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ULTRAHIGH-FREQUENCY CRYSTAL DEVICE OF THE ASYMMETRICAL CONDUCTIVITY TYPE

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FIG. 1

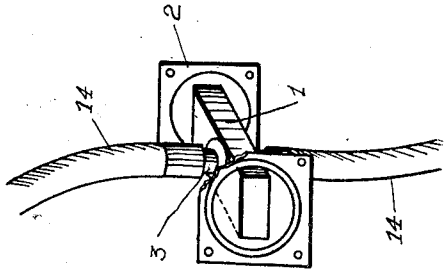
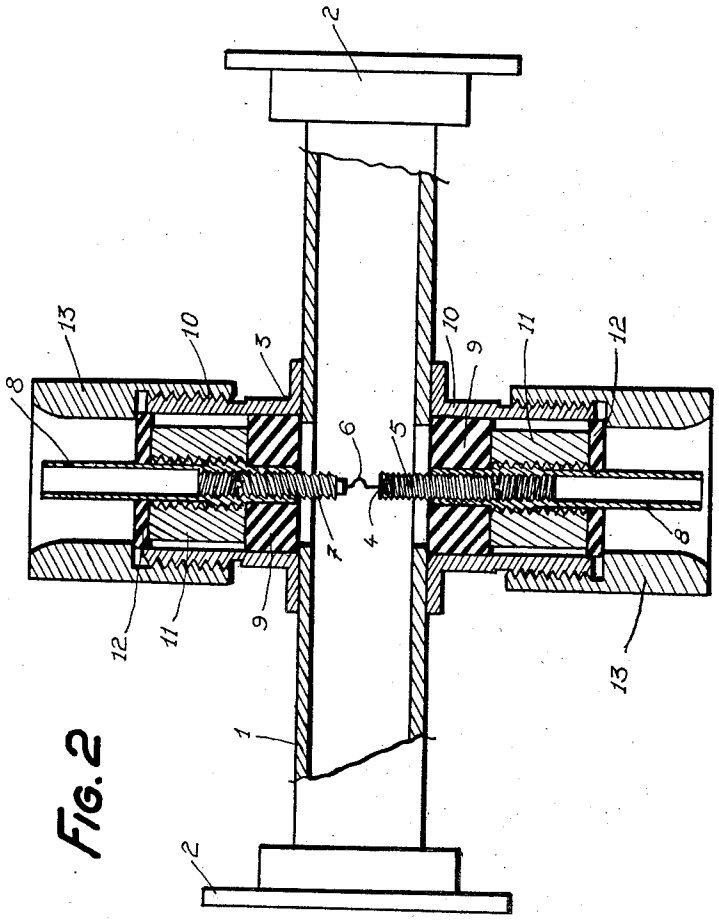


FIG. 2



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ULTRAHIGH-FREQUENCY CRYSTAL DEVICE OF THE ASYMMETRICAL CONDUCTIVITY TYPE

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3 Claims. (Cl. 250—31)

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This invention relates to high frequency crystal diodes or detectors of the kind now widely utilized for frequencies above 3,000 mc. such as would correspond to the upper portion of the "S," "X" and more particularly "K" bands (the "K" band comprising the waves of the order of centimeter).

It is known that the ultra high frequency crystal detectors of this type developed heretofore, have a number of drawbacks which may be divided into two groups, constructional and radioelectric.

The first group of drawbacks results from the extreme smallness of the component parts. Handling and assembling operations are difficult and the manufacture of the device is costly.

It is impossible to remove such component parts, in contrast to the devices used for wavelengths above 10 cm. where, among other removable elements, the detecting member is made exchangeable. In the present range, the fixed mounting of the component parts precludes any possibility of adjustment.

The second group of drawbacks results from dielectric losses of members which act as insulators and are arranged in parallel with a barrier layer. The derivated currents increase as a result of the insulators associated with the contact electrodes. This results in a shunting factor which is hardly acceptable in an asymmetrical conductivity device.

If coaxial connections are used, since the critical diameter for coaxial lines having normal impedance characteristic is about 0.5 cm., this type of connection is obviously unsuitable for wavelengths of the order of centimeter (see Borgnis, "Elektrische Nachrichten Technik," 1940, p. 47: "Die Konzentrische Leitung als Resonator").

The output capacitances have a fixed and determined value and therefore cannot be adapted to variable conditions of utilization. One of the objects of this invention relates to a circuit element for ultra high frequencies in which these drawbacks are reduced, if not eliminated.

A more specific object of the invention is a device comprising a wave guide corresponding to the frequencies employed and a crystal diode unit mounted in a direction substantially at right angle to the longitudinal axis of said wave guide and having electric characteristics adaptable to the limits corresponding to the frequencies employed.

Other features and advantages of the invention will appear from the specification in connection with the accompanying drawings which illustrate a preferred embodiment of the invention in diagrammatical fashion by way of example only.

In the drawings:

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Fig. 1 represents a perspective view of a ultra high frequency crystal detector according to the invention, and

Fig. 2 a longitudinal section of the same device, at an enlarged scale.

Referring to the drawings, 1 represents a wave guide corresponding to the frequencies utilized, having standard connecting flanges 2. Crystal detector unit 3 is arranged at right angle to the longitudinal axis of wave guide 1.

Crystal detector unit 3 itself, as apparent from Fig. 2, consists of a barrier-layer semi-conductor 4, which is supported on tip member 5, and engaged by point member 6 which connects with a second tip member 7, the barrier layer engaged by point member 6 being positioned centrally of guide tube 1.

Each of the tip members 5 and 7 consists of a screw-threaded rod engaging a corresponding internally screw-threaded socket 8 mounted in a washer 9 of insulating material which may be of the type known under the trade name of "Trolitul" or of polystyrene or any other equivalent plastic, or even of a material like ultra high frequency ceramic. Washer 9 is held inside a connecting tube 10 secured in any suitable manner to guide tube 1. Washer 9 also serves to center socket 8 and thereby tip member 5 or 7.

Another ring-shaped member 11, which consists of metal, is mounted on socket 8 and it serves to adjust output capacitance. By varying the diameter of ring 11 the output capacitance may be adapted to specific conditions of utilization.

Ring 11 is held in position by means of another insulating washer 12 (which may be of the same material as washer 9) and an internal screw thread socket 13 which may be screwed around connecting tube 10. Washer 12 also serves to center socket 8.

For positioning sockets 8 in the assembly described above, the sockets are provided with an external thread and screwed into the central opening of metal ring 11. This opening is provided with an internal screw-thread. However any other suitable connection may be used without exceeding the scope of the invention.

Similarly, socket 8, instead of being secured to metal ring 11, may be secured to insulating washer 9 by any suitable means (such as screwing). The latter would be particularly convenient where the selected output capacitance should result in omission of metal ring 11. In this case, socket 8 would form an adequate capacitance in relation to external tube 10.

It will be noted that semi-conductor 4 may be mounted excentrically with respect to the end of

screw 5. Thus it is possible by a simple rotation of screw 5, to scan the entire surface of semiconductor 4 to establish the point of optimum contact with point member 6.

By rotating and thereby displacing both screws 5 and 7 in axial direction, it will be possible to effect an adjustment for determining the point-surface contact of optimum output. After such adjustment, sockets 8 may be filled with any suitable body such as wax in order to maintain adjustment.

Sockets 8 also act as output members to which suitable wires 14 (see Fig. 1) are attached, leading to utilization apparatus. Sockets 8 are readily adaptable to various purposes.

The unit described may be used for example as a mixer. For this purpose, a short-circuiting device is connected behind one of the two flanges 2. One of sockets 8 is connected to a local oscillator, the other serves as a medium-frequency output device.

Should the capacitance on the oscillator side be too high, a short-circuiting device would be placed on this side which could serve to match the detector within the guide member. The oscillator would be connected to another wave guide connected with the first mentioned guide member.

The assembly described above could also be used, for example, as a receiving rectifier. For this purpose, one output capacitance should be increased by modifying corresponding metal ring 11 so that the low frequency may be taken off from one of the sockets 8; the other socket 8 remains short-circuited. There is also added a short-circuit behind the wave guide.

The asymmetrical conductivity unit described above has many advantages.

Firstly, it is composed of very simple parts of dimensions sufficient to facilitate handling and assembling.

Secondly, the dielectric losses are reduced to a value which renders them innocuous in relation to the operating frequencies because there are no losses in a direction parallel to the barrier layer.

Furthermore the device according to the invention is formed of removable and interchangeable parts, a requirement not met by present systems for wavelengths of the order of centimeter.

The device described consists of adjustable parts which make it possible to obtain the best possible output and to adapt the output capacitances to varying conditions of utilization.

Finally, coaxial operation occurs only after passing through the asymmetrical conductivity device. Thus, the drawbacks experienced with coaxial mountings such as used hitherto, in former devices, are avoided.

The constructional details of the device described and illustrated herein may be modified in various ways without affecting the spirit and scope of the invention.

What I claim is:

1. Crystal assembly of the asymmetrical conductivity type, comprising a wave guide corresponding to the frequencies utilized a crystal element a surface of which is freely exposed to the waves guided by said wave guide, a flexible point member extending freely exposed to said waves and transversely of the longitudinal axis of said wave guide, said point member being in contact with the exposed surface of said crystal element, means adjustably supported on said wave guide and supporting said crystal element, and means also adjustably supported on said wave guide and supporting said point member solely at its end remote from the contact with said crystal element; said crystal supporting means and said point member supporting means including respectively two electrode members and sockets supporting said electrode members in a position adjustable in a direction perpendicular to said longitudinal axis, thereby to form terminals for outside connections.

2. Crystal assembly of the asymmetrical conductivity type, comprising a wave guide corresponding to the frequencies utilized a crystal element a surface of which is freely exposed to the waves guided by said wave guide, a flexible point member extending freely exposed to said waves and transversely of the longitudinal axis of said wave guide, said point member being in contact with the exposed surface of said crystal element, means adjustably supported on said wave guide and supporting said crystal element, and means also adjustably supported on said wave guide and supporting said point member solely at its end remote from the contact with said crystal element; said crystal supporting means and said point member supporting means including respectively to electrode members and sockets supporting said electrode members in a position adjustable in a direction perpendicular to said longitudinal axis, and at least one interchangeable conducting member and two insulating members; said conducting member being supported on one of said sockets outside thereof between said two insulating members to adjust terminal capacitance.

3. Crystal assembly of the asymmetrical conductivity type, comprising a wave guide corresponding to the frequencies utilized, a crystal element a surface of which is freely exposed to the waves guided by said wave guide, a flexible point member extending freely exposed to said waves and transversely of the longitudinal axis of said wave guide, said point member being in contact with the exposed surface of said crystal element, means adjustably supported on said wave guide and supporting said crystal element, and means also adjustably supported on said wave guide and supporting said point member solely at its end remote from the contact with said crystal element; said crystal supporting means and said point member supporting means including respectively two electrode members and sockets supporting said electrode members in a position adjustable in a direction perpendicular to said longitudinal axis, and a conducting member for each of said sockets and two insulating members; said conducting member surrounding each of said sockets between said two insulating members and engaging a central portion thereof in replaceable position to permit variation of terminal capacitance.

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