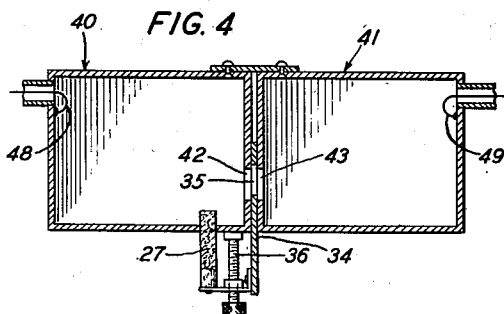
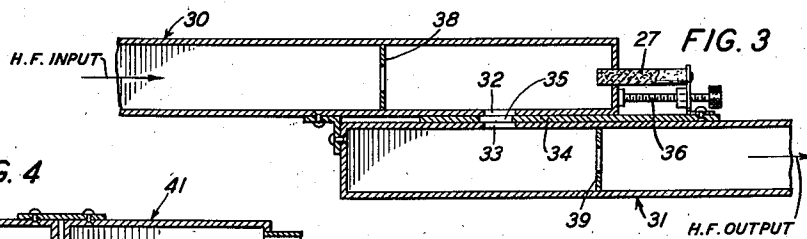
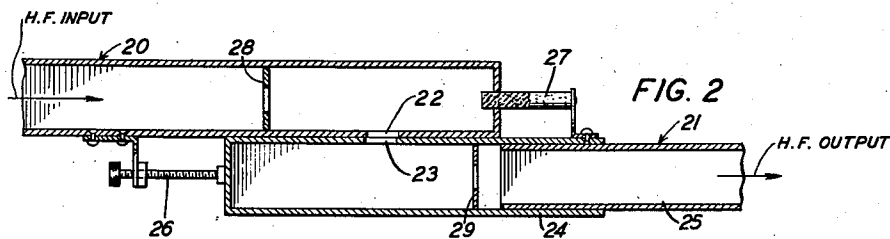
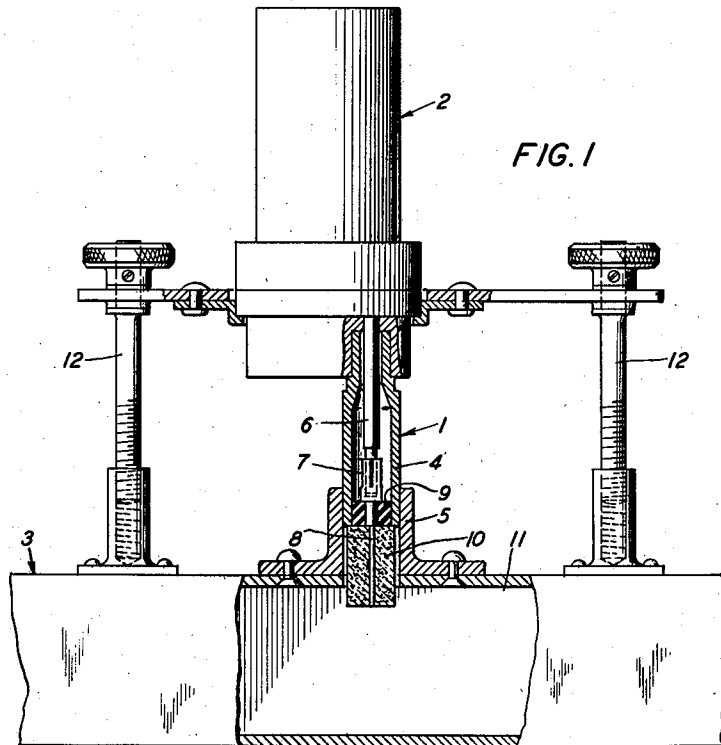


Dec. 18, 1951

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HIGH-FREQUENCY ENERGY ABSORBING,  
VARIABLE COUPLING DEVICE  
Filed Jan. 30, 1946

2,579,327



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2,579,327

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VARIABLE COUPLING DEVICENeen Lund, East Orange, N. J., assignor to Bell  
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Application January 30, 1946, Serial No. 644,269

13 Claims. (Cl. 178-44)

1

This invention relates to high frequency devices in which two circuits are coupled together to effect a transfer of high frequency energy therebetween.

An object of the invention is to reduce undesirable effects of changes in coupling between two high frequency circuits.

Another object is to obtain a broad band frequency characteristic for a wide range of coupling values.

Another object is to provide a coupling means which, while having the above desired characteristics, occupies a small space and is relatively simple and inexpensive.

Another object is to provide a desired type of coupling means which, while providing the desired coupling between two circuits, minimizes the effect or irregularities (such as impedance variations) of one circuit upon the other.

Usual types of high frequency couplings are sharply selective with respect to frequency, particularly at some adjustments of the coupling. Also wide variations in load and impedance are encountered as changes in coupling are made.

According to the present invention such difficulties are overcome by including in the device means for inserting loss in a circuit as the load on it is decreased with reduced coupling. In a preferred embodiment this loss is obtained by inserting loss material in to the high frequency electric field associated with the circuit.

Details of the invention are given in the following description and the appended drawings, in which:

Fig. 1 shows an embodiment where energy from a high frequency oscillator is delivered to a wave guide through a variable coupling arrangement between the wave guide and a coaxial line connected to the oscillator;

Fig. 2 shows an embodiment where the variable coupling is between two wave guide structures;

Fig. 3 shows a modification of Fig. 2, and

Fig. 4 illustrates an embodiment where the coupled circuits of the device are resonant cavities.

Fig. 1 illustrates an embodiment of the invention which has been employed and will be used to explain the principles involved. This figure shows a coaxial line 1 which is connected in a

2

known manner to an oscillator 2 and may be energized therefrom to transmit high frequency energy to the wave guide circuit through a variable coupling effected by the probe 8.

Within the scope of the invention the coaxial line may be energized in any suitable manner as well as by the oscillator indicated and other types of circuits may be coupled to it as well as the wave guide type shown. Also, the variable coupling may be from any type of circuit as well as from a coaxial type such as the line 1.

The outer conductor of the coaxial line comprises the members 4 and 5. Member 4 is slidable axially within the member 5 and makes a sliding contact therewith. The inner conductor of the coaxial line comprises the members 6 and 7 which are in electrical contact. The member 7 is supported in the center and at the end of member 4 by the insulating bushing 9. The slender portion 8 of member 7 projects beyond the end of member 4 and constitutes a coupling probe which may be projected into the space of the wave guide 3. The extent of such projection is increased as the member 4 is moved farther into the member 5. Member 10 is a high frequency loss member surrounding the probe portion 8 of member 7 and attached so as to move with the probe 8 in and out of the space of the guide as member 4 is moved in and out of member 5. It will be seen that the movement of member 4 within member 5 is effected by the adjusting screws 12 whereby the separation between the oscillator 2 and the wave guide 3 is altered, member 4 being attached to the oscillator housing and member 5 being attached to the wave guide shell 11. The loss member 10 is of a material capable of absorbing energy from a high frequency field to which it is exposed. This member may be of a mixture of graphite and ceramic, a mixture of graphite and phenolic resin or of any other suitable material. When the coaxial line circuit is energized and the probe 8 is projecting into the space of the wave guide energy will be transferred to the wave guide circuit as determined by the projection of the probe which acts in effect as a small antenna. In addition to the energy thus transferred from the coaxial line circuit to the wave guide circuit energy will be absorbed from the coaxial line circuit by the portion of the loss member 10

3

which is within the member 5 and, therefore, in the high frequency field between the member 5 and the probe 8. When the energy transferred to the guide is reduced by adjusting the screws 12 to increase the separation of the oscillator 2 and the guide 3 and so withdraw the probe 8 and member 10 from the guide space into the member 5 more of member 10 will be in the field of the coaxial line circuit and more energy will be absorbed by it from that field thus compensating for the reduction in energy delivered to the guide. In this manner the load and the impedance termination at the end of the coaxial line are suitably maintained over a range of coupling to the wave guide and undesirable reaction on the oscillator due to impedance changes is avoided.

Figs. 2, 3 and 4 illustrate crudely applications of the invention where a coaxial line coupling is not involved.

In Fig. 2 two wave guides 20 and 21 are coupled through an aperture which is variable in size by relative motion of the two guides. The two guides are in contact with each other or very close together so that in maximum coupling conditions the aperture 22 in guide 20 is aligned with aperture 23 in guide 21 so that high frequency energy may be transferred therethrough from one guide to the other. Guide 21 comprises two sections 24 and 25 which are in contact and may slide one within the other to permit relative longitudinal movement. In the arrangement shown the section 25 and guide 20 are fixed in position and section 24 is movable by means of the adjusting screw 26 to vary the coupling between the guides by varying the opening therebetween through the apertures 22 and 23. A loss member 27 attached to section 24 and so movable therewith is arranged to project through an opening into the space of guide 20 in varying degree as section 24 is moved to vary the coupling. As section 24 is moved to the left to reduce the coupling by reducing the opening through apertures 22 and 23 the loss member 27 is projected farther into the space of guide 20. Member 27 corresponds to member 10 of Fig. 1 previously described and as projected farther into the high frequency field in the space of guide 20 absorbs more energy from it to compensate for the reduction in energy transferred to guide 21 with the reduced coupling. Performance of the device is, therefore, similar to that of Fig. 1. The apertured partitions 28 and 29 may or may not be used. When used they provide a coupling between the closed end portions of the guides and the other portions conducting the energy where desired. By proper placing of these partitions the end portions of the guides may be made resonant chambers, as is well known.

Fig. 3 is similar to Fig. 2 except that a movable plate of conducting material is placed between the two adjacent guides 30 and 31 to vary the opening through the aligned apertures 32 and 33 and thus the coupling between the two guides which are fixed in position. This use of a movable plate makes it unnecessary to have either of the guides movable. The movable plate 34 is provided with an aperture 35 which when aligned with the fixed apertures 32 and 33 provides maximum coupling between the guides. The plate 34 is movable by means of the adjusting screw 36 to vary the alignment of the aperture 35 to vary the opening and thereby the electrical coupling between the guides. The loss member 27 is attached to the plate 34 and moves with it to

4

insert loss into the guide 30 as the load is decreased by reducing the coupling to guide 31 just as described in connection with Fig. 2. The apertured partitions 38 and 39 correspond to the partitions 28 and 29 of Fig. 2 and like them may or may not be used.

Fig. 4 shows an embodiment where two resonant cavities are coupled by a mechanism similar to that of Fig. 3. The plate 34 with aperture 35 is movable between the two adjacent cavities 40 and 41 to alter the opening and thereby the coupling through the apertures 42 and 43 in the shells of the cavities 40 and 41 respectively. The operation of this embodiment is the same as that of Fig. 3, the loss member 27 inserting a compensating loss into the cavity 40 when the coupling to cavity 41 is decreased. The loops 48 and 49 are shown as possible means for transferring energy between the cavities 40 and 41 and external circuits. Any other suitable energy transferring means including electron streams may be employed for this purpose.

It is obvious that many other embodiments of the applicant's invention are possible and that its utility is not limited to those shown as illustrative.

What is claimed is:

1. A high frequency device comprising a first high frequency circuit having an associated space occupied by a high frequency electric field when the circuit is energized, a second high frequency circuit an adjustable coupling between said circuits whereby an adjustable amount of high frequency energy may be transferred from the first circuit to the second circuit, a member of semiconductor material capable of absorbing energy from a high frequency field to which it is exposed and means operably connected to said adjustable coupling for adjustably exposing said semiconductor material to said field space associated with said first circuit whereby an adjustable amount of energy may be absorbed by said member of semiconductor material and the total energy taken from the said first circuit by the adjustable coupling and the semiconductor member maintained substantially constant as said transferred energy is changed.

2. A high frequency device comprising a first high frequency circuit having (when energized) a high frequency electric field associated therewith, a second high frequency circuit an adjustable coupling between said circuits whereby an adjustable amount of high frequency energy may be transferred from the first circuit to the second circuit, a member of semiconductor material capable of absorbing energy from a high frequency field to which it is exposed and which is adjustably exposed to the high frequency field associated with said first circuit, and means comprising a mechanical linkage between said coupling and said semiconductor material for adjusting simultaneously the said coupling between the first and second circuits and the exposure of the semiconductor material to the said high frequency field.

3. A high frequency device comprising means to produce a high frequency electric field in a space, adjustable coupling means to transfer high frequency energy from a high frequency field in said space and a loss member composed of a mixture of conducting and insulating materials capable of absorbing energy from a high frequency electric field when exposed thereto which may be exposed to said field space variably and means comprising a mechanical linkage between

5

said coupling means and said loss member for varying the exposure of the loss member to said field space in accordance with the adjustment of said coupling means.

4. A high frequency device comprising means to produce a high frequency electric field in a space, adjustable coupling means to transfer high frequency energy from a high frequency field in said space, a loss member composed of a mixture of conducting and insulating materials capable of absorbing energy from a high frequency electric field when exposed thereto which may be exposed to said field space variably and means comprising an operating mechanism common to said coupling means and said loss member to adjust simultaneously said coupling means and said exposure of the loss member said simultaneous adjustment operating to reduce said exposure of the loss member when increasing said coupling to increase the high frequency energy transfer.

5. In combination a high frequency wave guide, a coaxial transmission line electrically coupled to the said wave guide, the inner conductor of the coaxial line projecting beyond the outer coaxial conductor and into the space of the said guide, whereby high frequency energy may be transferred from the coaxial line to the guide, means for moving the said inner conductor longitudinally to alter the length of it projecting into the space of the guide whereby the energy transfer to the guide may be varied, a member of loss material composed of a mixture of conducting and insulating materials capable of absorbing energy from a high frequency electric field projecting from the interconductor space of the said coaxial line, and means whereby the said member is moved into the said interconductor space as the said inner conductor is moved to reduce its projection into the said space of the guide.

6. A high frequency device comprising a pair of hollow wave guides which are close together and one of which is movable with respect to the other, apertures in the guides capable of alignment to provide communication therethrough between the interior spaces of the two guides, the degree of alignment of said apertures being adjustable by movement of said movable guide to provide variable electrical coupling between the guides, a member of loss material capable of absorbing high frequency energy from a high frequency field to which it is exposed and means comprising a mechanical linkage between said movable guide and said member of loss material for moving the said loss member into the interior space of one of the guides as the said movable guide is moved to reduce the said coupling between the guides.

7. A high frequency device comprising a pair of hollow wave guides positioned near to each other, apertures in the guides in alignment and capable of providing communication therethrough between the interior spaces of the two guides, a plate of conducting material slidable between the said guides and over the apertures to vary the effective size of the said aligned apertures thus changing the opening between the two guides and the electrical coupling provided thereby, a member of loss material capable of absorbing high frequency energy from a high frequency field to which it is exposed and means comprising a mechanical linkage between said slidable plate and said member of loss material for moving the said member of loss material into the interior space of one of the guides as the said

6

slidable plate is moved to reduce the said coupling between the guides.

8. A high frequency device comprising a pair of resonant hollow cavities adjacent to each other and having apertures in their adjacent sides which are aligned and capable of providing electrical coupling between the interior spaces of the two cavities, a plate of conducting material slidable between the two adjacent sides of the cavities and over the apertures therein to vary the effective size of the opening through the apertures between the interior spaces of the two cavities and so vary the coupling therebetween, a member of loss material capable of absorbing high frequency energy from a high frequency field to which it is exposed and means comprising a mechanical linkage between said slidable plate and said member of loss material for moving the said member of loss material into the interior space of one of the cavities as the said slidable plate is moved to reduce the said coupling.

9. In a high frequency transmission device the combination of a source circuit having a high frequency electric field, an adjustable coupling means for transmitting high frequency energy from said source circuit, a high frequency energy absorbing member of semiconductor material adjustably exposed to said field and a mechanical linkage between said coupling means and said energy absorbing member, said linkage being operative to simultaneously vary the adjustments of said coupling means and said exposure of the energy absorbing member.

10. A high frequency transmission device comprising a pair of circuits each supporting a high frequency electric field when energized, means adjustably coupling the fields of the two circuits to permit the transmission of an adjustable amount of energy from one to the other, a member of semiconductor material capable of absorbing energy from a high frequency field to which it is exposed, means for adjustably exposing the member of semiconductor material to one of the said electric fields and a mechanical connection between said coupling means and said means for exposing the member of semiconductor material, said mechanical connection linking said adjustable coupling and exposing means to provide simultaneous adjustment thereof.

11. A device according to claim 10 in which the adjustable coupling means is a variable aperture in a boundary between the two electric fields.

12. A high frequency device comprising means for producing a high frequency electric field in a space, adjustable coupling means for transferring energy from a high frequency field in said space, a member of energy dissipative material capable of absorbing a substantial amount of energy from a high frequency electric field when exposed thereto, means for adjustably exposing said member to said field space, and means comprising a mechanical coupling between said coupling means and exposing means for adjusting simultaneously said coupling means and said exposure of the member of dissipative material said simultaneous adjusting means acting to reduce the exposure of said energy dissipative material when the coupling adjustment is changed to increase said transfer of energy.

13. In combination a high frequency load circuit, a coaxial transmission line, means for adjustably coupling said transmission line to said load circuit, whereby an adjustable amount of high frequency energy may be transferred from the coaxial line to the load circuit, a high fre-

quency energy absorber, means for adjustably coupling said transmission line to said absorber, whereby an adjustable amount of high frequency energy may be transferred from the coaxial line to the energy absorber, and means comprising a mechanical connection between the two said coupling means for adjusting them simultaneously, the simultaneous adjustment acting to reduce the energy transferred by one of said couplings as it increases the energy transferred by the other coupling.

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