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MEANS OF COUPLING ENERGY TO OR FROM A COAXIAL RESONATOR

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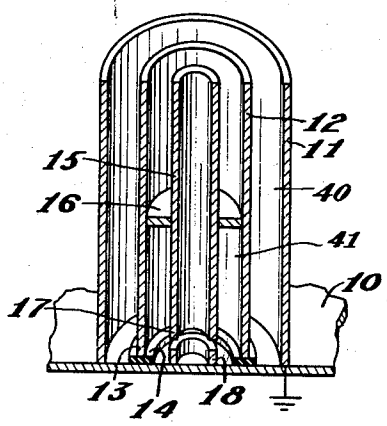


Fig 1

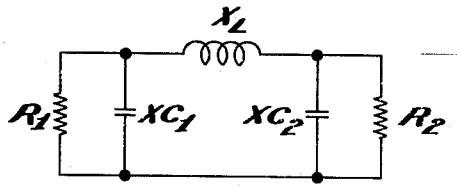


Fig 2

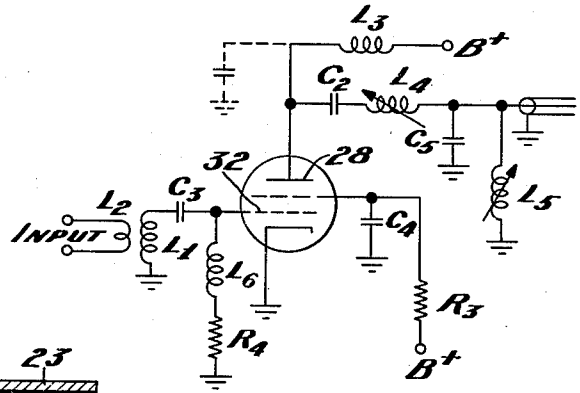


Fig 4

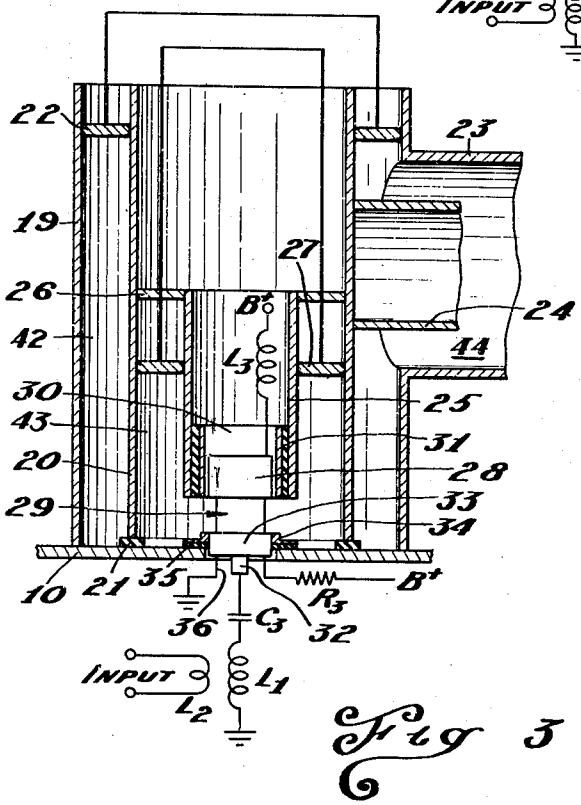


Fig 3

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MEANS OF COUPLING ENERGY TO OR FROM A COAXIAL RESONATOR

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2 Claims. (Cl. 179—171)

This invention relates in general to coupling means and in particular to means for coupling high frequency energy from a coaxial resonator.

It has been customary previously to couple energy from a coaxial resonator by using capacity probes which couple to the electric field or alternatively, by using inductive probes which couple to the magnetic field. The disadvantage of such coupling devices is that they distort the electric and magnetic fields.

It is an object of this invention, therefore, to provide means for coupling energy to or from a cavity resonator in a manner such that the electrical and magnetic fields are not distorted.

Yet another object of this invention is to provide an improved coupling means for a cavity resonator wherein the coupling is symmetrical with respect to the cavity and thus does not substantially distort the magnetic or electrical fields.

A further object of this invention is to provide an improved coupling means which is, in effect, an improved impedance matching means for use at high frequencies.

A feature of this invention is found in the provision for a coupling condenser mounted concentrically about one edge of a high frequency resonator so as to couple energy to or from an external line.

Further features, objects and advantages of the invention will become apparent from the following description and claims when read in view of the drawings, in which:

Figure 1 is a sectional view of a coaxial resonator mounted concentric with a coaxial line according to the principles of this invention;

Figure 2 is a schematic equivalent circuit of the coupling means of this invention.

Figure 3 is a practical embodiment illustrating the use of the principles of this invention in conjunction with a high frequency tube; and

Figure 4 is a schematic diagram of the structure shown in Figure 3.

Figure 1 illustrates a ground plane **10** which might, for example, be a copper plate to which is connected the outer conductor **11** of a coaxial transmission line **40**. The inner conductor comprises a cylinder **12** mounted concentrically within the member **11** and which has its bottom end **13** connected to an annular insulator **14** that is attached to the plate **10**. The insulator or dielectric **14** forms a capacitance between the end of the inner conductor of the transmission line and the ground plane **10**.

Mounted concentrically within the inner conductor **12** is a shaft **15** which may be hollow or solid as desired. It is supported by a conducting annular member **16**. The lower end **17** of the shaft **15** terminates above the plate **10**. An upwardly extending stub **18** is attached to the plate **10** and extends to a point near the end **17**. The stub **18** might be adjustable relative to the end **17** so as to vary the capacitance between the shaft **15** and ground.

The space between the shaft **15** and the inner conductor **12** below the annular member **16** forms a cavity

resonator **41** whose frequency is determined by the position of the annular member **16**. Inner conductor **12** is therefore a common wall between resonator **41** and transmission line **40**.

Energy may be coupled to or from the cavity resonator **41** thus formed by attaching an input or output line to the coaxial transmission line **40** comprising the outer conductor **11** and the inner conductor **12**.

It is to be realized, of course, that the physical dimensions of an input or output line which might be connected to the transmission line may be varied in outside diameter in a fashion well known to those skilled in the art. In general the ratio of the diameters of the inner and outer conductors is maintained constant.

Figure 2 is an equivalent circuit for the structure shown in Figure 1 wherein a resistor R_1 represents the resistive impedance of Xc_1 on the circuit, where C_1 is the capacitance between the stub **18** and the end of the line **15**. The resistance R_2 represents the characteristic impedance of the transmission line formed by **11** and **12**, and the Xc_2 represents the capacitive impedance of the capacitance formed by the insulator **14**.

It is to be noted that the condenser formed by the insulator **14** establishes a symmetrical pattern with respect to the cavity resonator so as to assure that the magnetic and electrical fields contained within the resonator will not be substantially destroyed or distorted.

A practial embodiment wherein a high frequency radio tube is being utilized is shown in Figure 3. The tube may be a 4X150A such as made by Eimac and which contains a screen grid, control grid, plate, and cathode. The plate has an annular ring attached to it with radial cooling vanes attached thereto through which a coolant is forced to dissipate the heat generated.

The plate **10** has a cylindrical member **19** mounted thereon and an inner cylindrical member **20** which is insulated from the plate **10** by an insulation or dielectric ring **21** to form a cavity resonator **42**. An annular conducting plunger **22** is mounted between the member **19** and **20** to tune it. Instead of connecting the coaxial cable to the upper ends of the members **19** and **20** as in Figure 1, the outer conductor **19** may be attached to a second outer conductor **23** which extends from one side and the inner conductor **20** may be connected to a second inner conductor **24** which extends transversely from the member **20** and through the outer conductor **23** to form a coaxial waveguide **44**.

An inner cylindrical member **25** is supported from the member **20** by a disc **26** and terminates above the plate **10**. A plunger **27** is annular in shape and is received between the member **20** and the member **25** so as to tune the cavity resonator **43** thus formed.

The plate **28** of the tube **29** is received within a metal sleeve **30** which is held by an insulative sleeve **31** that is connected to the inside of the member **25**. The grid **32** of the tube is connected to a condenser C_3 and an inductor L_1 which is in turn coupled to an input inductor L_2. The screen grid **33** of the tube is mounted in a metallic conductive disc **34** which is insulated from the plate **10** by an insulator **35**.

The insulation **35** forms a capacitance C_4 to ground. The cathode of the tube is connected to pins **36**, one of which is grounded, and the other is connected to a heating potential. The screen grid is connected to B plus through a resistor R_3.

The equivalent circuit of the structure shown in Figure 3 is shown in Figure 4 wherein like numerals refer to both figures. The plate **28** is connected to B plus through an inductor L_3.

The tube as illustrated may be used as an amplifier wherein the input supplied across the inductor L_2 varies the amplitude of the r. f. energy produced in the cavity

resonator by the tube **29**. The energy generated in the cavity resonator around the tube is coupled by the capacitance **21** which is designated as C_5 in Figure 4 and to the output coaxial line. L_4, L_5, and C_2 represent the equivalent circuit of the cavity resonator, and the plunger **27**, and voltage blocking condenser formed by insulation **31**.

It is seen that this invention provides means for coupling energy to and from a cavity resonator in a symmetrical fashion and in a manner not previously known.

Although the invention has been described with respect to particular embodiments thereof, it is not to be so limited as changes and modifications may be made therein which are within the full intended scope of the invention as defined by the appended claims.

I claim:

1. A symmetrical coupling system comprising, a ground plate, a first hollow cylindrical member connected to said ground plate and forming the outer conductor of a coaxial transmission line, a second hollow cylindrical member supported within the first cylindrical member and forming the inner conductor of a coaxial transmission line, an annular insulator attached between said ground plate and the lower end of said second cylindrical member to symmetrically pass electrical wave energy, a first tuning plunger generally annular in shape mounted between the first and second cylindrical members, a disc mounted within the second cylindrical member, an inner cylindrical member attached to said disc and extending downwardly therefrom, a second tuning plunger mounted between the inside of the second cylindrical member and said inner cylindrical member to tune the cavity resonator thus formed, means for injecting energy into said cavity resonator, an output coaxial line comprised of a first transverse cylindrical member attached to the first cylindrical member, and a second inner transverse conductor attached to the second cylindrical member and passing concentrically through the first transverse member, said coupling system providing an impedance match between said energy injection means and said output coaxial line.

2. Means for efficiently coupling an electron tube to an output coaxial line comprising, a ground plate, a first hollow conducting cylindrical member attached to said ground plate, a second hollow conducting cylindrical member mounted concentrically within said first cylindrical member, an annular dielectric member attached between an end of said second cylindrical member and said ground plate, a disc mounted within said second hollow cylindrical member, an inner conducting cylindrical member attached to said disc and extended toward said ground plate, a first tuning plunger generally annular in shape mounted between said first and second cylindrical members, a second tuning plunger annular in shape mounted between said second cylindrical member and said inner cylindrical member, the outer conductor of said output coaxial line connected transversely to said first cylindrical member, and the inner conductor of said output coaxial line connected transversely to said second cylindrical conductor, said electron tube coaxially supported with its plate connected to said inner cylindrical member and its grid connected to said ground plate, whereby an impedance match is obtained between said coaxial line and the plate of said tube by tuning said plungers.

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