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ANTENNA-DETECTOR COUPLING UNIT

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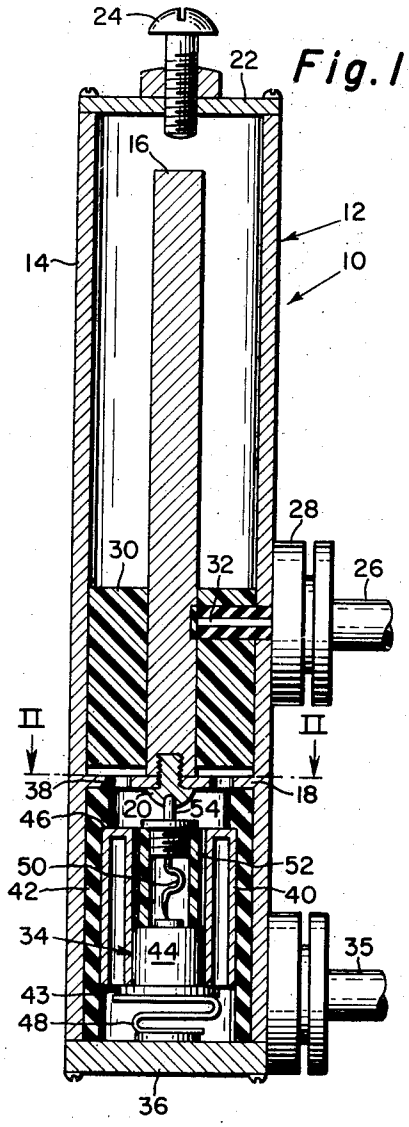

Fig. 1

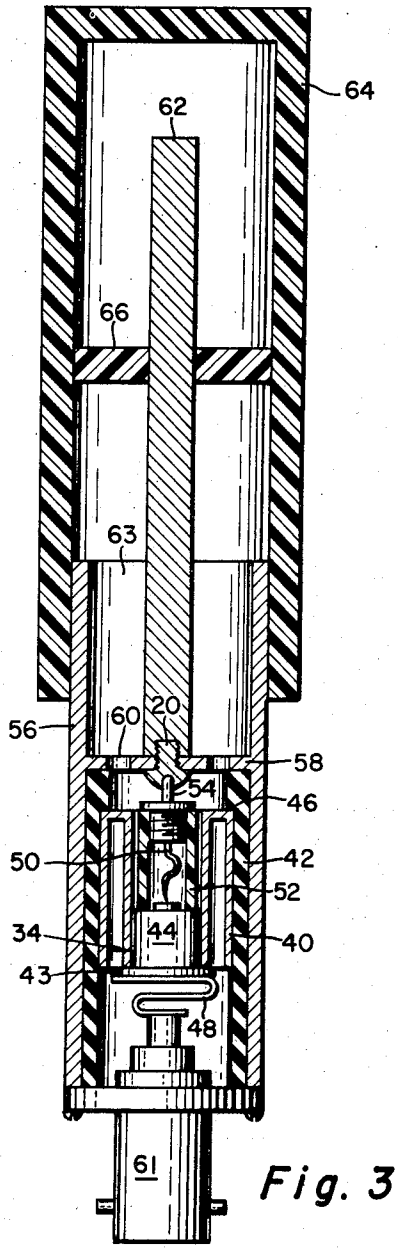

Fig. 3

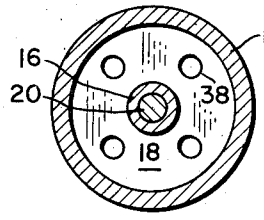

Fig. 2

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ANTENNA-DETECTOR COUPLING UNIT

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2 Claims. (Cl. 250—20)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to devices for transferring R. F. electrical energy, and more particularly to a coupling means for matching impedance loads to obtain maximum energy transfer.

Various methods have been employed for coupling a transmission line to a resonant section. The most common method employs an inductive coupling loop which consists essentially of a semi-circular piece of wire projected into the resonant line and arranged to enclose some of the magnetic lines of force. Another coupling method employs a probe, usually an extension of the inner conductor of a coaxial transmission line, so oriented, that it is parallel to the electric lines of force.

Although these coupling methods are reliable, they are relatively expensive to manufacture. In addition, resonant sections employing the prior couplings are not as rugged nor as compact as desired.

According to the present invention, it has been found that coupling into or from a resonant section or device can be accomplished by providing a separating or partition wall with at least one aperture extending therethrough. Where the separating wall is located in a resonant section at a high current field, the impedances on both sides of the wall can be matched by the use of one or more of such coupling apertures which ensures maximum power transfer. Coupling occurs in the sharing of the mutual impedance of the perforated wall much in the same manner as a conventional transformer transfers resistive impedances.

While it is recognized that narrow slot openings have been used in wave guides for the purpose of sampling or suppressing a particular frequency, an opening has never been used in the manner suggested by the present invention at a high current field to enable the matching of impedances to obtain maximum power transfer.

In one illustrated embodiment, the resonant device is a resonant cavity coupled by the invention to a crystal detector. In a second embodiment, the resonant device is an antenna assembly and the invention is utilized to couple into a crystal detector. It is apparent that the crystal detector is only representative of other dissipative impedance loads that can be matched by employing the invention coupling.

The objects of this invention are to provide an impedance matching means for coupling loads which is simple to construct, rugged in design, and provides a more compact arrangement of the coupled elements.

Another object is to provide an antenna, R. F. filter and crystal detector assembled as a single unit.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a longitudinal section of a tuned resonant cavity detector employing the coupling of this invention;

Fig. 2 is a cross-section of the resonant cavity of Fig. 1 taken along line II—II showing the disposition of the coupling openings; and

Fig. 3 is a longitudinal section of an antenna coupled by the invention to a crystal detector.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts through out the several views, there is shown generally in Fig. 1 a microwave tuned cavity detector **10** comprising one type of resonant device, such as a resonant cavity **12**, consisting of an outer metal tubular conductor **14**, which may be cylindrical in shape, and an inner metal conductor **16** axially disposed therein in spaced relation. Outer conductor **14** has an integral end wall **18** to which one end of inner conductor **16** is centrally mounted and secured by a screw **20** providing a good electrical connection. The opposite end of outer conductor **14** is closed by a removable wall **22** threadedly supporting an axially aligned tuning screw **24** adjustable with respect to the free end of inner conductor **16** to vary the capacitance therebetween for tuning the resonance of the cavity to the input frequency.

An R. F. input is connected to resonant cavity **12** by a coaxial cable **26** suitably clamped to outer conductor **14** by a connector **28**. Resonant cavity **12** may be temperature-compensated by means of a solid dielectric material **30** disposed within the lower end of the cavity which also serves to support an inner coaxial conductor **32** of input cable **26** in coupled relationship to the inner cavity conductor **16**. The temperature compensating feature and the details of connector **28** form no part of this invention being described in a pending U. S. patent application, Serial No. 486,302, filed by C. H. Bredall and J. B. Shannon now Patent No. 2,779,004.

A conventional crystal detector 34 is coupled to resonant cavity 12 for the well known purpose of detecting the modulation, or video signal by filtering out the R. F. component of the signal, and transmission by an output cable 35. Detector 34 is disposed in axial alignment with resonant cavity 12 on the other side of end wall 18, and suitably housed in an extension of outer conductor 12 being retained therein by a detachable end wall 36. The details of detector 34 will be described later.

One of the novel features of this invention resides in the discovery that crystal detector 34, or any other impedance load, can be coupled to the resonant section by means of one or more holes **38** extending through partition wall 18 and located at a high current field to achieve maximum power transfer. This manner of coupling affords a simple and inexpensive construction since the holes can be drilled, and, in addition, the assembly is compact and rugged being especially suitable for those installations subject to shock and rough usage. It is believed that coupling between the resonant section and the impedance load, represented by resonant cavity 12 and crystal detector 34, respectively, occurs in the sharing of the mutual impedance of perforated wall **18**. The impedance, and consequently coupling, within limits increases with the reduction of wall material as the hole size is increased. The amount of coupling is easily controlled by the size and number of holes drilled. In the embodiment disclosed in Fig. 2, four holes **38** of approximately 3/16" diameter were employed with satisfactory results. Because the terminations on each side of the perforated wall are power dissipative in nature, a resistive impedance is coupled from one side of partition wall 18 to the other much the same as a transformer transfers resistive impedances. For best efficiency, or maximum power transfer, the transferred impedance should equal or match the impedance considered, and

is reciprocal in nature for either side of the perforated wall. This concept applies equally well for the antenna modification in Fig. 3, later to be described, because of the free-space resistive impedance seen by the antenna.

Crystal detector 34 is concentrically disposed within a cylindrical metal choke 40 which in turn is snugly supported within an insulating retainer sleeve 42 confined between walls 18 and 36. A shoulder 43 on cartridge base 44 engages choke 40, the latter being seated against a shoulder 46 on the retainer sleeve by a leaf spring 48 supported by end wall 36. A tungsten whisker 50 housed in a ceramic case 52 contacts base 44 and at the other end is connected to a metal pin 54 having a base portion threaded into the case. The free end of pin 54 is conveniently seated in screw 20 providing a support therefor and good electrical connection with inner conductor 16 of the resonant cavity.

In the embodiment of Fig. 3, the resaonant device is an antenna and the novel coupling of this invention is utilized to couple into a crystal detector 34 which may be identical in construction to detector 34 in Fig. 1. In this modification detector 34, choke, and supporting elements are housed in the lower end of a metal housing 56 and adjacent one side of partition wall 58, the latter having coupling holes 60. Housing 56 is closed at the lower end by a bayonet type connector 61 for the video output of the crystal detector. Similarly as in the modification of Fig. 1, coupling holes 60 are located at high current field to enable the transfer of maximum power at low impedance.

A stub antenna element 62 is centrally mounted to partition wall 58 in the upper end of housing 56, the latter end serving as an R. F. filter 63. Antenna element 62 is covered by a cup-shaped radome covering 64, which may be polystyrene, Teflon, etc., telescopically mounted in fixed relation over housing 56, and is supported therein by a bead 66 suitably constructed of the same material as covering 64. The bead is located at a low-voltage point along the stub antenna element 62. Combining the antenna, filter and detector into a single unit has the advantage of permitting a long cable run after detection which might otherwise be prohibitive at the received frequency because of excessive cable losses.

The novel coupling of this invention affords maximum power transfer in a simple, compact and inexpensive construction. The absence of loops or other fragile coupling elements makes possible a rugged construction, particularly suitable for high shock conditions, such as are present in mobile installations.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A compact antenna-detector unit comprising a tubular housing formed of electrically-conductive material; a transverse partition wall intermediate the ends of said housing; an antenna stub supported at least in part by said partition wall and positioned to one side thereof in longitudinal axial alignment with said housing, that portion of said housing lying to the same side of said partition wall as said antenna stub acting as a first quarter-wave choke at the frequency of the carrier energy to be received by said antenna stub, the said partition wall being located at a point of high carrier current and low impedance; a crystal detector positioned on the opposite side of said partition wall from said antenna stub and in axial alignment with said tubular housing; a hollow cylindrical filter acting as a second quarter-wave choke located between said crystal detector and said housing and in coaxial alignment with the latter, the said partition wall being likewise located at a point of high current and low impedance with respect to the detected energy; and means to electrically couple said antenna stub to said crystal detector, said coupling means including at least one opening spaced intermediate said axially-aligned antenna stub and the inner surface of said tubular housing and extending through said partition wall, whereby power transfer between the said antenna stub and said crystal detector is achieved through a sharing by these sections of said unit of the mutual impedance presented by said partition wall.

2. A compact antenna-detector unit as set forth in claim 1, in which maximum power output from said unit is achieved by selecting the total open area of said partition wall so as to match the dissipative impedances of said antenna stub and crystal detector, respectively.

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