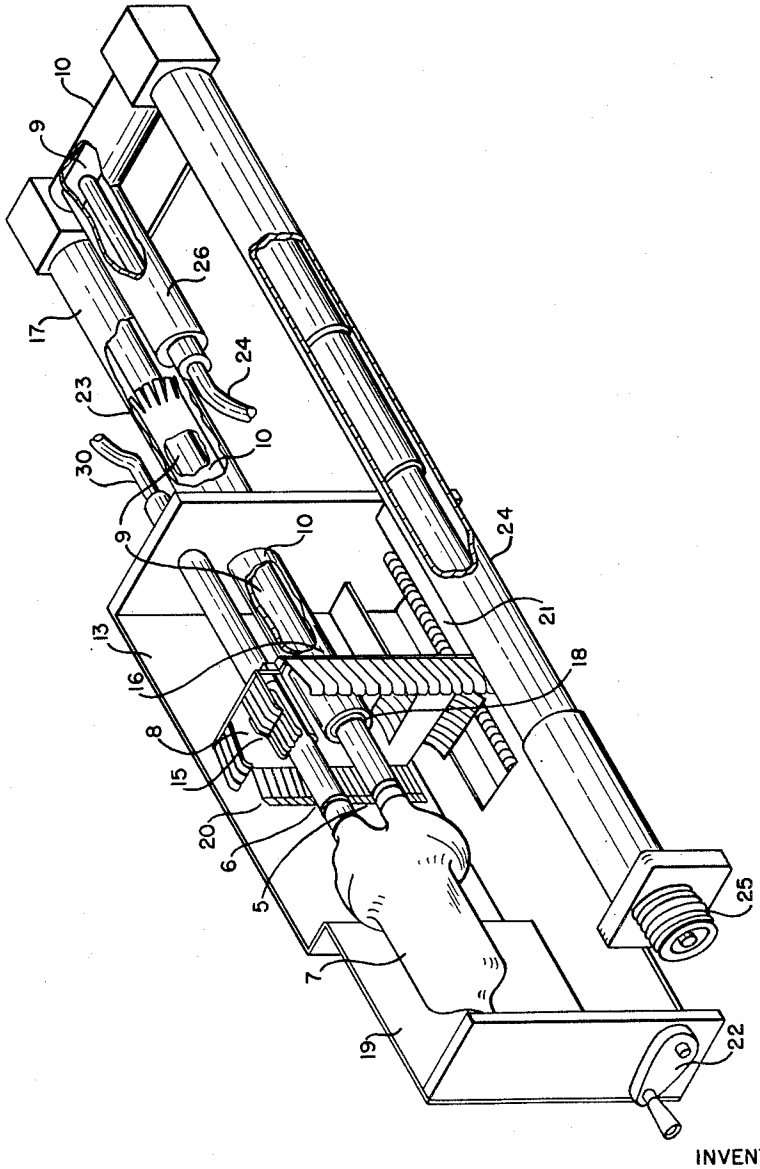
Dec. 26, 1950 O. I. STEIGERWALT 2,535,329

ARRANGEMENT FOR COUPLING A PARALLEL RESONANT LINE TO A COAXIAL LINE LOAD

Filed March 26, 1946



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Patented Dec. 26, 1950

2,535,329

UNITED STATES PATENT OFFICE

2,535,329

ARRANGEMENT FOR COUPLING A PARALLEL RESONANT LINE TO A COAXIAL LINE LOAD

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Application March 26, 1946, Serial No. 657,300

3 Claims. (Cl. 178—44)

1

This invention relates to resonant circuits and more particularly to a structure providing coupling between a load and a resonant parallel line circuit.

It is frequently desirable in high-frequency circuits to utilize a parallel line as the resonant circuit of an oscillator, and it is often desirable to couple a low impedance load to the line. This invention provides simple means for placing the load effectively in series with the resonant line to provide a transfer of energy to the load, particularly where the load includes a coaxial cable termination, and simultaneously affords means for adjustment of the electrical length of the resonant line.

Therefore, among the objects of the invention is to provide a means for coupling a coaxial cable terminating load to a resonant parallel line circuit; to provide such coupling while still permitting tuning of the resonant line circuit; and to provide such a coupling in which the load is effectively in series with a resonant parallel line of adjustable length.

Other objects, advantages, and novel features of the invention will be apparent from the description herein, wherein reference is made to the single figure of the accompanying drawing illustrating a preferred embodiment of the invention.

Referring now to the drawing, tubular conductors 5 and 6 act as a tuned parallel line leading to the anodes of a split-anode magnetron 7 to provide a resonant circuit. In the embodiment shown, line 5 extends through and beyond a slidable plate 8 to form the inner conductor 9 of a coaxial line 10, and line 6 is electrically connected to the outer conductor of coaxial line 10, so that the coaxial line may be considered to be in series with the parallel resonant line circuit.

Lines 5 and 6 extend through apertures in the slidable metallic plate 8, and sliding electrical contact between the plate 8 and line 6 is provided by finger elements 15 mounted upon plate 8. Plate 8 is further mechanically and electrically connected to a section of coaxial tubing 16, which extends about the inner conductor 9 adjoining line 5. The section of coaxial tubing 16 telescopes into and is electrically connected to a stationary outer conductor 17 of coaxial line 10. The coaxial line inner conductor 9 formed by the extension of line 5 is likewise tubular in structure. An insulating annular dielectric ring 18 which is fastened to the inner surface of coaxial tubing 16 serves to space line 5 within an aperture of plate 8 and to insulate the line 5 and its extension 9 from the section of coaxial tubing 16

2

which extends through said aperture. Dielectric ring 18 further furnishes physical support to the inner conductor 9 to maintain the spaced relationship necessary in coaxial line 10. A box-like metallic shield 19, here shown with certain sides removed to expose the inner structure to view, may be provided around the magnetron 7 and parallel lines 5 and 6 to prevent undesired radiation of energy and also to serve as a mount for the tube and parallel line structure. Slidable plate 8 may be further provided with finger elements 20 to contact the inner surfaces of the box-like shield 19 as shown. A worm 21 is mounted to extend perpendicularly to slidable plate 8 and to be actuated by a drive handle 22, so that engagement of worm 21 with a cooperating element (not shown) on metallic plate 8 will serve to adjust the effective lengths of lines 5 and 6 by positioning plate 8 along the parallel line. Telescoping section 16 of the outer conductor of coaxial line 10 may thus be advanced within or withdrawn from stationary outer conductor 17 with movement of plate 8. Telescoping section 16 is provided with finger elements 23 contacting the inner surface of stationary outer conductor 17 into which telescoping section 16 extends. The outer conductor of coaxial line 10 is thus continuous from slidable plate 8, and variable in length. The length of coaxial line 10 is thus increased as the effective length of the tuned parallel line is decreased, and vice versa. The coaxial line 10 is formed into a U-shape having two substantially parallel legs as shown. The telescoping leg of the U-shaped coaxial line is formed by the inner conductor 9 and the telescoping sections 16 and 17 as described, and the other leg 24 includes a series of transformer sections. The inner conductors of the transformer sections have decreasing diameters as shown, and the length of each section is one-quarter wavelength at the mid-frequency of the operating frequency band. An impedance matching structure is thus provided which is relatively insensitive to frequency changes. Leg 24 of coaxial line 10 leads to an output terminal 25 for connecting to a conventional low impedance coaxial line. A conventional quarter-wavelength stub 26 may be provided as shown in the arm connecting the two legs of the coaxial line. The inner conductor 24 of this stub 26 may be formed as a hollow tube connecting to the hollow inner conductor 9 of coaxial line 10. A coolant may thus be carried by the hollowed inner conductor of the coaxial line, to the tubular lines 5 and 6 which communicate with suitable cooling structure within the

magnetron 7. The line 6 is for this purpose further provided with a connecting tube 30 to complete the cooling circuit.

That part of the coaxial line along which tubing 16 moves may be designed to have a varying impedance along its length so that the impedance presented to the oscillator circuit by the load is a chosen function of the operating frequency. This diametral variation may serve to maintain the desired degree of coupling over the operating frequency band. The characteristic impedance of the coaxial line leg formed by the telescoping sections 16 and 17 may be designed to be lower than the characteristic impedance of the load to be connected to terminal 25. In the preferred embodiment, this leg is approximately one-fourth wavelength long at the lowest operating frequency at which plate 8 is fully advanced to maximize the length of lines 5 and 6. At the highest frequency, when plate 8 is retracted to make the effective length of lines 5 and 6 a minimum, the telescoping leg of the coaxial line is approximately one-half wavelength long.

The conductance presented to lines 5 and 6 at their effective junction with the coaxial line 9, 10 varies between substantially

$$\frac{R_L}{R_x^2}$$

at the lowest frequency and

$$\frac{1}{R_L}$$

at the highest frequency, where R_L is the impedance presented by the load and connecting coaxial line to the telescoping section 17, and R_x is the characteristic impedance of the telescoping leg 16, 17. The conductance presented to the resonant line circuit at plate 8 is transformed by resonant lines 5 and 6 to a suitable conductance at magnetron 7 for its proper operation.

It will be apparent to those skilled in the art that many variations of the invention are possible. As one example, other tubes than a magnetron oscillator could be used. Therefore, it is not desired to restrict the invention to the precise embodiment herein disclosed.

What is claimed is:

1. A resonant parallel line and load coupling structure, including two parallel resonant lines, a movable metallic plate having two apertures through which said lines extend, metallic members extending from said plate and providing contact with one of said lines, an annular dielectric member about the other of said lines insulating and spacing said other line within one said aperture, an inner coaxial conductor connected to and constituting a continuation of said other line, a section of coaxial tubing attached to said plate and extending about a portion of said inner coaxial conductor, a quarter wavelength stationary outer coaxial conductor extending about said section of coaxial tubing and said inner coaxial conductor, sliding contact means between said section of coaxial tubing and said outer coaxial conductor, and a coaxial transformer section electrically connected at one end to said outer and inner coaxial conductors and adapted at its other end to be connected to a load.

2. A resonant parallel line and load coupling structure, including two parallel resonant lines, a movable metallic plate having two apertures through which said lines extend, metallic members extending from said plate and providing contact with one of said lines, a dielectric member insulating and spacing the other of said lines within one said aperture, an inner coaxial conductor connected to and constituting a continuation of said other line, a section of coaxial tubing attached to said plate and extending about a portion of said inner coaxial conductor, a stationary outer coaxial conductor extending about said section of coaxial tubing and said inner coaxial conductor, and sliding contact means between said section of coaxial tubing and said outer coaxial conductor, said outer and inner coaxial conductors being adapted for connection to a load.

3. A resonant parallel line and load coupling structure, including two parallel resonant lines, a movable metallic member having sliding contact means to electrically connect said member with one of said lines, a dielectric member insulating and spacing said movable metallic member from the other of said lines, an inner coaxial conductor connected to and constituting a continuation of said other line, a section of coaxial tubing attached to said plate and extending about a portion of said inner coaxial conductor, a stationary outer coaxial conductor extending about said section of coaxial tubing and said inner coaxial conductor, and sliding contact means between said section of coaxial tubing and said outer coaxial conductor, said outer and inner coaxial conductors being adapted for connection to a load.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,401,634	Gubin	June 4, 1946

OTHER REFERENCES

Principles of Radar by Staff of the M. I. T. Radar School (page 7-48), Chapter VII, Technology Press, 1944.