June 5, 1951 E. A. KUCHARSKI 2,555,449

CAPACITIVELY COUPLED RADIO-FREQUENCY POWER SUPPLY

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FIG. 1.

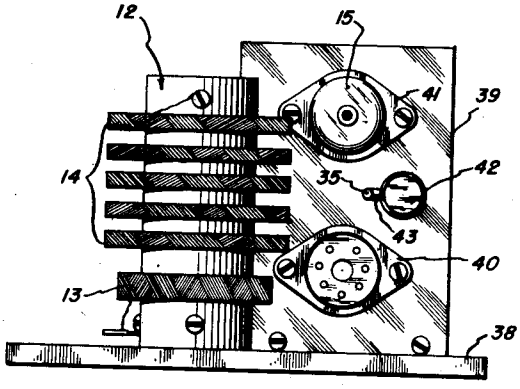


FIG. 2.

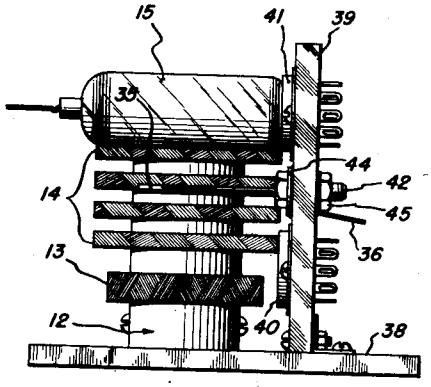
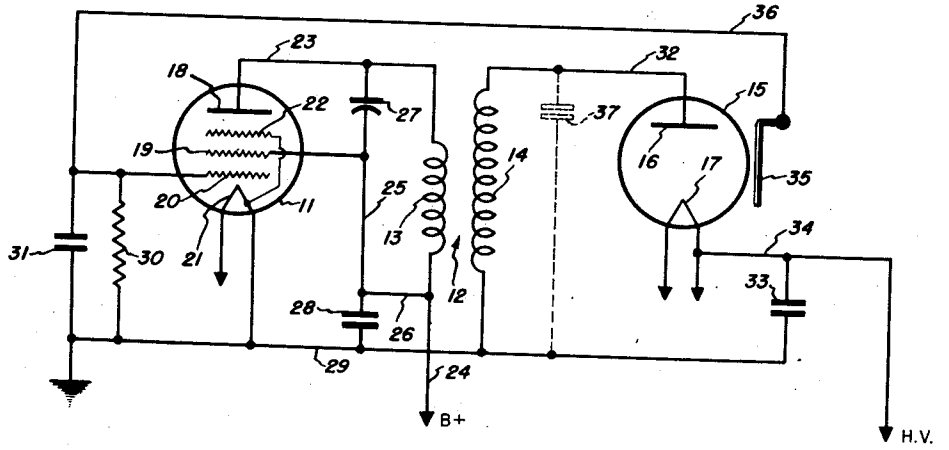


FIG. 3.



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CAPACITIVELY COUPLED RADIO-FREQUENCY POWER SUPPLY

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2 Claims. (Cl. 321—2)

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This invention relates to radio frequency power supplies, and more particularly to high voltage power supplies for use in electronic equipment.

A main object of the invention is to provide a novel and improved high voltage power supply for electronic equipment which is very stable in operation, which requires relatively low input voltages so that gaseous regulator tubes may be used for stability, and which is very compact in size.

A further object of the invention is to provide an improved high voltage radio frequency power supply for use with electronic equipment, said power supply being simple in construction, involving only a few parts, and being very stable in operation even under conditions of high humidity.

A still further object of the invention is to provide an improved high voltage, radio frequency, power supply for use in television receivers, Geiger-counters, and similar apparatus, particularly portable apparatus, said power supply being very efficient, employing capacitive coupling to obtain required feed-back and to tune the secondary circuit thereof (by a grid condenser) for stability. The power supply is also arranged so as not to be affected to any substantial degree by changes in input voltage, and includes means for conveniently varying the degree of capacitive feed-back coupling.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a front elevational view of an RF high voltage power supply unit constructed in accordance with the present invention;

Figure 2 is a side elevational view of the high voltage RF power supply unit of Figure 1;

Figure 3 is a schematic wiring diagram of the high voltage RF power supply unit of Figures 1 and 2.

Referring to the drawings, and more particularly to Figure 3, 11 designates a vacuum tube of the power pentode type employed to generate the radio frequency oscillations. Designated generally at 12 is a radio frequency transformer having a primary winding 13 of relatively few turns and a secondary winding 14 of a relatively large number of turns. Designated at 15 is a high voltage, half-wave rectifier having an anode 16 and a cathode 17. The tube 11 has a plate 18, a screen grid 19, a control grid 20, a cathode 21, and a suppressor grid 22 which is connected to cathode 21. Plate 18 is connected to one terminal of primary 13 by a wire 23. The other terminal of primary 13 is connected to the positive terminal of a suitable source of plate voltage by a wire 24. Screen grid 19 is connected to wire 24 by wires 25 and 26. Connected across primary 13

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at wires 23 and 25 is a variable tuning condenser 27, which may be a conventional trimmer condenser. A by-pass condenser 28 is connected between wire 26, wire 26 being connected to B+ taken from a gaseous regulator tube (not shown), and the grounded wire 29.

One terminal of cathode 21 is connected to said ground wire. A suitable source of filament voltage, not shown, is connected between the other terminal of cathode 21 and ground wire 29. Connected between grid 20 and ground wire 29 is a grid resistor 30, and connected across the resistor 30 is a ceramic condenser 31. This condenser is used because it facilitates starting when the power supply is first turned on. Another novel purpose of this condenser is that it tunes the secondary, thus increasing stability. One terminal of secondary 14 is connected by a wire 32 to the anode 16 of rectifier 15. The other terminal of the secondary 14 is connected to the ground wire 29. The rectifier cathode 17 is connected to a suitable source of filament voltage, not shown. A high voltage filter condenser 33 is connected between one terminal of the cathode 17 and ground wire 29 by a wire 34. Wire 34 is the high voltage output wire.

Designated at 35 is an electrode member positioned adjacent tube 15, and capacitively coupled with the anode 16 thereof. The tube 15 is preferably of the 1B3GT type, or of the 1654 type, commonly employed in high voltage RF power supply circuits, and has a vertical, cylindrical anode of substantial diameter whose outer surface is located only a short distance from the glass envelope of the tube. The electrode 35 is a vertical rod, such as a wire rod, positioned close to said glass envelope. At radio frequencies there is considerable capacitive coupling between electrode 35 and anode 16. Electrode 35 is connected by a wire 36 to the grid 20 of oscillator tube 11, providing feed-back from the output side of transformer 12 to the input circuit of the oscillator tube.

It will be seen from Figure 3 that tube 11 will oscillate (if the polarity of coil 12 being properly arranged) due to feed-back from the load circuit containing the transformer secondary 14 to the input circuit containing grid 20 and grid resistor 30. The frequency of oscillation may be regulated by adjusting variable condenser 27. When rectifier plate 16 is positive, electrode 35 is charged positive, also wire 36 which carries positive charge to grid 20 where it is rectified and a voltage drop takes place (positive voltage providing the drive for the oscillator tube). Grid 20 is negative with respect to ground, the greater the capacitive coupling, the greater being the negative voltage. This negative voltage is used to bias the oscillator tube, so that it is operating at cutoff. This negative voltage adjusts itself under different input

voltages. Thus, the tube has proper bias at all times. Due to the high-turns ratio of transformer 12, a high AC potential is impressed across rectifier plate 16 and ground, and the high rectified voltage appears between wire 34 and ground. This voltage is filtered by the filter condenser 33, so that high voltage DC is available between the output wire 34 and ground.

As above mentioned, the primary circuit of transformer 12 is tuned by the condenser 27. The secondary circuit of the transformer is tuned by the distributed capacitance existing across secondary 14, indicated in dotted view at 37, by the interelectrode capacitance of tube 15 and the coupling capacitance between electrode 35 and plate 16, and also by ceramic condenser 31. Since oscillator tube 11 is located physically near primary 13 and is at the same potential, and since the half-wave rectifier tube 15 is adjacent secondary 14, it has been found that higher current can be obtained than would be obtainable from an auto-transformer, and that the over-all stability of the unit is improved.

A power pentode is preferably employed as the oscillator tube, since such a tube will give good output under low ohm load resistance conditions. Also, relatively high-plate current is obtained with low-plate voltage, making the tube well suited for low voltage operation, as in portable equipment.

Since the RF power supply operates at low voltages, one can make use of gaseous regulator tubes for input voltage regulation. Of course, minor changes may be made without deviating from the above principles.

Referring now to Figures 1 and 2, 38 designates a horizontal supporting plate of insulating material, such as plastic or the like. Secured to plate 38 is a vertical insulating plate 39. Mounted on plate 39 is a socket 40 adapted to receive the oscillator tube 11, and mounted on said plate above socket 40 is a socket 41 adapted to receive the high voltage rectifier tube 15. Designated at 42 is a bolt extending through plate 39 between the sockets 40 and 41. The electrode 35 has a right-angled extension 43 formed with an eye 44 received under the head of bolt 42, whereby the electrode 35 is secured parallel to tube 15 and spaced between sockets 41 and 40. The position of electrode 35 may be varied by loosening the clamping nut 45 of bolt 42, permitting the extension 43 to be rotated. The nut 45 may then be tightened to secure the electrode 35 in a position providing a desired amount of capacitive coupling between the electrode 35 and the anode of tube 15.

The transformer 12 is mounted vertically on plate 38 with the primary winding 13 thereof located adjacent socket 40.

It will be seen from Figures 1 and 2 that the unit is very compact in size and that the physical spacing between the components is very small, thereby minimizing losses.

By employing capicitive feed-back, higher efficiency is obtained than is obtainable by the use of conventional tickler winding feed-back, since the conventional tickler winding consumes power. Also, by employing the arrangement described above, fewer and shorter leads are required and stability is improved, particularly under humid conditions. The electrode 35 is mounted so as to act as a shield between the rectifier tube and the oscillator tube, enabling the rectifier tube to be

mounted close to the oscillator tube without losing power, and permitting more compact design.

It is to be further noted that the electrode 35 is mounted in such a manner that only a very small part thereof touches the support 39, thereby minimizing leakage loss from the electrode.

Voltage step-up takes place in the secondary 14 of the transformer 12 due to resonance and to the high-turns ratio of the secondary to the primary 13. By grounding one terminal of the secondary 14, it has been found that higher current can be obtained than would be obtainable from an auto-transformer, and that the over-all stability of the unit is improved.

While a specific embodiment of a high voltage radio frequency power supply device has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In a high voltage direct current power supply system, the combination with an oscillator including an input grid, a rectifier including a cylindrical anode, and an RF transformer of a tuned nature consisting of a primary and secondary, of a rod-like electrode positioned adjacent to said rectifier tube and movable toward and away from the cylindrical anode thereof, and an input circuit consisting of a ceramic condenser and resistor connected between said input grid and ground and to said electrode, the secondary of said transformer being tuned by the distributed capacitance existing across said secondary, the interelectrode capacitance of said rectifier, the coupling capacitance between said electrode and said cylindrical anode, and said ceramic condenser.

2. In a high voltage direct current power supply system, the combination with an oscillator including an input grid, a rectifier including a cylindrical anode, and an RF transformer of a tuned nature consisting of a primary and secondary, of a rod-like electrode positioned adjacent to said rectifier tube and movable toward and away from the cylindrical anode thereof, an input circuit consisting of a ceramic condenser and resistor connected between said input grid and ground and to said electrode, the secondary of said transformer being tuned by the distributed capacitance existing across said secondary, the interelectrode capacitance of said rectifier, the coupling capacitance between said electrode and said cylindrical anode, and said ceramic condenser, and means operatively connected to said electrode for detachably securing the latter in select positions of its movement with respect to said cylindrical anode for selectively varying the coupling capacitance between said electrode and said anode.

EDWIN A. KUCHARSKI.

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The following references are of record in the file of this patent:

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