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RADIO FREQUENCY APPARATUS

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Fig. 1.

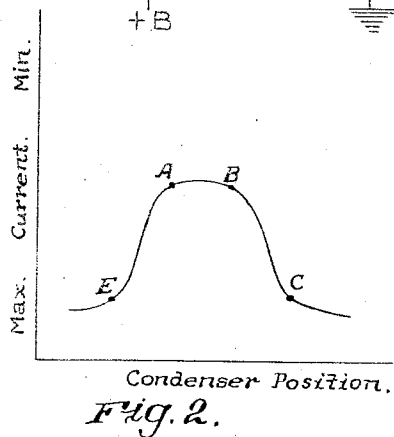
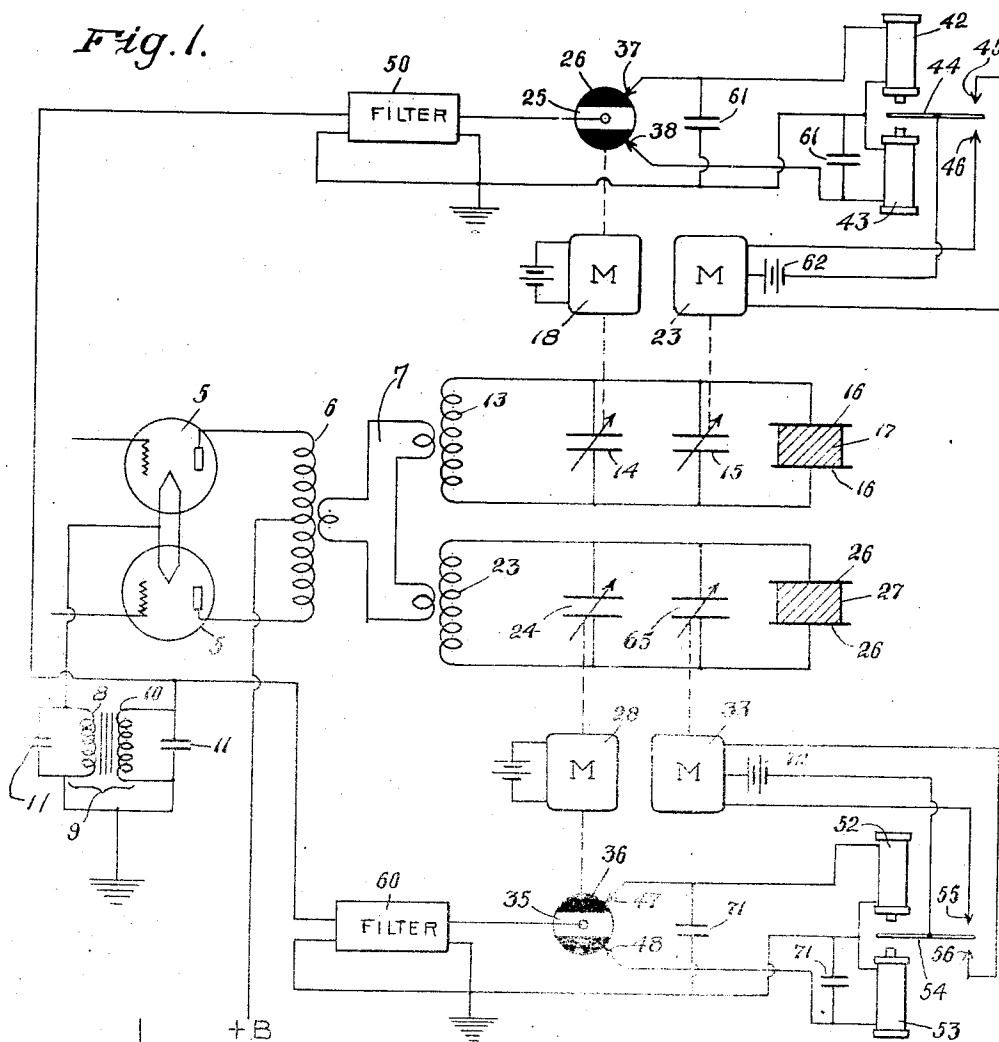


Fig. 2.

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RADIO-FREQUENCY APPARATUS

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2 Claims. (Cl. 250—36)

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This invention relates to radio frequency apparatus, and relates more particularly to automatically operated tuning controls for such apparatus.

In radio frequency apparatus such, for example, as a thermionic oscillator providing a high frequency, electrostatic field between electrodes for heating articles through dielectric hysteresis, changes in the dielectric loss, changes in the electric capacity, and other changes cause the load circuit to be thrown off resonance.

This invention provides for the operation of a plurality of load stations supplied with radio frequency energy from a common source, each station having automatically operated means for maintaining its load circuit tuned to resonance.

An object of the invention is automatically to maintain a plurality of load circuits coupled to a common source of radio frequency energy, tuned to resonance.

The invention will now be described with reference to the drawing, of which:

Fig. 1 is a circuit schematic illustrating this invention embodied in electrostatic heating apparatus, and

Fig. 2 is a chart illustrating a resonance curve resulting from the operation of the tuning controls of Fig. 1.

Referring now to Fig. 1, the push-pull connected, radio frequency amplifier tubes 5 adapted to have their inputs connected to the output of a conventional oscillator, are coupled through the plate coil 6 and the link coupling 7 to the load circuit coils 13 and 23. The coil 13 is tuned by the shunt condensers 14 and 15, and has the electrodes 16 with an article 17 to be heated, therebetween. The coil 23 is tuned by the shunt condensers 24 and 25, and has the electrodes 26 with an article 27 to be heated, therebetween.

The rotor of the condensers 14 and 24 are rotated continuously by the motors 18 and 28 respectively, as in conventional frequency wobblers circuits. The reversible motors 23 and 33 rotate the rotors of the condensers 15 and 25 respectively, for retuning the load circuits to resonance as same are detuned therefrom by load changes.

The center of the plate coil 6 is connected to +B as is usual in push-pull amplifier circuits. The primary winding 8 of the transformer 9 is connected to the cathodes of the tubes 5 and to ground whereby the space current drawn by the tubes passes therethrough. The secondary winding 10 of the transformer supplies voltages resulting from voltage variations across the primary winding 8, to reversing circuits for the motors 23 and 33 as will be described. The by-

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pass condensers 11 are for by-passing radio frequency currents.

The continuously rotated motor 18 rotates the rotor of the condenser 14, and also rotates the commutator 25 having the rectifier segment 25, which contacts in sequence, the contacts 37 and 38. The secondary 10 of the transformer 9 is connected through the filter 50 to the segment 25. The contact 37 is connected to one end of the energizing winding of the relay 42, and the contact 38 is connected to one end of the energizing winding of the relay 43. The other ends of the relay windings are connected together and to ground as is the filter 50 and the transformer secondary. The storage condensers 61 are connected to the contacts 37 and 38 and to ground.

The armature 44 of the relays 42 and 43 has the contacts 45 and 46 on the opposite sides thereof, and is connected to one side of the battery 62, the other side of which is connected to the reversible motor 23. The field winding of the motor is so connected to its armature and to the contacts 45 and 46 that when the relay armature 44 strikes the contact 45, the battery 62 is connected to rotate the motor in one direction, and when the armature 44 strikes the contact 46, the battery is reversely applied to the motor field causing reverse rotation.

The motor 18 as it rotates the commutator 25, alternately applies through the contacts 37 and 38, the rectified current from the secondary winding 10 of the transformer 9, to the relays 42 and 43. The storage condensers 61 maintain the relays energized when not energized from the commutator. The current rectified by the commutator is the alternating current component of the space current of the tubes 5. The commutator rectifies this current since rotated at the same speed as the rotor of the condenser 14 which causes its production. The rectified current supplied to one relay will be stronger than that supplied to the other relay if the load circuit is not tuned to resonance. The reason for this may be understood with reference to Fig. 2 which is a resonance curve with the capacities of the condenser 14 during one complete rotation of its rotor as ordinates, and the values of the rectified currents as abscissae.

When the load circuit is tuned to its resonance frequency, the variations in the capacity of the condenser 14 will result in the rectified currents having values between the points A and B on the curve of Fig. 2. This will result in both relays 42 and 43 receiving the same current during the rotation of the commutator 25, and their arma-

ture 44 will remain in its neutral position. If the load circuit is above resonance, the rectified current will vary between the points B and C on the curve. This will result in the relay 42 becoming more strongly energized causing the relay armature to strike the contact 46 and thereby causing the motor 23 to rotate in one direction to adjust the condenser 15 to retune the load circuit to resonance.

When the load circuit is tuned below resonance, the rectified current from the commutator 25 will vary between the points A and E on the resonance curve. This will result in the relay 43 becoming more strongly energized, and the armature 44 to strike the contact 45 causing the motor 23 to rotate in the opposite direction to adjust the condenser 15 to retune the load circuit to resonance.

The filter 50 will pass the frequency of the alternating current component caused by the rotation of the wobbler condenser 14, which frequency, by way of example, may be 100 cycles per second, but will not pass the frequency of the alternating current component caused by the rotation of the wobbler condenser 24, which frequency may be 250 cycles per second.

The continuously rotated motor 28 rotates the rotor of the condenser 24 in the other load circuit, and also rotates the commutator 35 having the rectifier segment 35, which contacts in sequence, the contacts 47 and 48. The secondary 10 of the transformer 9 is connected through the filter 60 to the commutator 35. The contact 47 is connected to one end of the energizing winding of the relay 52, and the contact 48 is connected to one end of the energizing winding of the relay 53. The other ends of the relay windings are connected together and to ground as is the filter 60 and the transformer secondary. The storage condensers 71 are connected to the contacts 47 and 48 and to ground.

The armature 54 of the relays 52 and 53 has the contacts 55 and 56 on the opposite sides thereof, and is connected to one side of the battery 72, the other side of which is connected to the reversible motor 33. The field winding of the motor 33 is so connected to its armature and to the contacts 55 and 56 that when the relay armature 54 strikes the contact 55, the battery 72 is connected to rotate the motor in one direction, and when the armature 54 strikes the contact 56, the battery is reversely applied to the motor field causing reverse rotation.

The motor 28 as it rotates the commutator 35, alternately applies through the contacts 47 and 48, the rectified current from the secondary winding 10 of the transformer 9, to the relays 52 and 53. The storage condensers 71 maintain the relays energized when not energized from the commuta-

tor. The rectified current to the relay 52 will be stronger when the load circuit is above resonance, causing the armature 54 to strike the contact 56 and causing the motor 33 to rotate in one direction to adjust the condenser 25 to retune the load circuit to resonance. The rectified current to the relay 53 will be stronger when the load circuit is below resonance, causing the armature 54 to strike the contact 55 and causing the motor 33 to rotate in the opposite direction to adjust the condenser 25 to retune the load circuit to resonance.

The filter 60 passes the 250 cycle alternating component caused by the rotation of the wobbler condenser 24, but will not pass the 100 cycle current caused by the rotation of the other wobbler condenser, whereby the filters 50 and 60 effectively isolate the controls of the two load circuits. Other filters and other load circuits could, of course, be added where the radio frequency source has sufficient capacity to handle the loads involved.

The invention is not, of course, limited to the exact circuits and circuit components illustrated.

What is claimed is:

1. Radio frequency apparatus comprising a thermionic tube, a plurality of load circuits coupled to said tube for receiving radio frequency energy therefrom, continuously operated means for each circuit for alternately increasing and decreasing the frequency to which the circuit is tuned, the continuously operated means for each circuit operating at a different frequency, tuning means for tuning each load circuit to resonance independently of said continuously operated means, a reversible motor for adjusting each tuning means, a transformer having a primary connected in the space current circuit of said tube, and means including means utilizing current from the secondary of said transformer and including frequency selective means for causing each motor to operate in one direction when its associated load circuit is tuned above resonance and to operate in the other direction when its associated load circuit is tuned below resonance.

2. Radio frequency apparatus according to claim 1 in which the current utilizing means includes synchronous rectifiers driven with the continuously operated means.

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