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2,526,579

VARIABLE REACTOR

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FIG. 1

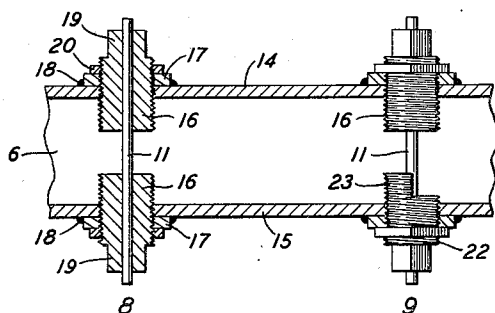


FIG. 3

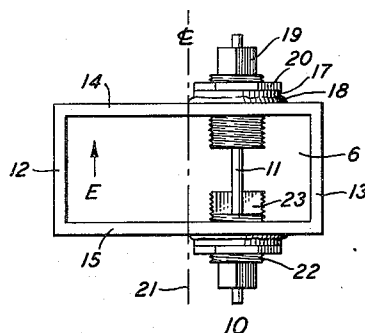


FIG. 2

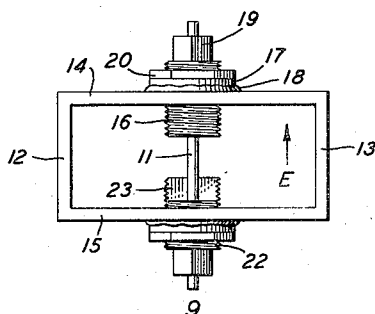


FIG. 4

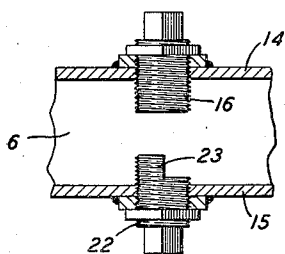
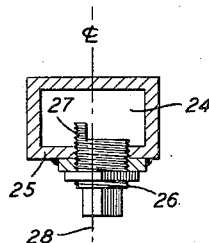


FIG. 5



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VARIABLE REACTOR

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15 Claims. (Cl. 178-44)

1

This invention relates to wave transmission and more particularly to variable reactors for use in wave guides.

An object of the invention is to provide a variable reactance which may be associated with a wave guide.

Another object is to provide a variable wave guide reactor which may easily be converted from an inductive to a capacitive element.

A further object is to provide a wave guide reactance, either inductive or capacitive, which may be varied simultaneously both in magnitude and in effective location within the guide.

In guided wave transmission systems there is often required a lumped shunt reactance which may be varied in magnitude as desired. Such a device may, for example, be used in wave transmission networks, such as wave filters. Another important use is in eliminating an undesired standing wave in a wave guide. In these, and in other applications, it is often also required that the effective location of the reactance within the guide be adjustable.

One embodiment of the variable wave guide reactor in accordance with the present invention comprises a rod which extends across the guide parallel to the electric field of the electromagnetic wave being transmitted. Such a rod provides an inductive shunt reactance the value of which depends, for one thing, upon its diameter. Therefore, in order to vary the reactance, means are provided for varying the effective diameter of the rod. These means may, for example, comprise a tuning plug of larger diameter than the rod, mounted upon one end thereof and movable along the rod. The plug may conveniently be screwed through a wall of the guide. In order to preserve the mechanical and electrical symmetry, which is sometimes desirable, a second similar tuning plug may be associated with the other end of the rod. As these plugs are moved toward each other the effective diameter of the rod is continuously increased, thereby decreasing the inductance and, consequently, the reactance.

In a modification of the invention the effective location of the reactance within the guide may be varied by providing an asymmetrical projection or probe on the inner end of the tuning plug, or one of the plugs if two are employed. This plug is arranged for rotation about its axis so that the center of the projection moves around the axis as the plug is rotated. If the plug is screwed through a wall of the guide both the magnitude of the reactance and its location are varied as the plug is screwed in or out.

2

If a capacitive, instead of an inductive, shunt reactance is desired, the rod may be omitted. If an extremely fine adjustment is not required the asymmetrical tuning plug may be used alone.

Reactors of the type described have their minimum reactance when located at the center of the guide, where the electric field has its greatest intensity. Also, the screw-type asymmetrical tuning plug, when centrally positioned, has a minimum change in reactance while being screwed through one turn. This may be an advantage when the emphasis is upon varying the location, rather than the magnitude, of the reactance.

Moving the reactor away from the center of the guide increases its reactance. For the inductive reactor, employing a rod, this permits using a rod of larger diameter, which is desirable in some cases from the mechanical standpoint. Then, too, the off-center, screw-type, asymmetrical plug provides a greater change in reactance during a single turn. This property is sometimes desirable as, for example, when a single plug is used to eliminate a standing wave in a guide.

The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawings, in which like reference characters refer to similar or corresponding parts and in which:

Fig. 1 shows in longitudinal section a wave guide incorporating two centrally positioned variable inductive reactors in accordance with the invention;

Fig. 2 is an end view of the wave guide and reactors shown in Fig. 1;

Fig. 3 is an end view of a wave guide incorporating an inductive reactor in accordance with the invention positioned off-center;

Fig. 4 is a longitudinal sectional view of a capacitive reactor in accordance with the invention; and

Fig. 5 is a transverse sectional view of a wave guide incorporating a single, asymmetrical capacitive tuning plug in accordance with the invention positioned off-center.

Figs. 1 and 2 show a section of wave guide 6 within which are located two variable shunt inductive reactors 8 and 9 in accordance with the invention. The reactor 8 comprises a rod 11, which may be made of metal, extending across the guide 6 in a direction parallel to the electric field E of the electromagnetic wave transmitted by the guide. When the guide 6 is of rectangular cross-section, with unequal cross-sectional dimensions, as shown, the electric field E will be

3

parallel to the narrower sides 12 and 13, as indicated in Fig. 2 by the arrow. The rod 11, therefore, is parallel to the sides 12 and 13 and extends across the guide 6 from one of the wider sides 14 to the opposite side 15. Each end of the rod 11 is slidably mounted in a tuning plug 16 of greater diameter than the rod 11. The plug 16 is threaded for engagement with the threads of tapped holes in the side 14 or 15 and a reinforcing disc 17, soldered to the side 14 or 15 as shown at 18. The plugs 16 have their outer ends 19 squared to facilitate turning and are locked in their adjusted position by means of a lock nut 20.

As the plug 16 is turned it moves along the rod 11, varying the effective diameter of the element as a whole and thereby varying the reactance. The reactance of the reactor 8 will be a maximum when the plugs 16 are flush with the sides 14 and 15, respectively, and a minimum when the plugs meet at their inner ends. There is thus provided a continuously variable wave guide inductor of simple construction.

The variable reactor 9 is similar to the reactor 8 just described except that one of the tuning plugs 22 is partly cut away at its inner end to leave an asymmetrical projection 23. Now, as the plug 22 is turned the center of the projection 23 describes a spiral about the axis of the plug. Since the effective location of the reactor 9 is dependent, to a certain extent, upon the position of the projection 23 it follows that the effective location of the reactance may be varied by turning the plug 22. Also, as the plug 22 is screwed in the inductance of the element 9 is decreased. There is thus provided a wave guide reactance which may be simultaneously varied both in magnitude and in effective location within the guide. The plug 16 associated with the reactor 9 may be screwed in or out for a fine adjustment of the magnitude of the inductance without affecting its location.

In the embodiment shown in Figs. 1 and 2 the reactors 8 and 9 are centered transversely in the guide 6. When thus centered, the inductance of the inductor 9 will undergo a minimum variation as the asymmetrical plug 22 is rotated through a single turn. This is of advantage when the object is to vary the location of the reactance with minimum change in its magnitude.

When centered, a given inductor such as 8 or 9 will have minimum inductance. The inductance may be increased by making the rod 11 smaller. However, a very large value of inductance may require a rod 11 too small for mechanical stability. This difficulty may be overcome by moving the inductor off center, which will increase the inductance for a rod of given diameter. Fig. 3 shows, for example, an end view of a wave guide 6 incorporating an inductive reactor 10 which is similar in all respects to the reactor 9 except that it is centered on one side of the center line 21 of the guide 6. When so positioned, a single turn of the asymmetrical plug 22 will cause a greater variation in the inductance, which may be desirable under some circumstances.

The inductive reactor 9 or 10 may be easily converted into a variable capacitive reactor by removing the rod 11, or at least that portion extending between the tuning plugs 16 and 22, as shown in Fig. 4. The plugs 16 and 22 oppose one another and may either be centered in the guide 6, as shown in Fig. 2, or located off center, as shown in Fig. 3. As the plug 22 is screwed into the guide 6 the capacitance is increased and

4

at the same time the effective location of the reactance is shifted longitudinally as the projection 23 moves from a position to the left of the axis of the plug 22, as shown, to a position to the right thereof. The plug 16 is screwed in or out to provide a fine adjustment of the capacitance only.

When an extremely fine adjustment of the capacitance is not required a single asymmetrical tuning plug may be used, as shown in Fig. 5. Fig. 5 is a transverse sectional view of a wave guide 24 of rectangular cross-section through one of the wider sides 25 of which is inserted the tuning plug 26. The plug 26 is similar to the plug 22 but the asymmetrical projection 27 has a smaller cross-sectional area compared to the cross-sectional area of the main portion of the plug. The plug 26 may be centered in the guide 24 or, as shown, it may be centered to one side of the center line 28 of the guide. When positioned off center the plug 26 has less capacitance, and consequently a higher impedance, and also during a single turn the reactance undergoes a greater variation than if the plug is centered. Such an off-center plug is particularly useful in eliminating an undesired standing wave in a wave guide.

What is claimed is:

1. In combination, a wave guide, a conductive rod extending transversely across said guide, a low impedance path between the walls of said guide and each end of said rod, and a tuning plug of greater diameter than said rod, said plug being mounted upon said rod and movable therealong and projecting through a wall of said guide part-way only across said guide.

2. The combination in accordance with claim 1 in which said tuning plug screws through said wall of said guide.

3. The combination in accordance with claim 1 in which said tuning plug is rotatable and has on its inner end a projection which is asymmetrical with respect to the axis of rotation of said plug.

4. A variable reactor comprising a wave guide, a conductive rod extending transversely across said guide, a low impedance path between the walls of said guide and each end of said rod, and a rotatable tuning plug of greater diameter than said rod mounted thereupon within said guide, said plug having on one end thereof a projection which is asymmetrical with respect to the axis of rotation of said plug.

5. A variable reactor in accordance with claim 4 in which the other end of said plug screws through a wall of said guide.

6. A variable reactor comprising a section of wave guide, a pair of opposed tuning plugs projecting into said guide through opposite walls thereof, a conductive rod of smaller diameter than said plugs connecting the inner ends thereof, and means for varying the distance between said plugs.

7. A variable reactor in accordance with claim 6 in which one of said plugs is rotatable and has on its inner end a projection which is asymmetrical with respect to the axis of rotation of said plug.

8. In combination, a wave guide and a rotatable plug projecting through a wall of said guide part-way only across said guide, said plug having on its inner end a projection which is asymmetrical with respect to the axis of rotation of said plug.

9. The combination in accordance with claim 8

5

in which said plug is transversely centered in said guide.

10. The combination in accordance with claim 8 in which said plug is centered to one side of the center of said guide.

11. The combination in accordance with claim 8 in which said plug is made of conductive material.

12. The combination in accordance with claim 8 in which said plug screws through said wall.

13. The combination in accordance with claim 8 which includes a rod conductively connecting the inner end of said plug to the opposite wall of said guide.

14. The combination in accordance with claim 8 which includes a rod conductively connecting the inner end of said plug to the opposite wall of said guide, said rod being removable.

15. A variable reactor comprising a section of wave guide, a pair of opposed tuning plugs projecting into said guide through opposite walls

6

thereof, and means for varying the distance between said plugs, one of said plugs being rotatable and having on its inner end a projection which is asymmetrical with respect to the axis of rotation of said plug.

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