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[54] **RESISTIVE POWER LOAD**

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[51] **Int. Cl.** **H01p 1/26,** H01p 3/08
[58] **Field of Search** .... 333/22 R, 22 F, 81 R, 81 A, 333/81 B, 84 R, 84 M

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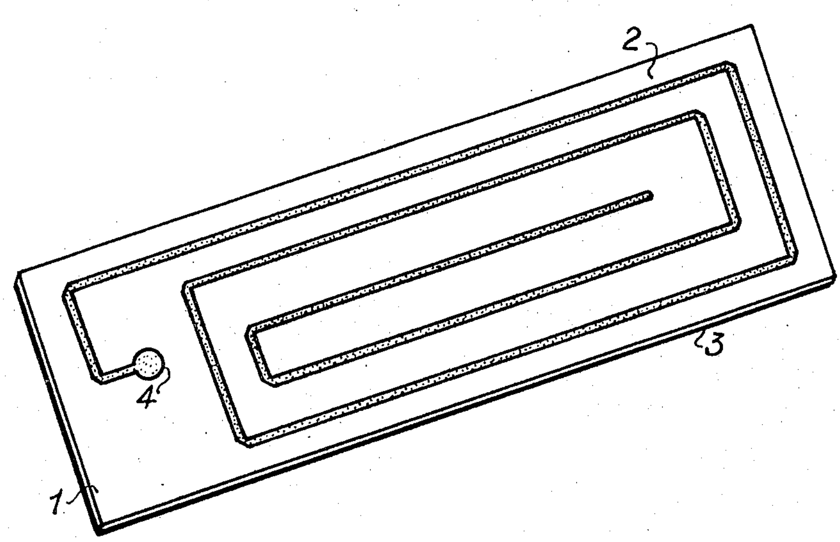
[57] **ABSTRACT**

A resistive power load for a microwave line of microstrip type. This load is constituted by a dielectric arranged between a conductor strip made of a metal having good conductivity, and an earthing plane made of a resistive metal alloy having good thermal conductivity. A load of this kind makes it possible to achieve substantial heat dissipation at the expense of only small volume and low weight.

6 Claims, 4 Drawing Figures



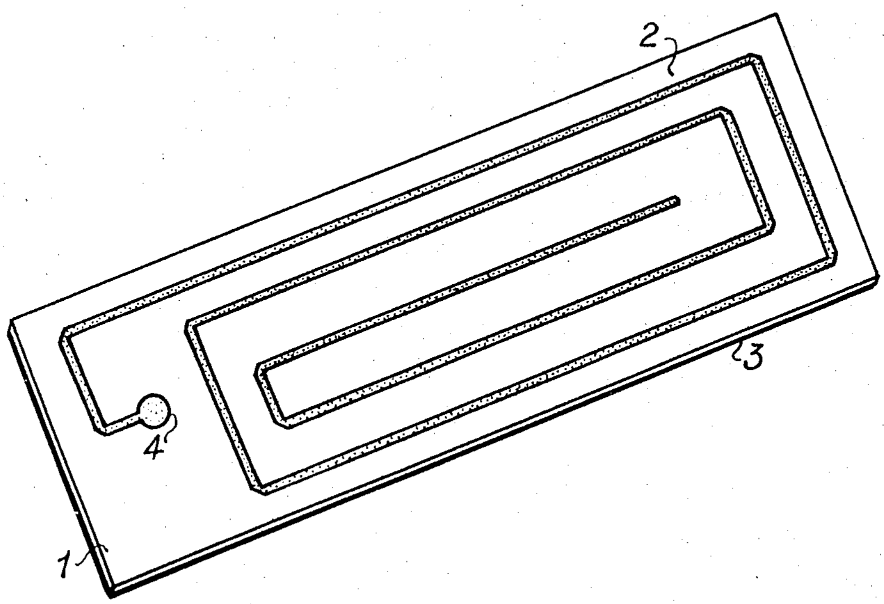


Fig 1

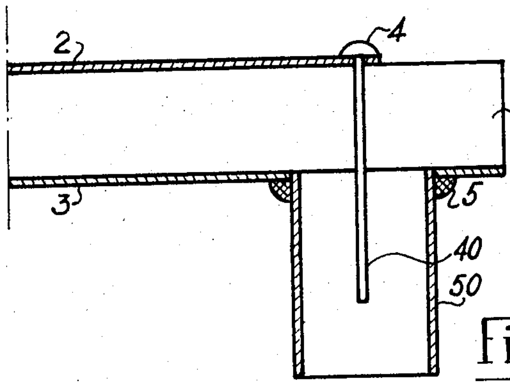


Fig. 2

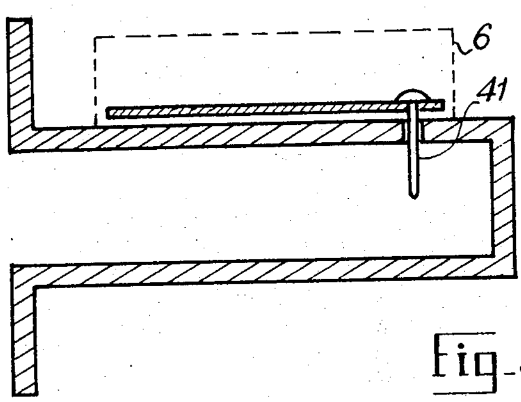


Fig. 3

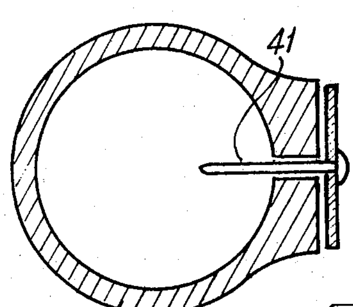


Fig. 4

RESISTIVE POWER LOAD

BACKGROUND

The present invention relates to improvements in resistive power loads, employed in microwave circuits. The invention applies more particularly to the design of a dissipative power load designed for transmission line matching applications, and of the type which produces progressive attenuation and dissipation of the power propagation through the load.

Microwave circuits and in particular circuits such as directional couplers and circulators utilised as insulating devices, frequently require a terminal matching element referred to as a "matched load." The load, in the operating frequency band, should constitute a pure resistance whose value is equal to the characteristic impedance of the circuit.

In accordance with known techniques, power loads are generally manufactured using coaxial line or a waveguide, in which the whole of the power is dissipated in a loss-loaded dielectric.

In accordance with the various solutions adopted, these loads have a greater or lesser size and weight, plus a high cost and high thermal impedance.

SUMMARY OF THE INVENTION

In accordance with the invention, there is provided a resistive power load, designed more particularly to act as a matched load for a microwave transmission line, having a micro-strip structure comprising a dielectric substrate, a metal strip and a metal earthing plane laid on each side of said dielectric substrate, said metal strip being constituted by a metal having a good conductivity, and said earthing plane of the structure being constituted by a resistive metal alloy having good thermal conductivity.

A resistive power load as specified above overcomes the aforesaid drawback.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features of the invention will become apparent from the ensuing description, given by way of non-limitative example with reference to the attached figures in which :

FIG. 1 is an embodiment of a dissipative power load in accordance with the invention ;

FIG. 2 is an example of the connection of the load to a coaxial point ;

FIG. 3 is an example of the matching of a microwave line in the form of a rectangular-section waveguide ; and

FIG. 4 is an example of the matching of a line in the form of a circular-section waveguide.

DESCRIPTION OF THE INVENTION

The object of the present invention is a resistive load of the microstrip type, illustrated in FIG. 1. This structure comprises a dielectric plate **1** or substrate, arranged between a conductive metal strip **2** and a metal surface **3** known as the "earthing plane." The dielectric substrate provides the metal conductors, generally deposited upon it by known techniques such as photogravure, with the requisite mechanical stability.

Substrate **1** utilised, is a low-loss dielectric material in order to limit the thermal dissipation there. Amongst the materials used, quartz and alumina ceramics exhibit

low losses. Beryllium oxide is used preferentially because it offers good thermal conductivity as well. The strip conductor **2** is formed of a metal having good conductivity and the present invention is characterised in that the earthing plane is constituted by a resistive alloy having good thermal conductivity and presenting a resistance to the currents flowing there so that it attenuates the energy of the microwave signal propagating through the structure. Nickel-chrome alloys or titanium and vanadium alloys are used in particular.

The transmission line deposited upon the substrate has a length such that the power is sufficiently attenuated at the end of the said line, and a width such that the impedance presented by the load at its input is equal to the characteristic impedance of the preceding transmission line. The earthing plane has a small thickness, in the order of only 6 to 10 microns, and is electrically at the earth potential of the preceding circuit, being connected to the earthing side of the latter at a single location **5** as close as possible to that end of the conductor strip constituting the load input.

A resistive load produced in accordance with the invention can be fixed flat, by its earthing plane, to a metal chassis or cast element, or thermal radiator. Because the earthing plane is constituted by a resistive metal, electric currents circulate at either side of said earthing plane.

If the surfaces of said earthing plane and the metal radiator element for which the load is to be attached, were perfectly true and flat, the electrical contact produced by their attachment would disturb the operation of the load. Electrical insulation is necessary and is achieved by means of a fine film of beryllium oxide grease or silicone grease, both of which have good thermal conductivity.

Where the surfaces are not particularly true, chance electrical contacts are less of a nuisance but the application of a grease film as indicated hereinbefore, is nervertheless necessary to improve thermal conductivity.

By utilising an aluminium radiator the trued surface of which, in contact with the earthing plane of the load, is covered with a fine film of aluminium oxide, it is possible to avoid the need for grease.

It is possible to manufacture loads in accordance with the invention which are "integrated" with the radiator and produced by integrated cicuit techniques, this using successive deposits upon a flat surface of an aluminium radiator, of a film of aluminium oxide, followed by the resistive earthing plane **3**, the dielectric **1** and the conductor strip **2**.

The arrangement of the conductor strip **2** upon the substrate **1** need not obey any hard and fast rules. FIG. 1 illustrates a load in accordance with the invention, the conductor of which is arranged in a spiral or serpentine form so that the first turns, which dissipate the major part of the load in order to achieve better heat distribution. It is generally necessary to arrange for a spacing between turns, in the order of three or four times the width of the conductor strip, in order to prevent parasitic coupling.

The connection of the load to the preceding circuit, is generally effected by soldering on a coaxial connection such as that shown in FIG. 2. At the input end **4** of the conductor strip, the central conductor **40** of the connection is soldered in position. The outer conductor

50 is connected to the opening plane by a solder ring 5.

The end 4 of the conductor strip is widened to improve impedance matching.

Where it is a waveguide which is being matched, it is possible to utilise a waveguide-coax junction between the waveguide being loaded and the matched load.

FIG. 3 illustrates a method of utilising the load on a waveguide. In this case, the load is attached to an external face of the waveguide, the energy being picked up by an antenna or probe **41** penetrating into the waveguide through an aperture formed in the wall thereof.

A casing **6** can be arranged on the load in order in particular to protect it against corrosion.

FIG. 4 illustrates a type of application to a circular waveguide, constituting a cross-polarisation absorber which makes it possible to absorb a parasitic or unwanted wave.

The use of heavy or bulky elements such as directional or non-directional couplers and prior art matched loads, is advantageously avoided and replaced by a load in accordance with the invention, assembled directly on a waveguide.

When used in mobile radars or transmitter antennas, loads of this kind secure a substantial reduction in the transport powers required.

The matched load described, can advantageously be employed for microwave circuits in particular ones comprising circulators or hybrid junctions. when associated with a circulator, it makes it possible to create a non-reciprocal device with a built-in load.

Its weight and size are around twenty times smaller than matched of conventional mached loads of the same power, and thus make it possible to use it with particular advantage in a small sized primary radar. In radars of this kind, the problem of the shadow created by the primary source, is a critical one. Sources which incorporate bulky elements, reduce the effective area of the antenna.

The use of the matched load in accordance with the invention, makes it possible to reduce the size of the primary source in such radars and consequently to improve their efficiency.

In a general way, these loads can be utilised in all areas of microwave work and can be mass-produced.

What we claim is :

1. A resistive power load, designed more particularly to act as a matched load for a microwave transmission line, having a micro-strip structure comprising a dielectric substrate, a metal strip and a metal earthing plane laid on each side of said dielectric substrate respectively, said metal strip being constituted by a metal having a good conductivity and said earthing plane of the structure being constituted by a resistive metal alloy having good thermal conductivity.

2. A resistive power load as claimed in claim **1**, wherein the metal strip is arranged upon the substrate in spiral or serpentine form, a first turn bordering the edges of the substrate and the remainder of the strip converging towards the centre thereof, the spacing between turns remaining in the order of three or four times the width of the strip and the overall dimensions of such a load being large compared with the wavelength of operation.

3. A resistive power load as claimed in claim **1**, comprising further a chassis wherein a film of silicone grease is supplied between the earthing plane and the chassis being also called metal radiator, in order to electrically insulate said earthing plane from said chassis whilst achieving good thermal conductivity.

4. A resistive power load as claimed in claim **3**, wherein a film of beryllium oxide grease is applied between the earthing plane and the chassis.

5. A resistive power load as claimed in claim **1**, which is manufactured by the successive deposition upon a flat face of an aluminium thermal radiator, of an aluminium oxide film, a resistive metal film, a thick dielectric film, and finally, the conductive strip.

6. In combination, a resistive power load as claimed in claim **1** and a waveguide, energy propagating in said waveguide and said energy being transmitted to said load for dissipation therein, said waveguide comprising at least a wall and said wall being in contact with said earthing plane of said load, a conductive probe being fixed to said load, an aperture in said wall of said waveguide for disposing said probe in said waveguide, whereby said energy propagating in said waveguide is picked up by said probe and transmitted to said dissipative load.

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