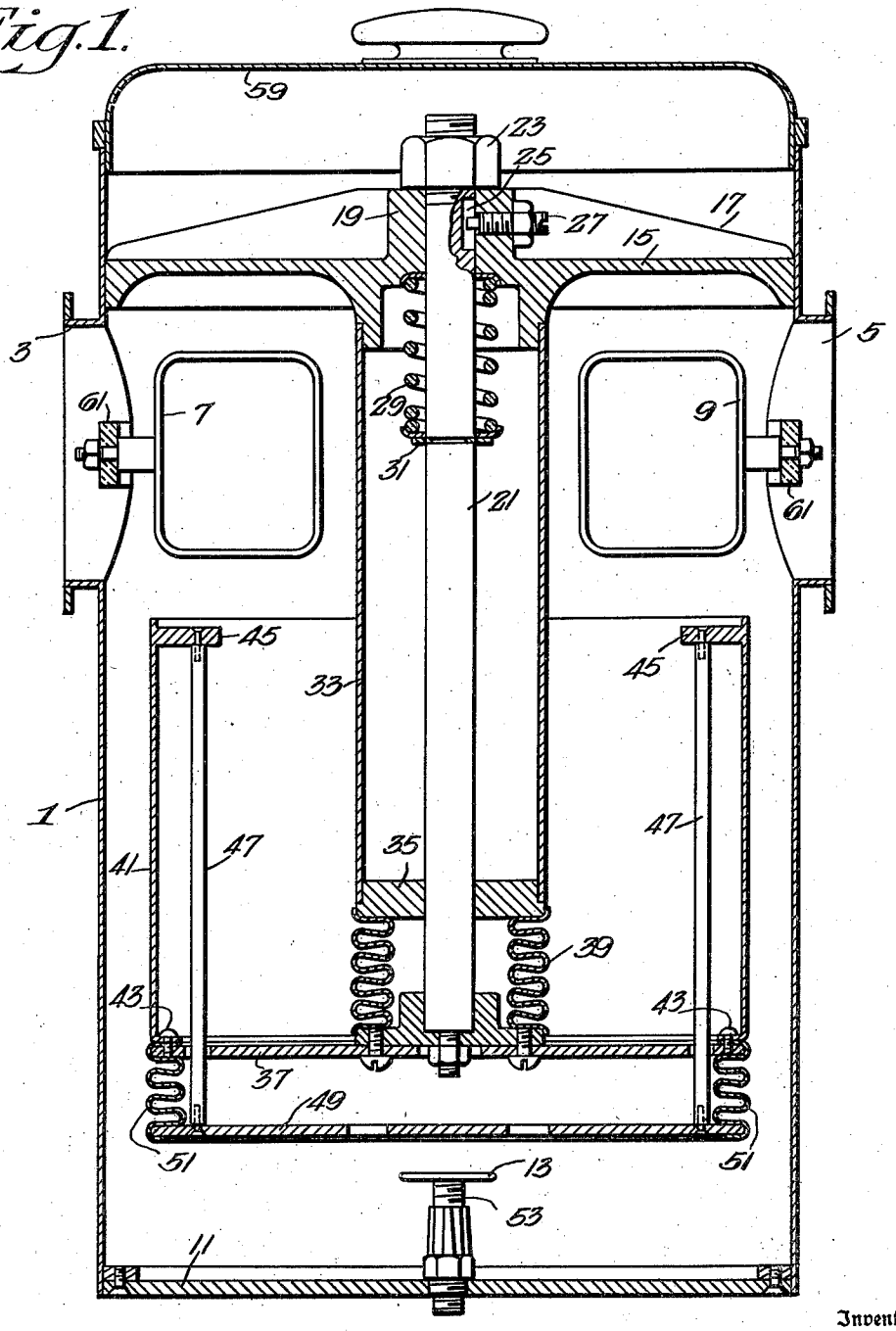
Jan. 3, 1939. J. W. CONKLIN 2,142,630

ULTRA HIGH FREQUENCY TANK CIRCUIT

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Fig. 1.



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Fig. 2.

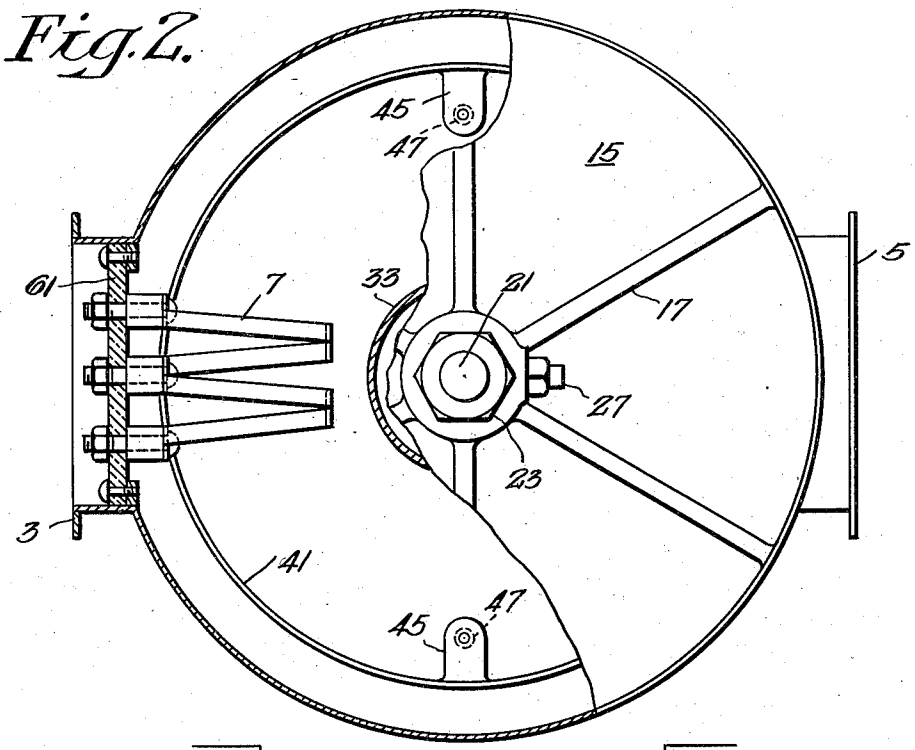
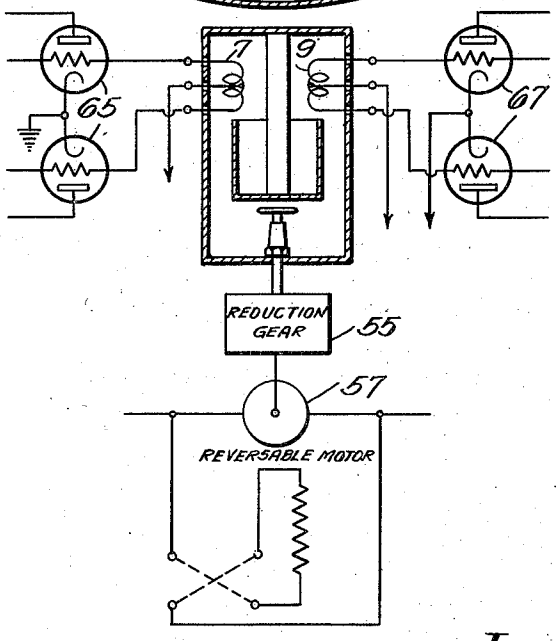


Fig. 3.



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ULTRA HIGH FREQUENCY TANK CIRCUIT

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Application July 28, 1937, Serial No. 156,114

4 Claims. (Cl. 178—44)

My invention relates to ultra high frequency tank circuits in which means are provided for compensation of the expansion caused by the heating of elements of the circuit as the result of the currents flowing therein.

It has been proposed to stabilize the frequency of ultra high frequency oscillatory currents by means of a quarter wave concentric line. While such resonant lines tend to stabilize high frequency currents flowing therein, it has been found that the heating effects of such currents expand the elements of the lines and thereby render the devices less stable. I am aware that several methods of temperature compensation have been proposed but my experience has been that the ordinary temperature compensation which is suitable for fairly high frequency currents is not sufficient for ultra high frequency oscillations. By ultra high frequency oscillations is meant oscillatory currents of thirty megacycles and upwards.

It has also been customary to design such concentric resonant line stabilizers for a particular frequency without providing means for adjusting the devices throughout a large range of frequencies. My present invention contemplates, as an object, providing means whereby an ultra high frequency tank circuit may be arranged within a small space and may be adjusted over a large range of frequencies.

Another object of my invention is to provide an improved means for temperature compensation in an ultra high frequency resonant circuit.

Another object of my invention is to provide means for vernier frequency adjustments from a point remote from the tank circuit.

An additional object is to provide a simple method of coupling, which may be adjusted for different frequencies.

My invention may be best understood by reference to the accompanying drawings in which

Figure 1 is a sectional view of one embodiment of my invention,

Figure 2 is a plan view of the embodiment shown in Fig. 1, and

Figure 3 is a schematic diagram representing the circuit employed with my invention and means for making vernier adjustments.

Referring to Fig. 1, within an outer hollow cylindrical conductor member 1 a pair of ports 3 and 5 are arranged to permit the insertion of coupling coils 7, 9. At the lower end of the hollow cylindrical member is secured a metallic base member 11, on which is suitably mounted a vernier adjusting member 13. A metallic spider 15 is mounted near the top of the hollow cylindrical member 1. The spider may be reinforced by flanges 17. The spider includes at its center a hub 19, which is drilled to take the supporting shaft 21. This shaft is preferably made of a material which has very low coefficient of expansion, such as invar steel.

The top portion of the shaft is threaded, and mounted thereon is an adjustment nut 23. The shaft is prevented from turning during adjustment by a keyway 25 and a set screw 27. A tensioning spring 29 is positioned between the spider 15 and a retaining collar 31, as shown. A conducting sleeve 33, surrounding the shaft 21 and spring 29, is secured by any suitable means to the spider 15. A collar 35 locates the lower end of the sleeve 33 with respect to the shaft 21.

On the lower end of the shaft 21 is suitably secured a metal disc 37. The space between the disc 37 and the metal sleeve 33 includes an expansion member 39, which is fastened to the sleeve 33 and collar 35 at one end and to the disc 37 at the other end. An inner metallic cylindrical member 41 is secured to the disc 37 by screws 43 or other convenient fastening means. The external diameter of the inner cylindrical member 41 is somewhat less than the internal diameter of the conductor member 1. A number of lugs 45 are fastened to the upper portion of the metallic cylinder 41; metallic rods 47 are secured to the lugs 45. These rods project downwardly through the disc 37. The rods 47 are preferably made of a metal having a very low coefficient of expansion. A second metallic disc 49 is fastened to the lower ends of the rods 47 so that the disc 49 is spaced from the disc 37. The space between the discs 37, 49 includes a metallic expansion member 51, which is fastened to the two discs as shown.

The vernier 13 is comprised of an armature which is mounted on a threaded adjusting screw 53. The adjusting screw may be coupled through a reducing gear 55 to a reversible motor 57, as shown in Fig. 3. It should be understood that the reversing motor is not essential to the invention inasmuch as the vernier 13 may be adjusted manually. A cover 59 may be mounted on the top of the cylinder member 1 to house the spider 15 and the adjusting mechanism.

In order to cover a range of wave lengths with one device, it should be understood that several different lengths of inner cylindrical members may be used. Each of said inner cylindrical members may be raised or lowered with respect to the base 11 to provide a course adjustment of

frequency, while the fine adjustment is obtained by the vernier 13.

In the operation of these devices, the radio frequency currents passing through the tank circuit will generate heat, which causes the cylindrical members 1, 33 and 41 to expand. While the two latter cylindrical members 33 and 41 expand, the effective length remains substantially constant because of the low coefficient of expansion of the invar steel members 21 and 47. Any expansion of the members 33 and 41 does not change the effective length of these members, because such expansion is taken up by the expansion members 39 and 51, respectively. The heating of the members 1, 33 and 41 will cause an increase in their respective diameters. If the several members 1, 33 and 41 are all made of the same material, the change in their diameters or radii will not change the ratio of the radii and, therefore, will not change the capacity between the several members. This statement may be made in view of the mathematical formula

$$C=\frac{0.2416\ Lk}{\log_{10}\frac{r_1}{r_2}}$$

which is an expression of the capacity between inner and outer coaxial cylinders, where r_1 equals the radius of the outer cylinder, r_2 equals the radius of the inner cylinder, L equals the length of each cylinder, C equals the capacity in micromicrofarads, and k equals the dielectric constant.

It wil be observed that the outer conductor member 1 is not provided with means for compensating for its expansion, while the inner cylindrical members are provided with temperature compensation means. It follows that as the member 1 expands, the distance between the vernier plate 13 and the disc 49 will increase. While this change in dimension could be prevented by tying the top and bottom of the member 1 with a plurality of invar steel rods, I prefer to make use of this expansion characteristic. The effect of a change in length of the cylindrical member 1, and hence of the capacity between the vernier and the disc member 49, is to give the tank circuit a characteristic which will increase in frequency as the temperature increases This increasing temperature-frequency characteristic may be offset by other variations of frequency with temperature which go in the opposite direction. I have found that several elements of the circuit, other than the tank circuit per se, show a frequency characteristic which decreases with increasing temperature. By suitably adjusting the physical dimensions of the vernier armature 13 and its space from the disc member 49, I have been able to obtain substantial cancellation of these opposing effects.

In Figs. 1, 2 and 3, similar reference numerals are used to indicate similar elements. In Fig. 2, the cover 59 has been omitted and the spider 15 is partly broken away to expose the inner cylindrical member 41. The coupling coil 7 is shown as mounted on an insulated member 61.

In Fig. 3, pairs of tubes 65 and 67 are shown connected in push-pull relation to the coupling coils 7 and 9, respectively. It should be understood that a capacitive coupling or a combination of capacitive and inductive coupling may be used.

Thus, I have described an ultra high frequency tank circuit including means for compensating for temperature variations therein. I have also illustrated one form of coupling means applied to the said circuit, a course frequency adjusting means, and means for remotely controlling a vernier adjustment of the frequency of said circuit.

I claim as my invention:

1. An ultra high frequency concentric line resonator including an outer hollow cylindrical conducting member and an inner coaxial conducting sleeve, a metallic spider connecting said outer cylindrical member and said conducting sleeve at one of their adjacent ends; a metallic supporting shaft of low temperature coefficient of expansion located within and extending through said conducting sleeve and supported at one end by said metallic spider; a first metallic disc whose diameter is less than that of said outer cylindrical member but greater than that of said conducting sleeve coaxially connected to the free end of said supporting shaft; an inner metallic cylindrical member connected at its circumference to said metallic disc and enclosing a substantial portion of said conducting sleeve; a plurality of metallic rods of low temperature coefficient of expansion secured to the free end of said inner metallic cylindrical member, the axis of said rods being parallel to the axis of said inner cylindrical member, said rods extending beyond said metallic disc; a second metallic disc supported by said rods; and a metallic base member closing the free end of said outer hollow cylindrical conducting member and capacitively coupled to said second metallic disc.

2. In a device of the character of claim 1, means enabling longitudinal movement of said supporting shaft for adjusting the frequency of said circuit.

3. An ultra high frequency concentric line resonator including an outer hollow cylindrical conducting member and an inner coaxial conducting sleeve, a metallic spider connecting said outer cylindrical member and said conducting sleeve at one of their adjacent ends; a metallic supporting shaft of low temperature coefficient of expansion located within and extending through said conducting sleeve and supported at one end by said metallic spider; a first metallic disc whose diameter is less than that of said outer cylindrical member but greater than that of said conducting sleeve coaxially connected to the free end of said supporting shaft; a conductive metallic expansion member connecting said conducting sleeve and said first metallic disc; an inner metallic cylindrical member connected at its circumference to said metallic disc and enclosing a substantial portion of said conducting sleeve; a plurality of metallic rods of low temperature coefficient of expansion secured to the free end of said inner metallic cylindrical member, the axis of said rods being parallel to the axis of said inner cylindrical member, said rods extending beyond said metallic disc; a second metallic disc supported by said rods; a conductive metallic expansion member connecting said second metallic disc to said first metallic disc and said inner cylindrical member; and a metallic base member closing the free end of said outer hollow cylindrical conducting member and capacitively coupled to said second metallic disc.

4. A device of the character described in claim 3 which includes a small metallic disc parallel to said second metallic disc and movably mounted on said metallic base member for adjusting the frequency of said tuned circuit.

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