June 10, 1969 P. V. COOPER 3,449,698
REACTIVE WAVEGUIDE POST
Filed March 24, 1967

Fig. 1.

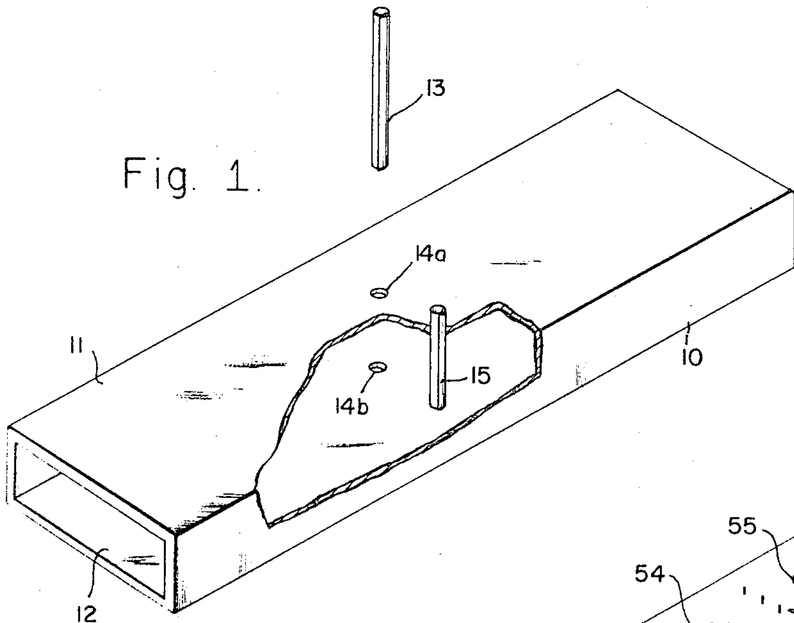


Fig. 4.

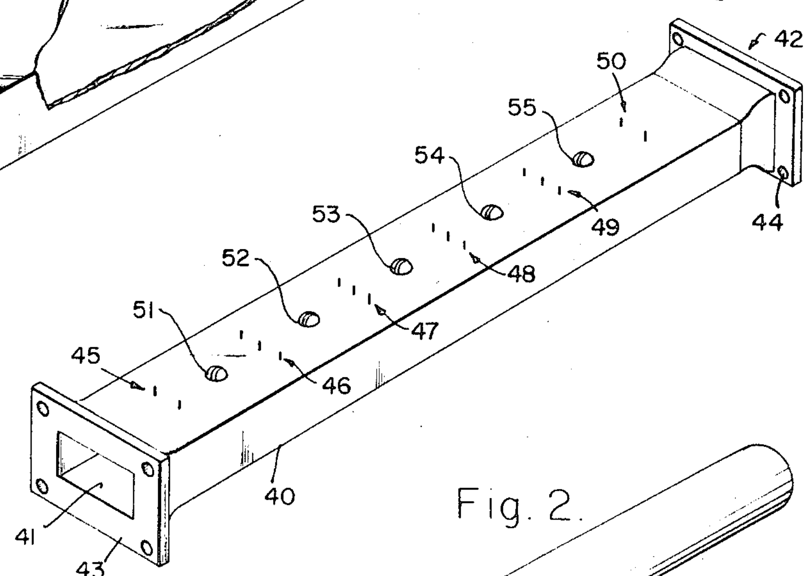


Fig. 2.

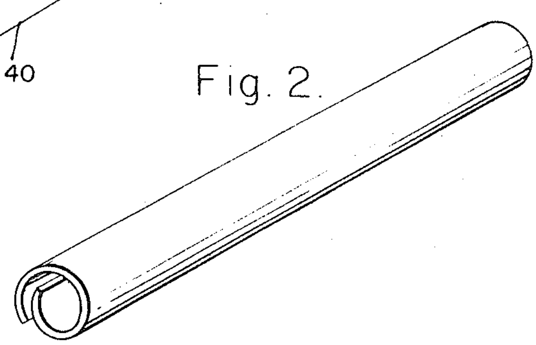
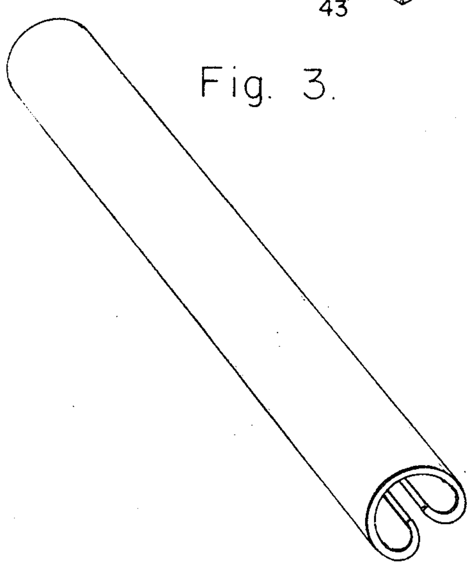


Fig. 3.



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3,449,698
REACTIVE WAVEGUIDE POST

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U.S. Cl. 333—98 3 Claims

ABSTRACT OF THE DISCLOSURE

An improved technique for the placement of reactive posts in hollow waveguiding structures. In order to simplify the mounting of conductive posts inside a waveguide, use has been made of spring-like roll pins. According to this technique, a hole or holes are drilled through the walls of the waveguide in the desired location. The roll pin is then deformed by squeezing, inserted through the hole or holes, and then released. The torsional spring action of the roll pin against the interior of the hole provides the electrical and mechanical connection. No soldering or other bonding is required.

FIELD OF THE INVENTION

This invention relates to electromagnetic waveguiding structures and more specifically to improved techniques for the utilization of conductive posts in said structures.

DESCRIPTION OF THE PRIOR ART

Hollow conductively bounded waveguide structures have been used for many years in connection with the transmission and utilization of microwave energy. In addition to their most common application—as a transmission media for electromagnetic wave energy—waveguides are also utilized as the basic building block for many active and passive microwave devices. For example, obstacles such as screws, posts, windows and irises have been utilized in waveguides for impedance matching, tuning or filtering.

If it is desired to introduce a capacitive load in a waveguide operating in the dominant TE_{10} mode, a post which extends into the interior of the guide from one wall parallel to the electric field vector can be utilized. By the same token, a post extending in the same direction completely across the waveguide between opposite walls will yield an inductive shunt susceptance. Of course, several posts and other obstacles can be, and usually are, used in combination to produce the desired network.

In the past, many techniques have been employed to locate and hold reactive posts in waveguides. Since the placing of such posts requires both good electrical and mechanical contact with the waveguide walls, bonding techniques such as soldering, brazing and welding have been widely utilized. Often, however, it is desirable to employ waveguides fabricated of materials, such as aluminum, which are not readily adapted to such bonding techniques. Of course, it is possible to first apply a coating or film of solderable material to a waveguide such as this to which the reactive posts may be soldered. This process, however, introduces other manufacturing steps in the fabrication process, thereby increasing costs.

With assemblies utilizing waveguides fabricated of aluminum or other material with which the above-mentioned bonding techniques are unsuitable, other approaches have been utilized. These include the use of threaded posts inserted into tapped holes in the waveguide wall or posts which are pressed into the holes in the waveguide walls. These techniques, however, are somewhat time-consuming, especially where many units are to be assembled.

It is an object of the present invention to provide a simplified technique for the placement of reactive posts in waveguides.

It is another object of the present invention to provide a simple reactive post-waveguide assembly requiring no bonding material.

SUMMARY OF THE INVENTION

In accordance with the principles of the present invention, these objects are accomplished with the aid of reactive posts of a special design which, when inserted into machined holes in a waveguide wall, provide the required mechanical and electrical contact by their inherent torsional spring action. This constrcution technique is made practical through the use of posts in the form of "roll pins" which are formed of a resilient conductive material such as stainless steel. The parts are formed by rolling a thin sheet of the material into a substantially circular cylinder of the desired diameter.

In practicing the present invention, holes are drilled through the walls of the waveguides in the desired locations. The diameter of each hole is slightly less than the diameter of the roll pin which is to be inserted therein. By applying pressure to opposite sides of the roll pins with pliers or other gripping instruments its diameter is decreased. The post is then easily inserted into the hole or holes. When the grip on the post is released the torsional spring action of the material causes the post to bear against the inside of the hole, thereby insuring the electrical and mechanical union desired.

BRIEF DESCRIPTION OF THE DRAWING

In order that the invention may be clearly understood and readily carried into effect it will now be described with reference, by way of example, to the accompanying drawing, in which:

FIG. 1 is a pictorial view, partially broken away, of an embodiment of the present invention.

FIG. 2 is an enlarged pictorial view of a roll pin useful in practicing the present invention.

FIG. 3 is an enlarged pictorial view of another roll pin of alternative geometry useful in practicing the present invention; and

FIG. 4 is a pictorial view of a five-section bandpass filter constructed in accordance with the teachings of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more specifically to the drawing, FIG. 1 is a pictorial view, partially broken away, of one embodiment of the present invention. In FIG. 1 a section of rectangular waveguide **10** having a pair of broad walls **11** and **12** is shown. In general, waveguide section **10** can be fabricated of a suitable conductive material such as brass, copper or aluminum. In addition, waveguide section **10** can be plated or coated with a thin layer of other material for improved conductivity or corrosion resistance.

A first inductive post **13** is shown in an unassembled position above waveguide section **10** opposite holes **14***a* and **14***b*, between which the post is to be mounted. A second conductive post **15** is shown in its assembled position extending between broad walls **11** and **12** of waveguide section **10**. Extending between broad walls **11** and **12**, posts **13** and **15** provide a shunt inductive load to wave energy propagating through waveguide **10** in the dominant mode.

As previously indicated, with a structure such as this, posts **13** and **15** are usually bonded to the waveguide walls by brazing, welding or soldering techniques. In keeping with the present invention, however, posts **13** and **15** comprise roll pins which have diameters slightly greater than the holes in which they are mounted. The roll pins are deformed within the elastic limits of the material from which they are fabricated by means of pliers or other gripping implements. While so deformed they can be readily inserted through the waveguide walls.

In FIGS. 2 and 3 there is shown in enlarged views two alternative roll pin configurations useful in practicing the present invention. The roll pins of FIGS. 2 and 3 can be fabricated of a thin sheet of conductive material having sufficient toughness and resiliency to withstand moderate deformation within its elastic limit. Roll pins of stainless steel are commercially available and have been employed for this purpose with satisfactory results. Although unplated stainless steel roll pins are generally satisfactory, it is, of course, possible to first plate the pins with a material having a higher conductivity.

After insertion through the holes formed in the broad walls of waveguide **10**, the pins are released. The resiliency of the pins causes them to tend to assume their original diameters, thereby causing them to bear against the inside surface of the holes. Thus, the bearing force of the roll pins against these surfaces provide the mechanical and electrical union required.

In FIG. 4 there is shown a pictorial view of a five-section microwave bandpass filter utilizing the inductive post configuration of the present invention. The filter of FIG. 4 utilizes the electrical design procedure described in an article entitled "Design of Microwave Filters With Multiple Post Susceptance" by K. B. Whiting, appearing in the Proceedings of the I.R.E. Australia, August 1963, at pages 623–630.

Briefly, this filter comprises a section of rectangular waveguide **40** having an input end **41** and an output end **42**. Coupling flanges **43** and **44** at the input end and output end respectively, facilitate coupling of the filter structure to other components of the microwave system in which it is employed. A first pair of posts comprising roll pins **45** is disposed in waveguide **40** near input end **41** in the manner described above in connection with FIG. 1. A set of three posts comprising roll pins **46** is disposed in waveguide **40** at a second transverse region. Similarly, consecutive sets of three posts each, **47**, **48** and **49**, are disposed along waveguide **40** at separate transverse regions. Finally, a second pair of posts consisting of roll pins **50** is located in waveguide **40** near the output end **42**.

The net inductive susceptance of the sets of posts **45** through **50** serve to define five separate coupled cavity regions within waveguide **41**. Tuning of the first coupled cavity is achieved by a tuning screw **51** which extends through the center of one of the broad walls of waveguide **40** between posts **45** and **46**. Similarly, the second, third, fourth and fifth cavities are tuned by means of tuning screws **52**, **53**, **54** and **55**.

In all cases, it is understood that the above described embodiments are merely illustrative of but a small number of the many possible applications of the principles of the present invention. Numerous and varied other arrangements including those using waveguides of other

cross-sectional diameters can be readily devised in accordance with these principles by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A reactive microwave device comprising, in combination:

a section of hollow conductively bounded rectangular waveguide;

a plurality of reactive obstacles disposed within said waveguide at predetermined locations, each of said reactive obstacles extending between and conductively connected to a pair of opposite walls of said waveguiding structure;

said device characterized by obstacles which comprise hollow thin-walled roll pins of generally cylindrical shape;

said roll pins being fabricated of a resilient conductive material, said roll pins being mounted in apertures formed in said walls at said locations and held therein by the torsional spring action of said pins.

2. In combination:

a hollow conductively bounded waveguiding structure capable of supporting propagating electromagnetic wave energy;

at least one obstacle disposed within said waveguiding structure and electromagnetically coupled thereto, said obstacle comprising a thin-walled roll pin of substantially circular cross section, said roll pin being formed of a resilient conductive material;

at least one circular aperture extending through a wall of said waveguiding structure and adapted to receive said roll pin, said aperture having a diameter slightly less than the diameter of said roll pin.

3. In a microwave device of the type having a conductively bounded waveguiding structure capable of supporting propagating electromagnetic wave energy and having at least one conductive post disposed within said structure and conductively connected to at least one wall thereof, said device being characterized by a conductive post of roll pin construction extending through an aperture in said wall and held therein by the torsional spring action of said roll pin acting on the interior surface of said aperture.

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U.S. Cl. X.R.

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