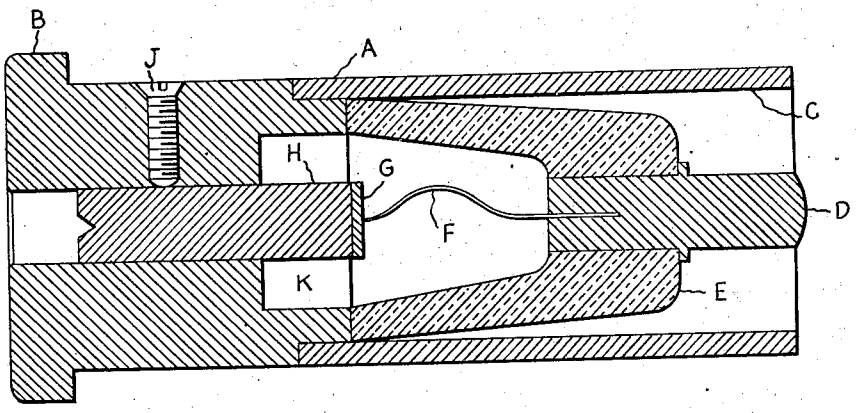
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CRYSTAL DETECTOR

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CRYSTAL DETECTOR

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This invention relates to the construction of pre-adjusted crystal detectors of the silicon-tungsten type which have been found suitable for use in so called microwave receivers and are particularly applicable to wave-lengths within the band below 10 cms.

One object of the invention is to provide a mechanically stable assembly which can be handled without disturbing the "catwhisker" contact adjustment and which is not affected by variations in ambient temperatures.

A further object of the invention is to fix the crystal in a position where it can effectively be matched into a concentric line so that most of the signal power is absorbed by the detector and the standing waves set up in the line are reduced to a very small amplitude.

A crystal detector adapted for direct connection to and forming the termination of a concentric line according to the invention comprises a cylindrical metal head having an axial bore for receiving a crystal-mounting plunger adjustable therein, the crystal end of the head having a recess of such dimensions that, with the crystal-mounting plunger in position, the crystal is mounted at a quarter wave length (or an odd multiple thereof) from the head, and a cup-shaped insulating member secured to the head and supporting the cat's whisker coaxially with the crystal-mounting plunger, the insulating member and cat's whisker being so dimensioned as to form an effective half-wave length (or multiple thereof) connection to the central conductor of the concentric line.

For a better understanding of the invention reference should now be made to the drawing the single figure of which shows in cross-section the constructional features of a crystal detector assembly embodying the invention.

Referring to the drawing, this shows the crystal G and cat-whisker wire F which constitute a continuation of the inner conductor D of a concentric line, and which in conjunction with outer conductor C, comprising a metal tube attached to a metal head A, terminates a concentric line, having substantially the same characteristic impedance up to the point where the inner conductor enters a cup-shaped insulator E.

The cup-shaped insulator E is preferably made of low-loss ceramic material and is provided with a hole through the bottom through which the inner conductor of the concentric line projects to join one end of the cat-whisker wire F. The rim of the ceramic cup and the inner surface of the hole therein are silver plated so that the cup may

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be soldered firmly to an inner circular flange on the metal head A. The inner conductor is firmly attached and supported by a soldered joint through the hole, thus effecting a rigid assembly which has been found to be proof against mechanical shock or temperature changes after the contact adjustment. Contact adjustment is effected by means of a slidable plunger H to which at one end the crystal wafer G is attached by means of a plating and soldering process. After the contact adjustment has been made to obtain the desired detecting characteristic, the plunger H is fixed in position by means of a set screw J.

A flange B is provided on the head to facilitate the withdrawal of the crystal cartridge from its holder in the end of the line.

The impedance match is effected as follows:

The length of the recess K in the metal head A and the crystal-mounting plunger constitute a ¼ wave-length sleeve which ensures that the position of the crystal is definitely located in the line one quarter of a wave-length (or an odd multiple thereof) from a point of zero potential, or short circuit. This positioning of the crystal facilitates the matching of the latter through another effective quarter wave section, comprising the cat-whisker wire which is dimensioned and so disposed to transform the relatively high crystal impedance into the line impedance in a manner well known in concentric line practice.

The apparent mismatch introduced by the presence of the insulating material, where the latter supports the inner conductor, is offset by making distance from the inner to outer faces of the ceramic supporting member on the axis an effective ½ wave-length long. This length, as is well known, corresponds to $\lambda/\sqrt{\epsilon}$ where λ=wave length in air and ϵ=dielectric constant of the material. Thus, the distance between the inner and outer surface constitutes $\lambda/2$ and the impedance will therefore be the same on each side of the insulation.

Crystal detectors so constructed have successfully been matched into concentric lines operating at wave lengths of the order of 1 cm. and the mismatch introduced; expressed as a standing wave voltage ratio set up in the line and measured by means of a travelling detector has been less than 1.2:1.

In the following claims where we refer to an odd multiple or an integral multiple of a quarter or one-half wave-length, we intend to include the multiplier one.

While we have described only a preferred embodiment of our invention by way of illustration,

many modifications will occur to those skilled in the art; and we therefore wish to have it understood that we intend in the appended claims to cover all such modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A high frequency crystal detector arranged to be directly connected to and to terminate a concentric transmission line comprising a cylindrical metal head having an annular recess at one end thereof to form a central mounting post, said recess having a depth equal to an odd multiple of a quarter wave-lenth at said frequency, a crystal element fixed to the end of said post, a cup-shaped insulating member fixed to said head and enclosing said crystal element, and a central conducting member projecting through said insulating cup and carrying a cat's whisker engaging said crystal, said insulating member adjacent said central conducting member having a thickness effectively equal to an integral multiple of a half wavelength at said frequency.

2. A high frequency crystal detector arranged to be directly connected to and to terminate a concentric transmission line comprising a cylindrical metal head having an axial bore therein, a metal plunger fixed in said bore and carrying at one end a crystal element, the crystal end of said head being recessed to a depth equal to an odd

multiple of a quarter wavelength at said frequency, a cup-shaped insulating member fixed to the recessed end of said head and having centrally mounted in the base thereof a conducting member spaced from said crystal, and a cat's whisker fixed to said central conducting member and engaging said crystal, the base of said insulating member having a thickness effectively equal to an integral multiple of a half wave-length at said frequency.

3. A high frequency crystal detector arranged to be directly connected to and to terminate a concentric transmission line comprising a cylindrical metal head having an axial bore therein, a metal plunger adjustably mounted in said bore and carrying at one end a crystal wafer, the crystal end of said head being recessed to a depth equal to an odd multiple of a quarter wave-length at said frequency, a cup-shaped insulating member fixed to the recessed end of said head end and having mounted centrally in the base thereof a conducting member spaced from said crystal and a cat's whisker fixed to said conducting member and engaging said crystal, the base of said insulating member having a thickness effectively equal to an integral multiple of a half wavelength at said frequency.

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