April 27, 1965 W. HOTINE 3,181,094

VARIABLE SHORTED COAXIAL LINE

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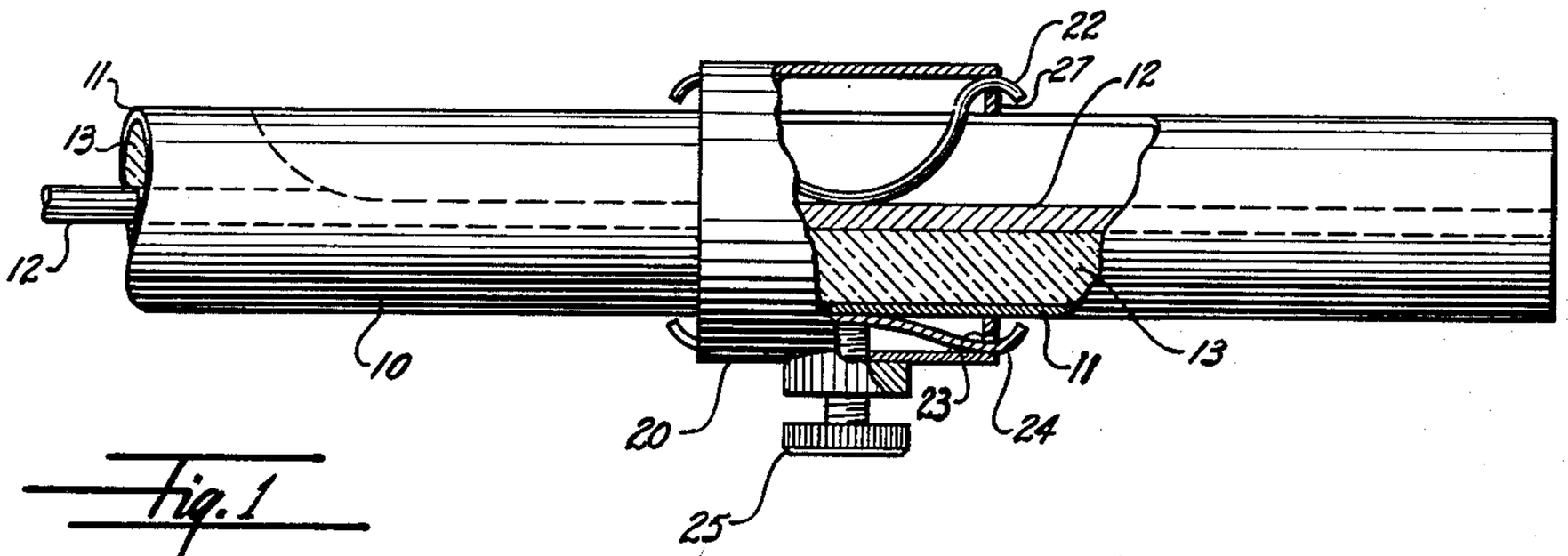

Fig. 1

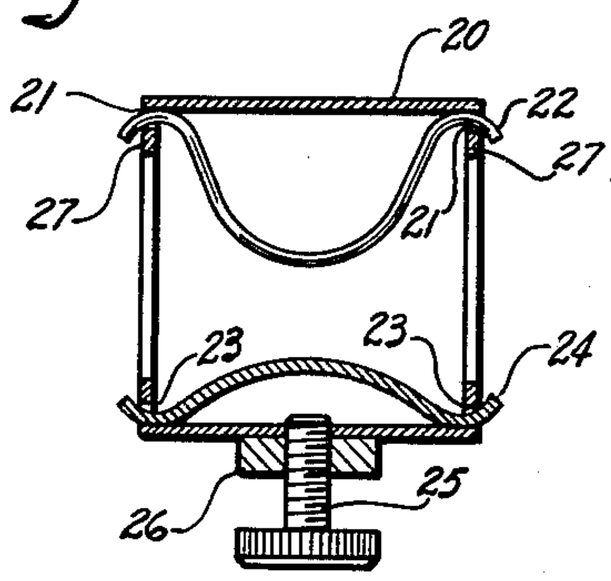

Fig. 2

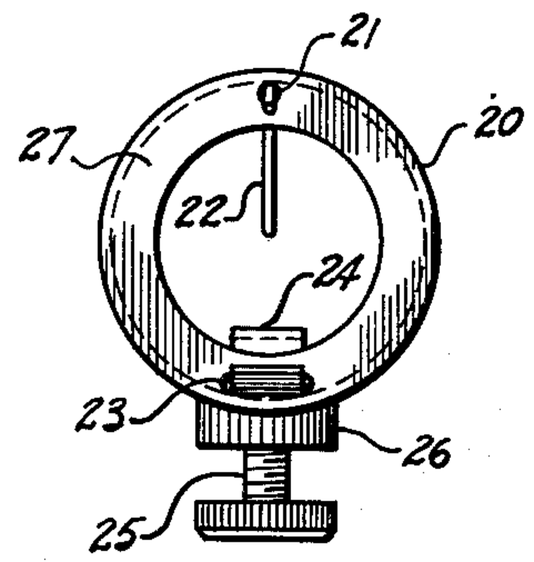

Fig. 3

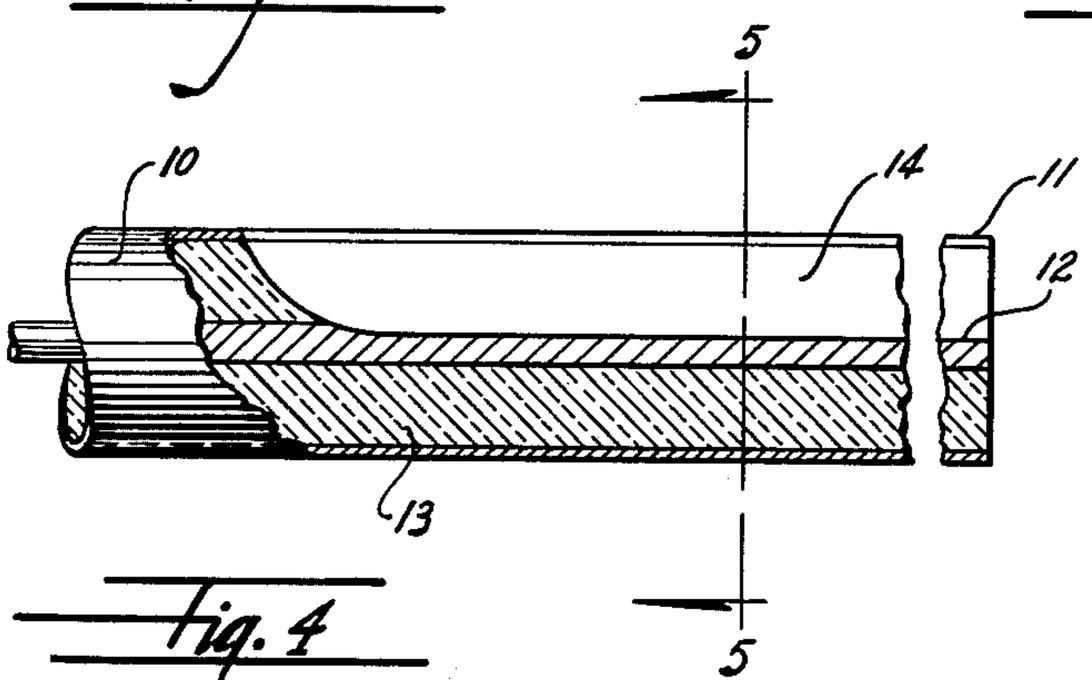

Fig. 4

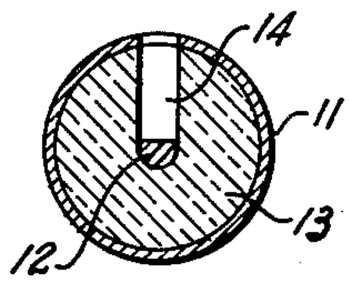

Fig. 5

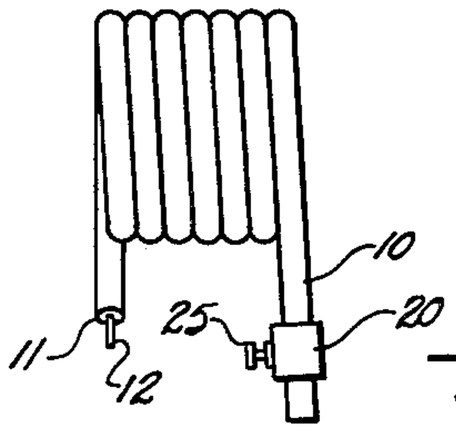

Fig. 6

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VARIABLE SHORTED COAXIAL LINE

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This invention relates to a variably shorted coaxial line and more particularly to an arrangement for shorting the electrical circuit between the shield and inner conductor of a solid dielectric coaxial line at selected locations along the line.

In using high-frequency, electromagnetic wave energy, it is often necessary to employ tunable coaxial stub lines. Tunable stub lines in the past have utilized air dielectric coaxial lines or strip lines. Disadvantages attendant with using such lines are that the lines often occupy considerable space and are quite heavy. They also require a complicated shorting arrangement that is expensive to make and maintain.

Therefore it is an object of this invention to provide an improved variably shorted coaxial line.

It is another object of this invention to provide an improved, simplified, tunable coaxial stub line arrangement.

It is another object of this invention to provide an improved tunable coaxial stub line arrangement having reduced space and weight requirements.

It is another object of this invention to provide an improved device for variably shorting solid dielectric coaxial lines.

The variably-shorted, coaxial line of this invention includes a solid dielectric coaxial line with at least one inner conductor. The coaxial line has a narrow slot cut longitudinally along the line, through the outer shield and through the dielectric material exposing the inner conductor to contact from outside the shield. A variable shorting device encircles the shield and is capable of being slidably positioned along the shield and selectively retained in a given position along the line by a spring arrangement. The spring arrangement includes spring contact means positioned on the metallic member and projecting through the slot in the line to connect the inner conductor electrically with the outer shield and a spring means for resiliently holding the member at a given position along the coaxial line. The variable shorting device can be moved along the longitudinal length of the coaxial member shorting the inner conductor to the outer shield at the position of the shorting device along the slot in the coaxial line and then locked in that position by a locking means. The particularly desired shorting location of the shorting device may be adjusted through trial and error.

Other objects and many attendant advantages of this invention will be readily apparent as the same becomes better understood by reference to the following description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIGURE 1 is an illustrative view of the solid dielectric coaxial line with the variable shorting device positioned thereon.

FIGURE 2 is a cross-sectional view of the variable shorting device of this invention.

FIGURE 3 is an end view of the variable shorting device of this invention.

FIGURE 4 is a partial cross-sectional view of a solid coaxial line illustrating the slotted portion.

FIGURE 5 is a cross-sectional view of FIGURE 4 taken along line 5—5.

FIGURE 6 is a side view of a portion of a solid dielectric coaxial line with the shorting device mounted thereon that forms a compact stub line arrangement.

Referring now to FIGURE 1, a solid dielectric coaxial line 10 is shown having an outer shield 11 enclosing solid dielectric material 13 with an inner conductor 12 imbedded therein. For purposes of exemplification, the coaxial line 10 may comprise a solid dielectric 50 ohm coaxial line of the semi-rigid type having a steel copper plated inner conductor of .036" outside diameter and a copper, silver plated outer conductor or shield of .140" outer diameter with a solid Teflon filter of .116" outer diameter. Such a semi-rigid coaxial line may be bent around a one-half inch radius and will remain set in its bent position.

The line 10 is slotted radially outward from the inner conductor 12 along the longitudinal length of the line 10 exposing the inner conductor. The length of the slotted portion of the line will be that necessary to afford the desired positioning of the variable shorting device. Slot 14 may be made with a saw or other known means and preferably has a relatively narrow dimension with respect to the outer circumference of the line which narrow dimension slightly exceeds the width of spring contact means 22.

A variable shorting device comprises an outer metallic cylindrical member 20 with shoulder or end ring portions 27. The inside diameter of the cylindrical member 20 and shoulder members 27 exceeds the outer diameter of the coaxial line 10 permitting the shorting device to slide along the length of line 10. Apertures 21 in shoulder portions 27 are aligned to receive the hooked end portions of a metallic spring contact means 22. The hooked end portions extend through apertures 21 flexibly retaining the curved spring contact member 22 in the desired position. As can be seen spring contact member 22 is capable of projecting through slot 14 and making electric contact with inner conductor 12.

On the opposite side of the cylindrical member 20 are apertures 23 through shoulder members 27. Apertures 23 are aligned to hold a spring means 24 that comprises a leaf spring having a curved inner portion and hooked end portions. The hooked end portions extend through apertures 23 flexibly holding contact means 24 in the desired position for cotnaining shield 11 and resiliently holding the variable shorting device to desired location along line 10. A screw means 25 extends through a threaded opening in the wall of cylindrical member 20 for pressing against the spring means 24 thereby locking the variable shorting device along the length of line 10.

In operation, high-frequency, electro-magnetic wave energy flows through inner conductor 12 in the normal manner. The variable shorting device 20 is slid onto the end of line 10 in alignment with slot 14 so that the spring contact means 22 extends into slot 14 and bears on the inner conductor 12. The shorting device 20 is then slidably moved along the length of the slotted portion of line 10 to the desired position. At this desired position, spring contact means 22 electrically connects conductor 12

to shield **11** either directly through cylindrical member **20** or through spring member **24** and then through cylindrical member **20**. After the desired position of the variable short is found by sliding adjustment, screw **25** is then turned locking the shorting device in that position. The end of screw **25** extending through the wall of cylindrical member **20** presses against the width dimension of leaf spring **24** thereby reducing the possibility of screw member **25** piercing the outer metallic shield **11** of the coaxial line **10**.

As a representative showing in FIGURE 6, a 22 inch stub line made of the type solid dielectric coaxial line previously described may be coiled to occupy a one inch cube. Such a solid dielectric line would be equal in electrical lengths to a 32 inch air dielectric line, as the electrical length is inversely proportional to the square root of the dielectric constant of the line insulating material. A 32 inch air dielectric line would occupy considerably larger space than a one inch cube and could not be bent to any configuration as can the solid dielectric line.

Having described my invention, I claim:

1. A variably shorted coaxial line comprising, a substantially flexible, solid dielectric coaxial line with an outer metallic shield and at least one inner conductor, said coaxial line having a longitudinal slot through said outer shield exposing said inner conductor along a given length of said line, a conductor member adapted to be slidably positioned on said line along said slot and be in electrical contact with said shield, contact means held by said conductor member and projecting through said slot for electrically connecting said inner conductor to said conductor member at the particular point of location of said conductor member along said length of said line, and resilient means held by said conductor member on the side of said line substantially opposite to said contact means for biasing said contact means into said contact with said inner conductor.

2. A variably shorted coaxial line comprising, a solid dielectric coaxial line with an outer metallic shield and at least one inner conductor, said coaxial line having a narrow longitudinal slot through said outer shield and through said solid dielectric exposing only one side of said inner conductor along a given length of said line, a cylindrical conductor member adapted to fit around said line, said conductor member having open ends and a diameter exceeding the diameter of said coaxial line, said open ends having inwardly projecting shoulder portions, said shoulder portions having aligned apertures therethrough at locations on opposite sides of said cylindrical member, spring contact means held by said apertures for electrically connecting said inner conductor to said cylindrical member and spring means held by said apertures for resiliently holding said cylindrical member at a particular position along said line and for providing electrical contact between said shield and said cylindrical member.

3. A variably shorted coaxial line comprising, a flexible solid dielectric coaxial line with an outer metallic shield and an inner conductor, said coaxial line having a narrow longitudinal slot through said outer shield and through said solid dielectric exposing said inner conductor along a given length of said line, a cylindrical conductor member adapted to fit around said line, said cylindrical member having open ends and a diameter exceeding the diameter of said coaxial line, said open ends having inwardly projecting shoulder portions, said shoulder portions having aligned apertures therethrough at locations on opposite sides of said cylindrical member, spring contact means for electrically connecting said inner conductor to said cylindrical member, spring means for holding said cylindrical member to a particular position along said line and for providing electrical contact between said shield and said cylindrical member, said spring contact means having a curved length with hooked end portions, said hooked end portions projecting through aligned ones

of said apertures in said shoulders in a manner that said curved portion is biased away from said cylindrical member and into said slot electrically contacting said conductor, said spring means having a curved length with hooked end portions, said hooked end portions projecting through other of said aligned apertures at a position on the side opposite said spring contact means in a manner that said curved portion of said spring is biased away from said cylindrical member and into electrical contact with said shield, and screw means projecting through said cylindrical member and into contact with said curved length of said spring means for forcing said curved length into contact with said shield locking said cylindrical member to said line at said particular position.

4. A variable shorting device for a substantially flexible, solid dielectric coaxial line having an outer metallic shield with a longitudinal slot through said outer shield and said solid dielectric exposing only one side of at least one inner conductor along a given length of said line, said shorting device comprising a conductor member adapted to be slidably positioned on said line along said slot and in electrical contact with said shield, contact means held by said conductor member and projecting through said slot for electrically contacting only said one side of said inner conductor connecting said inner conductor to said conductor member at the particular point of location of said conductor member along said length of said line, and resilient means held by said conductor member on the side of said line substantially opposite to said contact means for biasing said contact means into said contact with said inner conductor.

5. In a variably shorted coaxial line having an outer metallic shield with a longitudinal slot through said outer shield and through said solid dielectric exposing an inner conductor along a given length of said line, a shorting device comprising a conductor member adapted to fit around said line and electrically contact said shield, spring contact means held by said conductor member on one side thereof and projecting through said slot for electrically connecting said conductor to said conductor member at a particular point of location of said conductor member along said length of said slot, and spring means held by said conductor member on the side of said conductor member opposite said one side for biasing said spring contact means into contact with said inner conductor member.

6. A variable shorting device for a solid dielectric coaxial line having an outer metallic shield with a longitudinal narrow slot through said outer shield and through said solid dielectric exposing an inner conductor along a given length of said line, said shorting device comprising, a conductor member being capable of fitting around said line and in electrical contact with said shield, said conductor member having a length shorter than the longitudinal length of said slot and being capable of slidably moving along said line, spring contact means held by said conductor member on one side thereof and projecting through said slot for electrically connecting said inner conductor to said conductor member at a particular point of location of said conductor member along said length of said slot, spring means held by said conductor member on the side of said conductor member opposite said one side for biasing said spring contact means into contact with said inner conductor, and lock means coacting with said spring means for locking said conductor member at a location along said line.

7. A variable shorting device for a solid dielectric coaxial line having an outer metallic shield with a longitudinal slot through said outer shield and through said solid dielectric exposing an inner conductor along a given length of said line, said shorting device comprising, a conductor member adapted to fit around said line and electrically contact said shield, spring contact means held by said conductor member on one side thereof and projecting through said slot for electrically connecting said

inner conductor to said conductor member at a particular point of location of said conductor member along said length of said slot, spring means held by said conductor member on the side of said conductor member opposite said one side for biasing said spring contact means into contact with said inner conductor, and lock means co-acting with said conductor member and said line for locking said conductor member to said line.

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