June 26, 1951 F. C. ISELY 2,557,969

SHIELDED ULTRA HIGH FREQUENCY TUNING APPARATUS

Filed Dec. 29, 1948 2 Sheets-Sheet 1

FIG. 1

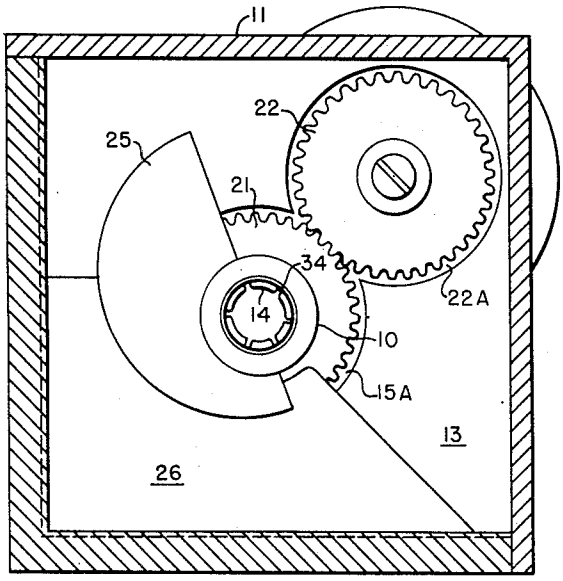
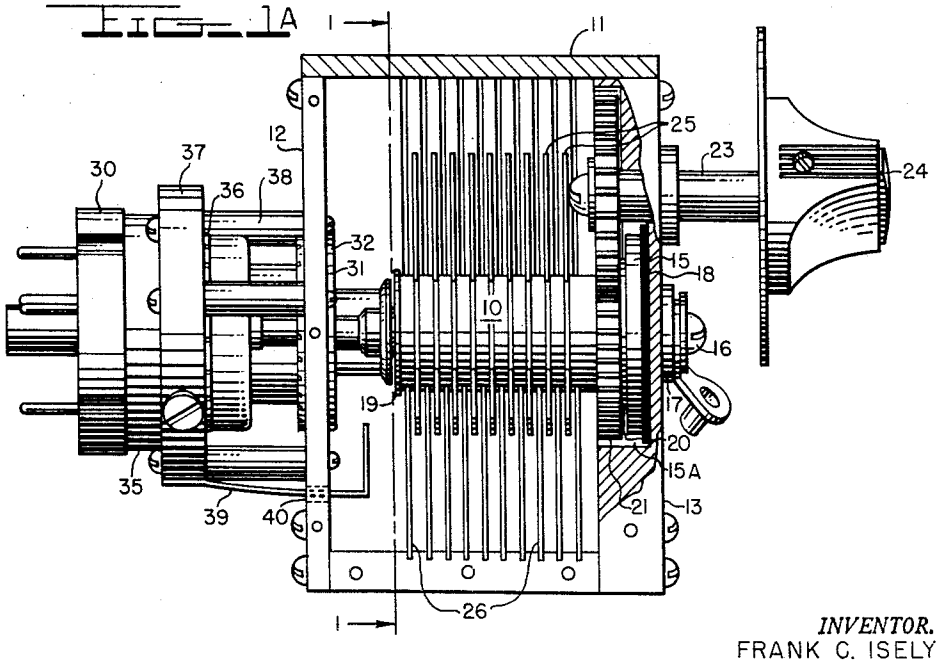


FIG. 1A



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FIG. 2

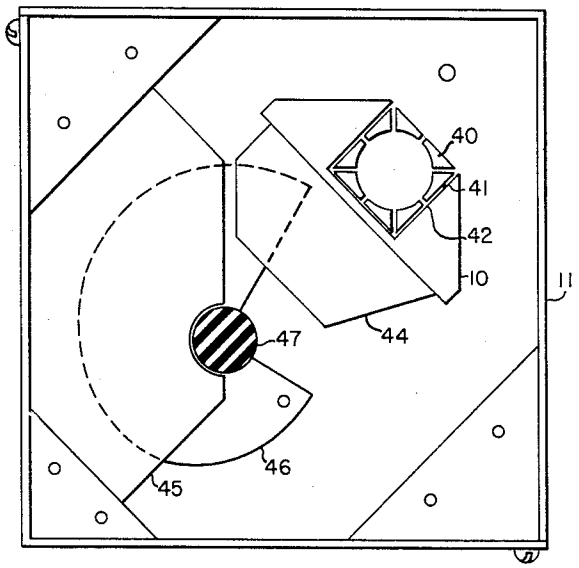
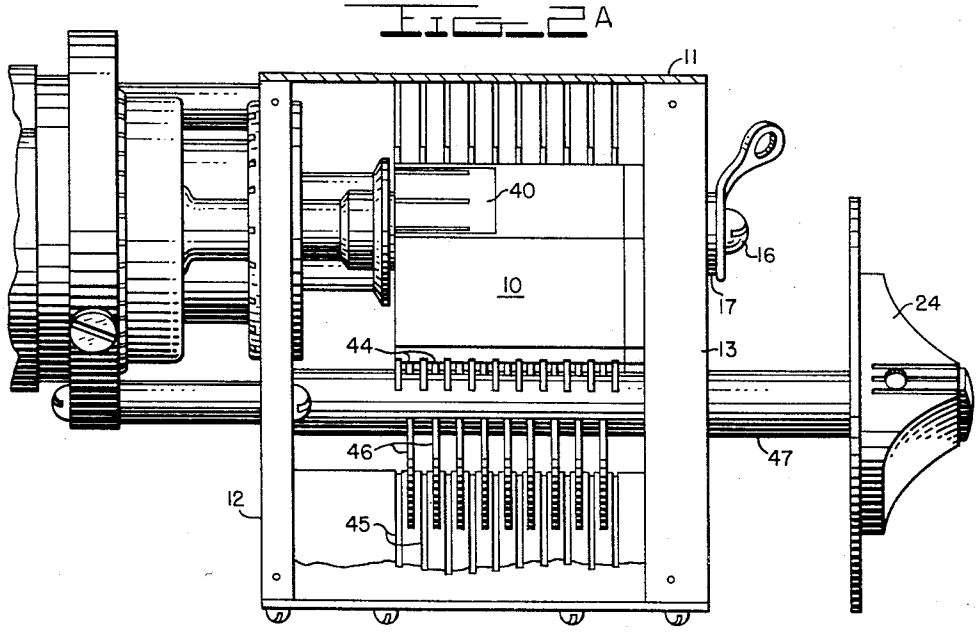


FIG. 2A



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SHIELDED ULTRA HIGH FREQUENCY TUNING APPARATUS

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The present invention relates to ultra-high frequency tuning apparatus, and is particularly concerned with the problem of providing a tunable line controlled (distributed constant) circuit wherein tuning may be accomplished without varying the physical length of the line.

Another object of the present invention is to provide ultra high frequency apparatus readily tunable over a wide frequency range.

Another object of the present invention is to provide a simple, inexpensive distributed constant tuning circuit.

Still other objects and features of the present invention will become apparent upon careful consideration of the following detailed description when taken together with the accompanying drawings, in which:

Figs. 1 and 1A are partial sectional front and side views respectively of one embodiment of the invention.

Figs. 2 and 2A are partial sectional front and side views of a second embodiment of the present invention.

Referring now more particularly to Figs. 1 and 1A there is shown in detail an anti-resonant shielded line tuner constructed in accordance with the teachings of the present invention. This embodiment is in the nature of a quarter wave concentric line section and comprises a tubular inner conductor 10 shielded by a box like outer conductor 11. The latter consists of front and back end plates 13 and 12 and four side plates which are undesignated.

The inner conductor 10, as hereinafter described, is shorted at radio frequencies to end plate 13 of outer conductor 11 and is rotatably supported in coaxial relation with respect to said end plate by a stationary center post 14.

Center post 14 serves both as a bearing support and as a short circuiting capacitor for the tubular inner conductor 10. As a bearing support, center post 14 is bolted to the end plate 13 by screw 16, which for reasons soon to become apparent is insulated from end plate 13 by fiber washer 17. A pair of flanged brass sleeve bearings 19 and 20 are inserted in opposite ends of the inner conductor and snugly surround the center post 14 to provide suitable bearing surfaces for the inner conductor and to provide a conductive path between the same and the center post 14.

As a short circuiting capacitor, center post 14 terminates in a flat circular flange plate 15 which fits into a circular recess 15A formed in the end plate 13. A sheet of mica 18 inserted in the

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recess 15A between the flange plate 15 and the end plate 13 insulates the center post from the end plate. Flange plate 15 and end plate 13 are thus seen to form the two plates of a short circuiting capacitor, while the mica 18 serves as the dielectric therefor.

To provide rotation of the inner conductor 10, the same is terminated at the end thereof adjacent end plate 13 in an integrally formed gear wheel 21. Engaging gear wheel 21 is a suitable fiber spur gear 22 mounted in a circular recess 22A milled on the inside face of the end plate 13 adjacent the first recess 15A. Fiber spur gear 22 is keyed to a shaft 23. The latter emerges from end plate 13 and terminates in a suitable tuning knob 24.

To tune the line a set of stator plates 26 uniformly spaced along substantially the full length of the line is mounted on the inside of the side walls of the outer conductor 11 and extend inwardly in toward the inner conductor 10. Mounted on the inner conductor 10 and rotatable therewith is a set of rotor plates 25 uniformly spaced along substantially the full length of the inner conductor 10. Rotor plates 25 are arranged to mesh with the stator plates 24 whereby the distributed capacitance of the line and hence the tuning of the line may be varied with rotation of the inner conductor 10.

In operation, the maximum frequency to which the circuit may be tuned is attained when the rotor plates are fully out of mesh with the stator plates. In this condition the resultant frequency of the circuit is governed by the electrical length of the center conductor 10 plus whatever lengthening effect the fringe capacity between the rotor and the stator condenser plates has on the circuit. In practice the center conductor 10, is of course, cut to approximate an electrical quarter wavelength at the highest frequency to which the circuit is to be tuned.

The minimum frequency to which the circuit tunes obtains when the rotor plates 25 are fully meshed with the stator plates 26.

From the foregoing it becomes apparent that in using the present invention as an R. F. tank circuit, such as a wave trap, suitable energy input and output electromagnetic or electrostatic energy probes, not shown, may be inserted into the circuit at any suitable point. It is also apparent that while the present embodiment has been described as being so dimensioned as to function in a one quarter wave resonant mode, other odd electrical quarter wave modes also may

be employed without departing from the spirit of the invention.

In the present embodiment of the invention the stator plates are shown as being trapezoidal and the rotor plates semi-circular. This representation is, of course, solely for the purpose of illustration and is not a limitation in that the respective shapes of the condenser plates may assume any suitable configuration.

In some instances it might be desired to so form the plates as to produce a straight line frequency variation, whereas in other instances a logarithmic frequency variation may be desired.

In employing the present embodiment in the production of oscillations a "light house" vacuum tube 30 may be introduced into the circuit as illustrated in Fig. 1A.

To this end, end plate 12 of the outer conductor 11 is apertured at 31 just above the center conductor 10. The aperture 31 is lined with a flexible annular contact ring 32 adapted to engage the grid ring terminal of the "light house" tube 30, while the center post 14 is slotted as shown at 34 to permit contact with the plate cap of the tube 30.

Appropriate B^+ potential may be connected to screw 16 to provide suitable plate supply potential for the tube.

The cathode ring terminal 35 of tube 30 is seated in a flexible annular contact ring 36 supported by an annular member 37. The latter in turn is insulated from and mechanically fixed to end plate 12 by a plurality of stand-off insulators 38.

To provide regenerative feedback, the cathode is electrostatically coupled to the anode circuit by a suitable capacitive feedback strap 39. Strap 39 is fed through an aperture 40 cut in the end cover 12, and is conductively attached at one end to the cathode contact or support 37 and terminated at its other end in capacitive relation to the anode.

In the embodiment shown in Figs. 1 and 1A it will be recognized that a sliding contact exists between the center post 14 and the inner conductor 10. In certain applications, such sliding contact may give rise to undesirable noise and the embodiment illustrated in Figs. 2 and 2A may be preferred.

In the embodiment of Figs. 2 and 2A, to which reference is now made, the inner conductor of the line is made stationary and a split stator type of tuning arrangement is employed, whereby sliding contacts are avoided.

In particular the inner conductor 10 is set-off from the axis of the outer conductor 11 and is again provided with an R. F. short to the end plate 13 by means not shown. The inner conductor 10 contains a niche 41 into which a slotted contactor 40 may be inserted to engage the plate cap of a light house tube much as in the same manner as hereinbefore described. A sheet of mica 42 is placed in the niche 41 to insulate the contactor from the inner conductor 10, while a screw 16 is again used to hold the contactor 40 in place and to provide a terminal for supplying a plate supply connection to the contactor 40.

For tuning purposes, two sets of stator plates are employed. One set 44 is uniformly distributed along the length of the inner conductor 10 and extends laterally away therefrom. The other set 45 is attached to one of the side walls of the outer conductor and extends laterally away therefrom in matching relation to the plates of the first set. Interposed between the two sets of stator plates is a set of rotor plates 46 arranged and distributed to lie in mutually meshing relation to the both sets of stators.

In this embodiment the lowest frequency of operation obtains when the rotor plates are positioned to effect maximum meshing with both sets of stator plates. The highest frequency obtains when the rotor plates are positioned for least meshing with at least one set of stators.

For the purpose of raising the high frequency end to its uppermost limit, the rotor plates are so shaped relative to the stator plates that when the rotor plates are positioned to fully mesh with one set of stator plates, namely 45, no meshing with the other set 44 exists.

To prevent the occurrence of spurious modes of operation, the rotor plates are mounted on an insulating shaft 47, whereby each rotor plate is insulated from the other.

In other respects the arrangement of this embodiment is substantially identical to that shown in Figs. 1 and 1A, both in its construction and in application. Here again, however, and for purposes of simplification, no energy input or output probes or loops are shown.

Although I have shown and described only certain and specific embodiments of the present invention it will be readily understood that numerous other modifications and embodiments are possible thereof without departing from the spirit of the invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. A tunable ultra-high frequency circuit comprising, a pair of essentially co-extensive, parallel conductors equal in length to an odd number of electrical quarter wave-lengths at the highest frequency of operation, a set of condenser stator plates attached to and uniformly distributed over substantially the full length of at least one of said conductors and extending laterally away therefrom toward the other conductor, a set of condenser rotor plates rotatably positioned to mesh with said stator plates and operative to uniformly vary the distributed capacity between the conductors, and a high frequency short circuit connecting means separate from said condenser plates connected across one pair of adjacent ends of said conductors.

2. A tunable ultra-high frequency circuit comprising, a pair of parallel conductors equal in length to an electrical quarter wave-length or multiple thereof at the highest frequency of operation, a separate set of condenser stator plates attached to and uniformly distributed over substantially the full length of each of said conductors, each of said sets of stator plates extending laterally away from its respective conductor toward the other conductor, a set of condenser rotor plates rotatably positioned to mesh with said stator plates and operative to uniformly vary the distributed capacity between the conductors.

3. A tunable ultra-high frequency circuit comprising, a pair of essentially co-extensive parallel conductors equal in length to an odd number of electrical quarter wavelengths at the highest frequency of operation, means providing a high frequency short circuit between one pair of adjacent ends of said conductors, a separate set of condenser stator plates attached to and uniformly distributed over substantially the full length of

each of said conductors, each of said sets of stator plates extending laterally away from its respective conductor toward the other conductor, a set of condenser rotor plates rotatably positioned to mesh with said stator plates and operative to uniformly vary the distributed capacity between the conductors.

4. A tunable ultra-high frequency circuit comprising, a pair of conductors equal in length to an electrical quarter wave-length or multiple thereof at the highest frequency of operation, one of said conductors being larger in diameter than the other, the conductor of larger diameter surrounding the other so as to form a line section having inner and outer conductors, a set of condenser stator plates attached to and uniformly distributed over substantially the full length of at least one of said conductors and extending laterally away therefrom toward the other conductor, a set of condenser rotor plates positioned to mesh with said stator plates and operative to uniformly vary the distributed capacity between the conductors.

5. A tunable ultra-high frequency circuit comprising, a pair of conductors equal in length to an odd number of electrical quarter wavelengths at the highest frequency of operation, one of said conductors being larger in diameter than the other, said one of said conductors surrounding the other so as to form a shielded line section, means providing a high frequency short circuit between one pair of adjacent ends of said conductors, a set of condenser stator plates attached to and uniformly distributed over substantially the full length of at least one of said conductors and laterally extending away therefrom toward the other conductor, a set of condenser rotor plates positioned to mesh with said stator plates and operative to uniformly vary the distributed capacity between the conductors.

6. A tunable ultra-high frequency circuit comprising, a pair of conductors equal in length to an odd number of electrical quarter wavelengths at the highest frequency of operation, one of said conductors being larger in diameter than the other, said one of said conductors surrounding the other so as to form a shielded line section, means providing a high frequency short circuit between one pair of adjacent ends of said conductors, a separate set of condenser stator plates attached to and uniformly distributed over substantially the full length of each of said conductors, each of said sets of stator plates extending laterally away from its respective conductor toward the other conductor, a set of condenser rotor plates rotatably positioned to mesh with said stator plates and operative to uniformly vary the distributed capacity between the conductors.

7. A tunable ultra-high frequency circuit comprising, a pair of conductors equal in length to an odd number of electrical quarter wavelengths at the highest frequency of operation, one of said conductors being larger in diameter than the other, said one of said conductors surrounding the other so as to form a shielded line section, means providing a high frequency short circuit between one pair of adjacent ends of said conductors, a separate set of condenser stator plates attached to and uniformly distributed over substantially the full length of each of said conductors, each of said sets of stator plates extending laterally away from its respective conductor toward the other conductor, an insulated rotor shaft, a set of condenser rotor plates mounted on said shaft and rotatably positioned to mesh with said stator plates, thereby to uniformly vary the distributed capacity between the conductors.

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