

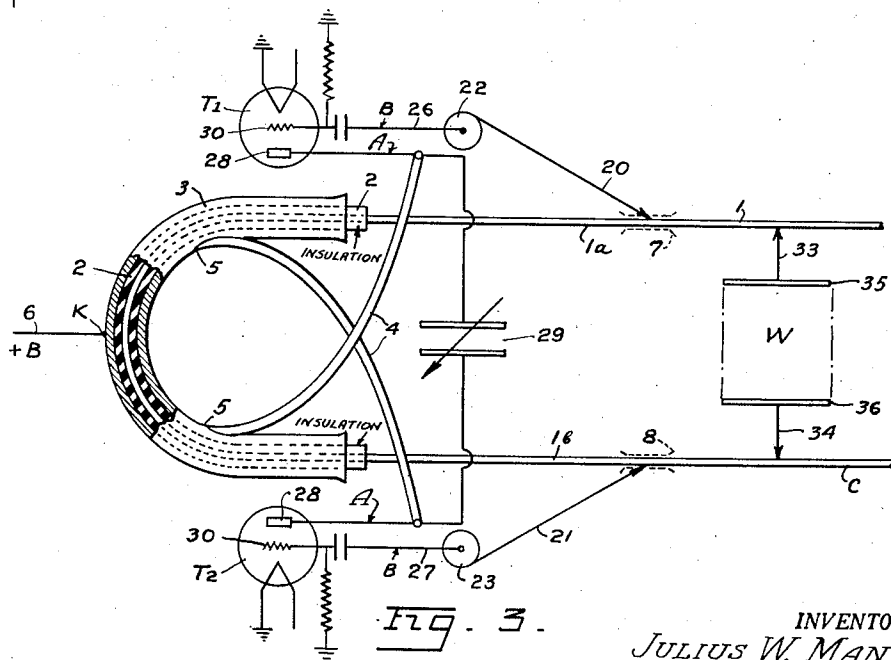
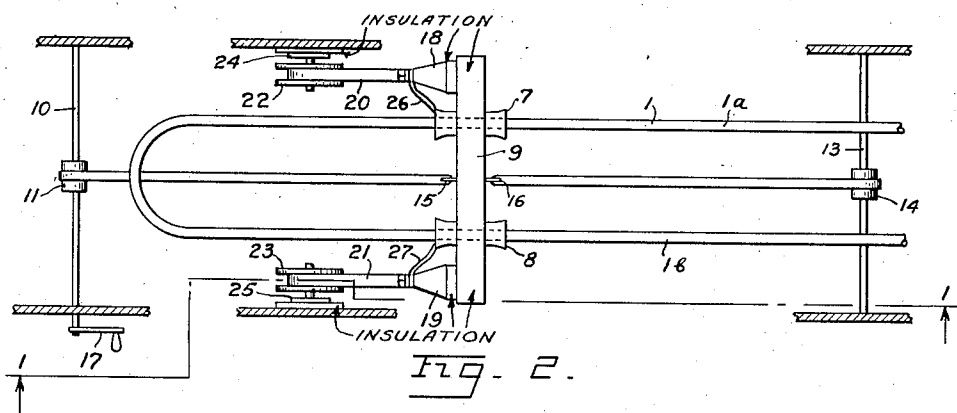
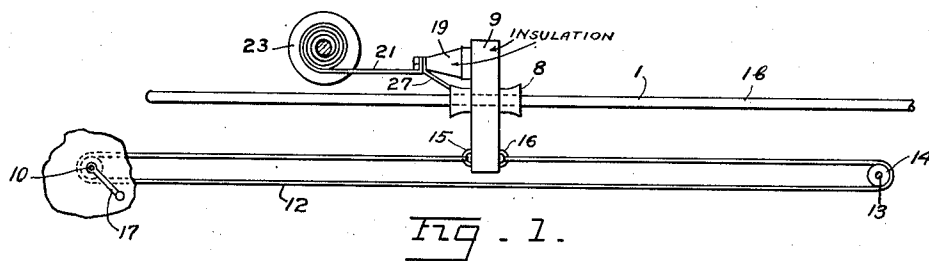
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J. W. MANN ET AL

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VARIABLE GRID CIRCUIT

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INVENTORS
JULIUS W. MANN
BY GEORGE F. RUSSELL
Munn, Liddy & Blacum
ATTORNEYS

UNITED STATES PATENT OFFICE

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VARIABLE GRID CIRCUIT

Julius W. Mann and George F. Russell,
Tacoma, Wash.

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6 Claims. (Cl. 250—36)

The present invention relates to a means for changing the length of the grid inductance for controlling grid excitation and it consists of constructions and arrangements hereinafter described and claimed.

The purposes of our invention are to facilitate changes in the grid circuit of a radio frequency oscillator; to vary the grid excitation while the oscillator is in operation and simultaneously therewith, making changes in the total length of the grid inductance.

A further purpose of our invention is to utilize fully the inherently stable characteristics of the radio circuit shown in our copending application, Serial No. 407,530, filed August 20, 1941, by tapping at an infinitely variable number of places the take-off leads to the grids along the inductance which forms at least for a portion of its distance next adjacent to its current antinodal position both grid and output circuits.

Another object of our invention is to make possible the use of a variable adjustment on the grid inductance without employing a variable condenser in the grid circuit.

A further object of our invention is to adjust grid excitation by varying primarily the grid inductance in such manner as to minimize the addition of capacity to the grid circuit.

Other objects and advantages will appear in the following specification, and the novel features of the device will be particularly pointed out in the appended claims.

Our invention is illustrated in the accompanying drawing forming a part of this application, in which:

Figure 1 is a schematic view of the device taken along the section line 1—1 of Figure 2;

Figure 2 is a schematic plan view of the device; and

Figure 3 is a wiring diagram showing the invention incorporated in a radio circuit.

While we have shown only the preferred form of our invention, it should be understood that various changes or modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

In connection with our copending application, Serial No. 451,064, filed July 15, 1942, covering a composite radio frequency inductance and used in conjunction with the radio circuit set forth in our copending application, Serial No. 407,530, that portion of said mutual inductance which is the common portion of both the grid and the output circuits for a portion of their respective lengths next adjacent to their respective current

antinodal positions, is a portion of the grid circuit of the radio frequency oscillator of which this circuit is a part.

In the copending radio circuit application above mentioned, the plate tank circuit carries a variable condenser for ready adjustment of its basic frequency. Over a given range and under a given range on the plate tank condenser certain minor adjustments upward or downward should desirably be made in the amount of grid excitation obtained for a proper balance between the grid excitation desired at one frequency and that desired at a frequency considerably different from the first. In a vacuum tube oscillator where sufficient power is to be utilized for practical commercial operations, it has been found in most instances that the capacity between grid and cathode in the vacuum tube is greater than is the corresponding capacity between the plate and the cathode of the same tube. This is true with a triode vacuum tube and may not necessarily be true with other types. High frequency being usually desired, however, and the intertube capacitive relationships being as they are, it is apparently desirable to have as little added capacity as possible in the external components of the grid circuit in order not to overbalance the capacitive relationship of the internal tube capacities between the respective capacities of grid to cathode and plate to cathode.

In the circuits above described, the variable capacity has been placed in the plate tank circuit with a unique arrangement in our present case of varying the grid excitation without the use of a variable condenser in the grid circuit in order to minimize the addition of capacitance in the grid circuit.

Between grids 30 in tubes T₁ and T₂ may be placed a variable condenser, however, but such a condenser would place emphasis on and vary the capacity of the grid circuits, thus enabling the grid circuits to be tuned. Such a condenser, likewise, may be placed, and would be effective for controlling resonance at points other than directly connecting the grids 30, such as between leads 26 and 27, 20 and 21 or even members 1a and 1b. A capacitance introduced into the circuit would create a point of bunched capacity and while it would accomplish the purpose of peaking excitation by changes in the capacity rather than by varying the length of the inductance, it will at the same time introduce into the circuit the added and dangerous hazard of being a breeding place for parasitics. Our experience has shown that while parasitics may not always

be introduced, when they are, they not only lead to unstable characteristics but they may and often do result in destruction of certain component parts of the circuit resulting from a displaced heating effect and they will always cause an absorption of useful energy otherwise properly employed in the load.

The grid circuit in the composite inductance shown in Figure 1 of our copending application, Serial No. 451,064, is common with the output circuit for a portion of their respective lengths next adjacent to their common coupling current antinodal position. The desirability of this common inductance between grid and output circuits is described and shown in our two copending applications above mentioned. As mentioned above also, it is desirable under conditions of frequency changes caused by a swing in the variable capacity of the plate tank circuit, or a change in the frequency of the load to have variability in the grid output circuit in order to adjust to a nicety during operation and without the use of a variable capacity, the length of the grid circuit, in such manner as to increase or decrease the excitation on the grids by lengthening or shortening the physical length of the grid circuit.

If the dimensions of a grid circuit are changed by increasing or decreasing the inductance and/or capacity from peak excitation, the amplitude of the standing waves in the circuit decrease from maximum. This decrease in amplitude implies a reduction of current and consequently voltage in the circuit which reduces thereby the resulting grid excitation. The variable grid design, as set forth and claimed in this application, brings about changes in the dimensions of the grid oscillatory circuit so easily and in such ready proportions as to allow grid excitation to be maintained at its proper level.

In listing the additional novelties which this invention incorporates, we might say that an infinite number of variable positions for tapping the grid inductance during oscillation is one of the features. Another novelty is that this means allows adjustment to an infinite number of positions so that grid excitation may be varied during operation by physically lengthening or shortening the grid inductance rather than by varying a capacitance in the grid circuit.

Novel means is used to provide a wider range of lengths which may be added to or taken away from the length of the grid inductance by doubling or halving the lengths over the actual manual movement required. This is accomplished through the extension of or retraction on a reel arrangement without substantially effecting grid capacitive relationships. This means, further, utilizes a commonplace mechanical expedient of a slide contact to accomplish accurate changes in excitation of the grids. This means allows the inductive rather than the capacitive factor to vary over wide ranges and hence pretty much leaves alone intertube capacities and inter-circuit capacities otherwise relatively fixed during oscillations.

The subject matter of this application has to do with and concerns solely the manner in which this variability in grid excitation and grid circuit length may be obtained. The advantages of being able properly to adjust grid excitation at will, during the operation of the radio frequency oscillator, is perfectly apparent because it is found to be an undesirable loss of time and effort to be constantly adjusting a radio frequency oscillator during operation through the customary practice

of "wiggling in" where the more ordinary type of radio frequency oscillator is employed.

The grid adjustment is illustrated schematically in Figures 1 and 2, and is incorporated in a radio circuit in Figure 3, this radio circuit being disclosed in our copending application Serial No. 407,530. The grid output circuit coil comprises a tube 1 that has only one half a loop formed therein. The tube can have one or more loops formed therein according to the frequency of the radio circuit used and the tube may be solid if desired. The portion of the tube 1 that is formed into one half a loop is covered by an insulating sleeve 2, see Figure 3. Around this sleeve we mount a tubular member 3 that has a half turn formed therein. The plate coil 4 has a number of loops, although for clarity only one loop is indicated in Figure 3. The coil has its mid-portion physically connected to the tube 3 at 5. The physical connection is such that a center point K of the coil 4 will be at the center of the tube 3 which in turn will be at the center of the half loop of the coil 1. The mid-point K of the coil 1 will be enclosed by the sleeve 2 which in turn is enclosed by the tube 3. In this way the centers of the two coils are placed in concentric relation with the sleeve 2 insulating the two centers from each other. The wire 6 leading from the center of the tube 3 connects with the B+ source of current.

Before completing description of Figure 3, it is best to describe the grid adjustment shown in Figures 1 and 2. The tube 1 illustrated in these two figures is the grid output circuit coil and this tube has a one-half loop formed therein and has parallel sides. Metallic sleeves 7 and 8 are slidably mounted on the parallel tube portions and are connected by a bridging insulating member 9. The sleeves make electrical connection with the tube arms 1a and 1b and they are moved along the arms by the insulating bridging member 9. Means is used for moving the bridge 9 and sleeves 7 and 8. A shaft 10 has a spool 11 around which one or more turns of a cord 12 is wound. A second shaft 13 has a spool 14 for receiving one or more turns of the cord 12 and the ends of the cord are connected to the movable bridge 9 at 15 and 16. The endless loop 12 thus provided is actuated when the shaft 10 is rotated by a crank or dial 17, and this will move the bridge 9 and sleeves 7 and 8 along the arms 1a and 1b in the desired direction.

The bridge 9 carries insulators 18 and 19 which have the free ends of conductor tapes 20 and 21 secured thereto. The tapes 20 and 21 are wound on reels 22 and 23 which in turn are rotatably mounted in insulating bases 24 and 25. Electrical conductors 26 and 27 electrically connect the tapes 20 and 21 to the sleeves 7 and 8 respectively. It will be noted that as the sleeves 7 and 8 are moved away from the looped end of the tube 1, the tapes 20 and 21 are extended from the reels 23 and 24. This in effect doubles the amount of conductor added into the grid circuit or halves the amount of conductor removed from the grid circuit, this depending upon in which direction the bridge 9 is moved. The portions of the tapes 20 and 21 wound upon the reels 22 and 23 are electrically grounded to the reels because the convolutions of the metallic tape portions on the reels contact each other. The moving of the sleeves 7 and 8 along the arms 1a and 1b provide an infinite number of tapes to the coil 1. The use of the tapes 20 and 21 speed up the change because twice as much grid coil is

added into the coil 1 or subtracted from the coil as is shown by the movement of the bridge 9.

It is best now to return to a description of Figure 3 in which our grid adjusting device is used. The circuit is the same as that shown in our copending applications Serial Nos. 407,530 and 451,064. The plate circuit is indicated generally at A and comprises plates 28 in radio tubes T1 and T2, the inductance coil 4, and a variable condenser 29 which is shunted across the inductance coil, leads of which to plates 28 are crossed. The grid circuit is indicated generally at B and comprises grids 30 and leads 26, 27, 20, 21 and coil 1 from shoes 7 to 8 through point K. An output, pick-up or work circuit, indicated generally at C, has the inductance coil 1 which is concentric with coil 4. The circuit C also has adjustable leads 33 and 34 that are connected to plates 35 and 36 between which the work W is placed. The leads 33 and 34 are adjustably connected to the coil 1. It will be noted that the leads 26 and 27 of the grid circuit B are connected through the reels 22 and 23 to the arms 1a and 1b of the coil 1 by the slidable sleeves 7 and 8. The metallic tapes 20 and 21 form a part of the grid circuit and the reels 22 and 23 are indicated diagrammatically in Figure 3. The coil 1 with its arms 1a and 1b forms a part of both the grid and output circuits. In other words, the grid and output circuits are physically the same for a portion of their lengths.

We claim:

1. The combination with a radio circuit having plate, grid and work circuits, the grid and work circuits having an inductance which is common to both, the plate and combined grid and work inductances being inductively connected at their coupling current antinodal position, and means for varying the grid excitation by lengthening or shortening the grid inductance next adjacent to the coupling current antinodal position.

2. The combination with a radio circuit having plate, grid and work circuits, the grid and work circuits having an inductance which is common to both, the plate and combined grid and work inductances being inductively connected at their coupling current antinodal position, and means for varying the distributed capacity of the grid circuit by lengthening or shortening the grid circuit next adjacent to the coupling current antinodal position.

3. In a radio circuit, the plate, grid and work circuits being coupled together so that the current antinodal positions of the three circuits is at one point, and means for varying from peak or to peak the grid excitation by lengthening or short-

ening the grid circuit next adjacent to its inductance current antinodal position.

4. In a radio frequency oscillator, a grid circuit having an inductance with parallel arms, a slide contact movable along each arm of the inductance for changing the effective length of the inductance, means for simultaneously moving the contacts to an infinite number of positions along the arms of the inductance, an output circuit connected to a portion of the grid circuit inductance so that the inductance is common to both circuits, the sliding contacts varying along the length of the inductance next adjacent to the physical center point of the inductance which is common to both circuits for the purpose of changing the length of the grid circuit.

5. In combination, an inductance having a coiled end and parallel arms, a pair of contacts movable along the arms for varying the effective length of the inductance, common means for simultaneously moving the contacts along the arms, a reel associated with each contact and having conducting tapes electrically connected to the contacts for increasing the length of the inductance, said tape being unwound from the reels when the contacts are moved along the arms and away from the coiled end, whereby the effective length of the added inductance when the tapes are unwound by the movement of the contacts away from the coiled end will be approximately double the distance the contacts move and the effective length of the subtracted inductance when the tapes are wound on the reels by the movement of the contacts toward the coiled end will be approximately double the distance the contacts move.

6. In combination, a grid circuit including an inductance having a pair of arms extending therefrom, a pair of contacts movable along the arms for varying the effective length of the inductance, grid leads electrically connected to said contacts for varying the length of the inductance, whereby a movement of the contacts along the arms and away from the first-mentioned inductance will increase the effective length of the inductance and will likewise increase the effective length of the grid leads which will also add to the effective length of the inductance, the length of effective inductance added being approximately twice the distance the contacts move, and a movement of the contacts in the opposite direction will reduce the effective length of the inductance twice as much as the actual distance moved by the contacts.

JULIUS W. MANN.
GEO. F. RUSSELL.