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COAXIAL LINE TUNER HAVING TWO SPACED ADJUSTABLE SHUNT INDUCTORS

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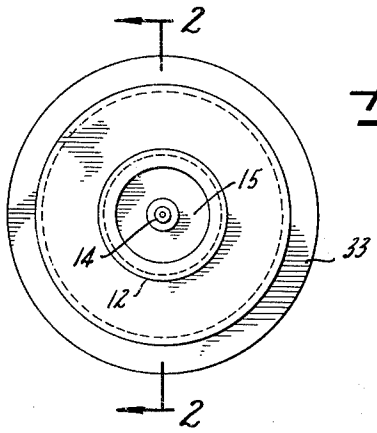


Fig. 1.

Fig. 2.

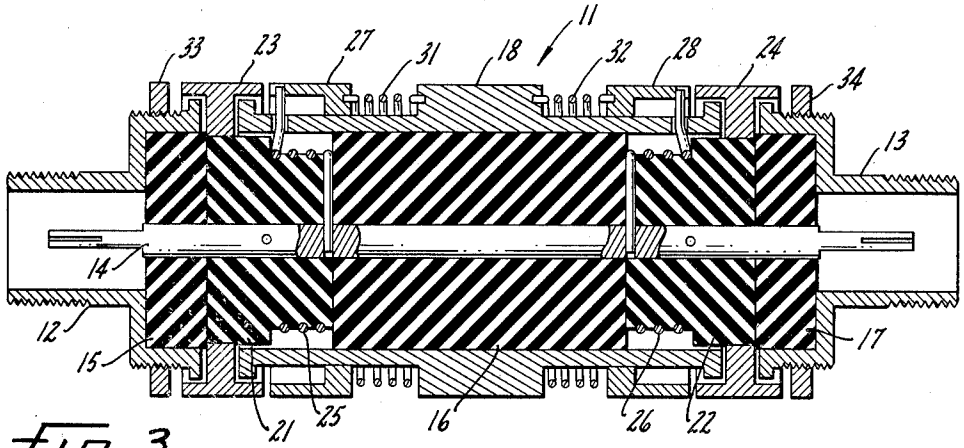


Fig. 3.

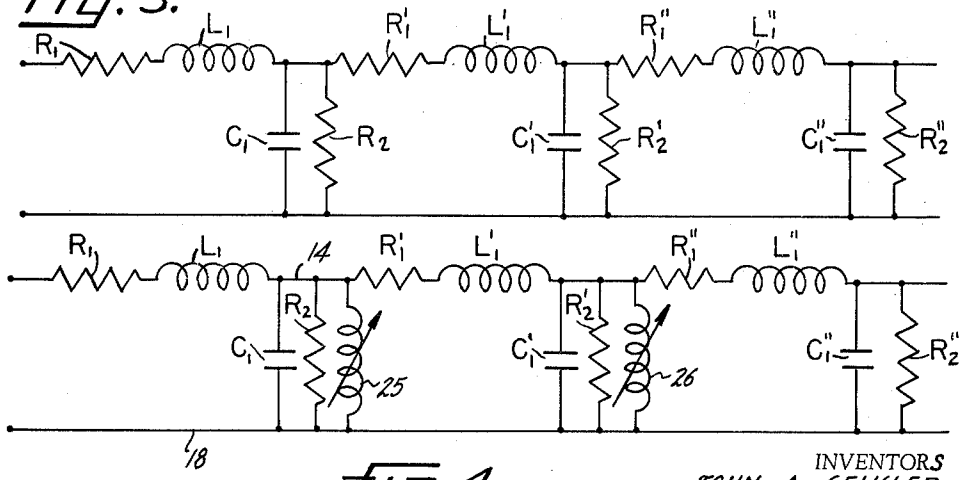


Fig. 4.

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COAXIAL LINE TUNER HAVING TWO SPACED ADJUSTABLE SHUNT INDUCTORS

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The present invention relates to an electronic tuning device and more particularly to a double-stub transmission line tuner for use in microwave circuits.

Double-stub transmission line tuners are provided for introducing a controlled disturbance in a transmission line in order to cancel out a similar existing disturbance. In a typical transmission line tuner, a pair of channels are provided at right angles to a main transmission line channel and a sliding stub is provided in each of the channels for impedance matching. These conventional tuners are, however, both delicate and bulky, and are not adaptable to simple packaging arrangements.

In the present invention, the tuner is comprised of a pair of variable susceptances separated by a fixed distance, however, each adjustable length line is comprised of a helix of wire wound concentric with respect to a center conductor. The center conductor is spaced from an outer conductor by a solid insulator which is fixed to the inner conductor and means are provided for unwinding the helix of wire from the inner conductor onto the outer conductor. This arrangement permits a significant decrease in the size of the tuner, as compared to conventional tuners and furthermore, the tuner of the present invention is rugged, reliable, and relatively inexpensive.

It is therefore a general object of the present invention to provide an improved transmission line tuner for use in microwave circuits.

Another object of the present invention is to provide a pair of coaxial adjustments for tuning a microwave circuit.

Still another object of the present invention is to provide a small, rugged tuner for microwave circuits that occupies a minimum amount of space.

A further object of the present invention is to provide an improved tuner for varying the shunt susceptance of a line.

Other objects and advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

FIGURE 1 is a front view of a preferred embodiment of the present invention;

FIGURE 2 is a sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is a schematic diagram showing an equivalent circuit for a short length of transmission line; and

FIGURE 4 is a schematic diagram showing an equivalent circuit of the embodiment shown in FIGURE 2 of the drawing.

Referring now to the drawing, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown a coaxial line **11** having connectors **12** and **13** on each end thereof. An inner conductor **14** is rotatably supported by insulators **15**, **16**, and **17**, and outer conductor **18** is supported by insulator **16**. Insulators **21** and **22** are attached to inner conductor **14**, and knobs **23** and **24** are attached to insulators **21** and **22**, respectively. Insulators **21** and **22** are each provided with a reduced diameter portion that has a spiral groove on the outer periphery thereof.

Wires **25** and **26** are wrapped in the grooves of the spirals of insulators **21** and **22**, respectively, and one end

of each wire is connected, as by soldering, to the inner conductor **14**. The other ends of wires **25** and **26** are passed through slots in the outer conductor **18** and are connected to take-up reels **27** and **28**, respectively. The take-up reels are spring loaded by means of coil springs **31** and **32** so that as insulators **21** and **22** are rotated the wire will be drawn through slots in the outer conductor **18** by the spring action of take-up reels **27** and **28** and thus become in contact with the outer conductor **18**. Locking rings **33** and **34** are provided in order to lock knobs **23** and **24**, respectively, after the desired position of insulators **21** and **22** is obtained. It can readily be seen that wires **25** and **26** provide an adjustable length line thereby forming two variable susceptances separated by a fixed distance.

FIGURE 3 of the drawing illustrates an equivalent circuit for a short length of transmission line. This equivalent circuit for a transmission line is well-known in the art and a mathematical analysis therefor can be found on pages 4 through 6 of the textbook "Transmission Lines, Antennas and Wave Guides" by King, Mimno, and Wing. (McGraw-Hill Book Co., Inc., New York, N.Y. (1945).)

FIGURE 4 of the drawing shows an equivalent circuit of the embodiment shown in FIGURE 2 of the drawing. Wires **25** and **26**, which are helically wound on insulators **21** and **22**, respectively, each are adjustable thereby forming two variable susceptances separated by a fixed distance. Wires **25** and **26**, which are the effective elements that alter the characteristic impedance of the transmission line, change the impedance in the line an an inductive manner. By way of example, the present invention may have application where the frequency range of the coaxial line might extend between 1–1000 megacycles. Below one megacycle, the size of the helical coils and other components become so large as to be unwieldly.

In operation, assuming that connectors **12** and **13** are connected in a coaxial microwave circuit, tuning is accomplished by loosening rings **33** and **34** from engagement with knobs **23** and **24** and then turning the knobs. Rotation of knobs **23** and **24** in a clockwise direction causes the wires **25** and **26**, respectively, to be unwound from insulators **21** and **22**, and the spring loaded take-up reels **27** and **28** winds the wires around the body of the outer conductor **18**. Likewise, rotation of knobs **23** and **24** in a counterclockwise direction causes the wires to be rewound on the insulators **21** and **22**. As the length of wire in contact with the outer conductor is varied, the shunt susceptance of the line is varied.

It can thus be seen that the present invention provides an improved device for varying the shunt susceptance of a line, and that the improved device is small and compact.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood, that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A tuner for a microwave transmission line comprising:

(a) an inner conductor,

(b) an outer conductor insulated from said inner conductor,

(c) first and second insulators attached to said inner conductor,

(d) first and second wires having a plurality of turns wound one each around each said first and second insulators, said first and second wires each having one end connected to said inner conductor with a length of the other end wound around said outer conductors, and

(e) means for separately varying the length of said wires wound around said outer conductor.

2. A tuner for a microwave transmission line comprising:
(a) an inner conductor,
(b) a tubular outer conductor surrounding said inner conductor and electrically insulated therefrom,
(c) first and second insulators attached to said inner conductor,
(d) first and second wires having a plurality of turns wound one each around each said first and second insulators, said first and second wires each having one end connected to said inner conductor with a length of the other end wound around said outer conductors,
(e) separate means for rotating said first and second insulators, and
(f) separate means for winding said first and second wires around said tubular outer conductor when said first and second conductors are rotated in one direction.

3. A tuner for a microwave transmission line as set forth in claim 2 wherein said separate means for winding said first and second wires around said tubular outer conductor each comprises a spring loaded take-up wheel for winding said wire on said tubular outer conductor.

4. A tuner for a microwave transmission line as set forth in claim 2 wherein separate locking means are provided for said separate means for rotating said first and second conductors.

5. A tuner for a microwave transmission line comprising:
(a) an inner conductor,
(b) a tubular outer conductor surrounding said inner conductor and electrically insulated therefrom,
(c) first and second insulators attached to said inner conductor, each said insulator having a helical groove around the periphery thereof,
(d) a first wire wound in the helical groove of said first insulator and a second wire wound in the helical groove of said second insulator, said first and second wires each having one end connected to said inner conductor with a length of the other end being wound around said tubular outer conductor, and

(e) means for separately varying the length of said wires wound around said tubular outer conductor.

6. A tuner for a microwave transmission line comprising:
(a) an inner conductor,
(b) a tubular outer conductor surounding said inner conductor and electrically insulated therefrom,
(c) first and second insulators attached to said inner conductor, each said insulator having a helical groove around the periphery thereof,
(d) a first wire wound in the helical groove of said first insulator and a second wire wound in the helical groove of said second insulator, said first and second wires each having one end connected to said inner conductor with a length of the other end being wound around said tubular outer conductor,
(e) separate means for rotating said first and second insulators, and
(f) separate means for winding said first and second wires around said tubular outer conductor when said first and second conductors are rotated in one direction.

7. A tuner for a microwave transmission line as set forth in claim 6 wherein said separate means for winding said first and second wires around said tubular outer conductor each comprises a spring loaded take-up wheel for winding said wire on said tubular outer conductor.

8. A tuner for a microwave transmission line as set forth in claim 6 wherein separate locking means are provided for said separate means for rotating said first and second conductors.

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