode pin 58 of tube 20, while pipe 52 is offset rearwardly at 60 for connection to the right-hand anode pin 62 of tube 22. Figure 4 clearly shows the manner in which these pipes are offset forwardly at 56 and rearwardly at 60 to maintain so far as possible the desired sym-

metry of the oscillator. Power may be taken from the resulting output circuit by any suitable coupling, here illustrated by a magnetic coupling loop 64 (Figure 1), formed at the end of a transmission line 66 leading to an antenna or other apparatus using the oscillator power.

The electrical arrangement of the oscillator is diagrammatically illustrated in Figure 2. This shows the tubes 20 and 22 with their grids connected by symmetrically opposed loops 28, 36, 30, and 29, 37, 31. The anodes are connected by symmetrically opposed loops 24, 34, 26, and 25, 35, 27. The cathodes are connected by a cathode loop 44, 48, 46, the midpoint of which may be grounded as indicated at 70. Grid bias potential is applied by means of a lead 72, preferably connected to the midpoint or nodal point of one of the grid-to-grid loops. In the present case, a bias potential is developed across a bias resistor 74, preferably shunted by distributed or lumped capacitance 76. In addition to the symmetrically opposed anode loops, the anodes are additionally connected by the output circuit, this being indicated in Figure 2 by the loop 50, 54, 52. Positive D.-C. potential is applied to the anodes by means of a lead 78 connected to the midpoint or nodal point on the output loop. A choke 80 may be inserted in the D.-C. power supply. The transmission line 66 (Figure 1) is not shown in Figure 2.

Reverting to Figure 1, it will be understood that the ground connection (70 in Figure 2) may be made to the metal fitting 82 at the bottom of the cathode pipes 44, 46; that the grid bias connection (72 in Figure 2) may be made to the center of either of the shorting bars 36 or 37 or, if more convenient, to the ends of either pair of pipes at the insulation blocks 32, 33; and that the anode potential connection (78 in Figure 2) may be made to the midpoint of the shorting bar 54, or, if more convenient, may be made to the upper ends of the pipes 50, 52 at the top support 84.

The coupling between the plate and grid loops may be varied by changing the diameter of the horizontal pipes. This incidentally changes the resonant frequency of the loops, but that in turn is readily compensated by readjustment of the position of the shorting bars.

The construction of the supporting structure shown in Figure 1 is self-evident from the drawing. Other forms of supporting structure or mounting may be employed, and the oscillator may be disposed in other positions than that shown. Although it is convenient for purposes of description to refer to the pipes as being either horizontal or vertical, it should be understood that this terminology is employed primarily with a view to defining the relative rather than the absolute positions of the pipes.

It is believed that the construction and operation, as well as the advantages of my improved oscillator, will be apparent from the foregoing detailed description.

The example here illustrated is a low power oscillator using tubes known commercially as RCA 3012. However, the same principles may be used with larger tubes having similar electrode supports using diametrically-opposed pins. The oscillator is unusually efficient, and has the advantage that oscillators of different frequency may be built with one type of tube. The horizontal conductors for the loops are preferably hollow tubes, and are referred to in the claims as pipes, but this terminology is employed primarily for convenience, it being understood that other straight conductors may be employed, and that the claims are intended to be construed as though the term "pipe" is synonymous with "line."

It will therefore be apparent that while I have shown and described my invention in a preferred form, changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, as sought to be defined in the following claims:

I claim:

1. An oscillator comprising a pair of vacuum tubes each including an envelope housing cathode, grid, and anode electrodes with diametrically-opposed pins supporting the anode, and another pair of diametrically-opposed pins spaced from the first pins and supporting the grid, said tubes being disposed in collateral relation with the pins of both tubes in parallel planes, four pipes extending in parallel relation from the four pins on one side of the tubes, four pipes extending in parallel relation from the pins on the other side of the tubes, said pipes forming a continuation of said pins, shorting bars on the plate pipes to form symmetrical plate-to-plate loops, and shorting bars on the grid pipes to form symmetrical grid-to-grid loops.

2. An oscillator comprising a pair of vacuum tubes each including an envelope housing cathode, grid, and anode electrodes with diametrically-opposed pins supporting the anode, and another pair of diametrically-opposed pins spaced from the first pins and supporting the grid, said tubes being disposed in collateral relation with the pins of both tubes in parallel planes, four pipes extending in parallel relation from the four pins on one side of the tubes, four pipes extending in parallel relation from the pins on the other side of the tubes, said pipes forming a continuation of said pins, and insulation members receiving and supporting the outer ends of the four pipes on each side of the tubes, shorting bars slidably disposed on the plate pipes to form symmetrical plate-to-plate loops, and shorting bars slidably disposed on the grid pipes to form symmetrical grid-to-grid loops.

3. An oscillator comprising a pair of vacuum tubes each including an envelope housing cathode, grid, and anode electrodes with diametrically-opposed pins supporting the anode, and another pair of diametrically-opposed pins spaced from the first pins and supporting the grid, said tubes being disposed in collateral relation with the pins of both tubes in parallel planes, four pipes extending in parallel relation from the four pins on one side of the tubes, four pipes extending in parallel relation from the pins on the other side of the tubes, said pipes forming a continuation of said pins, shorting bars on the plate pipes to form symmetrical plate-to-plate loops, shorting bars on the grid pipes to form symmetrical grid-to-grid loops, another pair of pipes connected to the cathodes of the tubes, a shorting bar thereacross to form a cathode-to-cathode loop, and another pair of pipes connected to the anode pins, said pipes forming an output circuit for the oscillator.

4. An oscillator comprising a pair of vacuum tubes each including an envelope housing cathode, grid, and anode electrodes with diametrically-opposed pins supporting the anode, and another pair of diametrically-opposed pins spaced from the first pins and supporting the grid, said tubes being disposed in collateral relation with the pins of both tubes in parallel planes, four

pipes extending in parallel relation from the four pins on one side of the tubes, four pipes extending in parallel relation from the pins on the other side of the tubes, said pipes forming a continuation of said pins, and insulation members receiving and supporting the outer ends of the four pipes on each side of the tubes, shorting bars slidably disposed on the plate pipes to form symmetrical plate-to-plate loops, shorting bars slidably disposed on the grid pipes to form symmetrical grid-to-grid loops, another pair of pipes connected to the cathodes of the tubes, a shorting bar thereacross to form an adjustable cathode-to-cathode loop, and another pair of pipes connected to the anode pins, said pipes forming an output circuit for the oscillator.

5. An oscillator comprising a pair of vacuum tubes each including an upright envelope housing cathode, grid, and anode electrodes, with diametrically-opposed horizontal pins supporting the anode, and another pair of diametrically-opposed horizontal pins spaced from the first pins and supporting the grid, said tubes being disposed in collateral relation with the pins of both tubes in parallel planes, four straight pipes extending horizontally in parallel relation from the four pins on one side of the tubes, four straight pipes extending horizontally in parallel relation from the pins on the other side of the tubes, said pipes forming a continuation of said pins, insulation members receiving and supporting the outer ends of the four pipes on each side of the tubes, shorting bars slidably disposed in the plate pipes to form symmetrical plate-to-plate loops, shorting bars slidably disposed on the grid pipes to form symmetrical grid-to-grid loops, a pair of vertical pipes connected to the cathodes of the tubes, a shorting bar thereacross to form an adjustable cathode-to-cathode loop, and another pair of vertical pipes connected to the anode pins, said pipes forming an output circuit for the oscillator.

6. An oscillator comprising a pair of vacuum tubes each including an envelope housing cathode, grid, and anode electrodes with diametrically-opposed pins supporting the anode, and another pair of diametrically-opposed pins spaced from the first pins and supporting the grid, said tubes being disposed in collateral relation with the pins of both tubes in parallel planes, said tubes also having a cathode lead-in and two cathode heater lead-ins, four pipes extending in parallel relation from the four pins on one side of the tubes, four pipes extending in parallel relation from the pins on the other side of the tubes, said pipes forming a continuation of said pins, shorting bars on the plate pipes to form symmetrical plate-to-plate loops, shorting bars on the grid pipes to form symmetrical grid-to-grid loops, another pair of pipes connected to the cathode lead-ins, a shorting bar thereacross to form a cathode-to-cathode loop, a pair of cathode heater supply conductors running through each of said cathode pipes, and connected to the cathode heater lead-ins, a grid bias lead connected to one of the grid-to-grid loops, another pair of pipes and shorting bar connecting anode pins and forming an output circuit for the oscillator, and an anode D.-C. potential supply lead connected to said output circuit.

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