Dec. 24, 1946. W. D. LA RUE 2,413,186

ART OF MOUNTING CRYSTAL DETECTORS

Filed Feb. 28, 1942

FIG. 1.

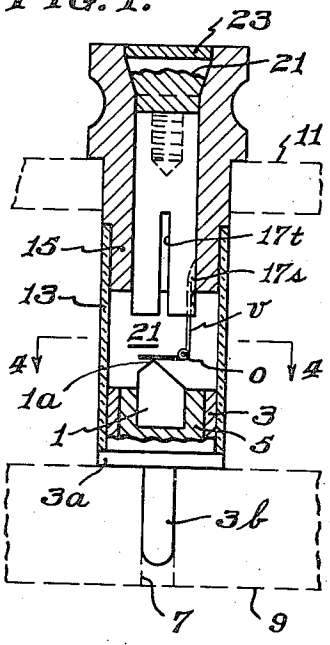


FIG. 2.

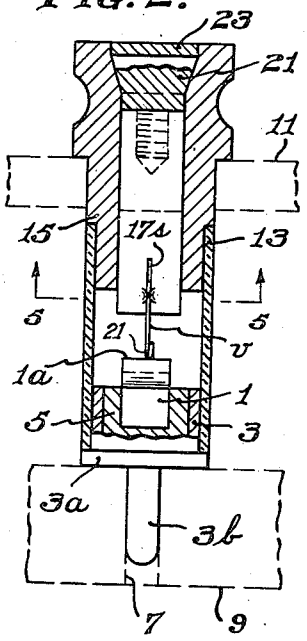


FIG. 3.

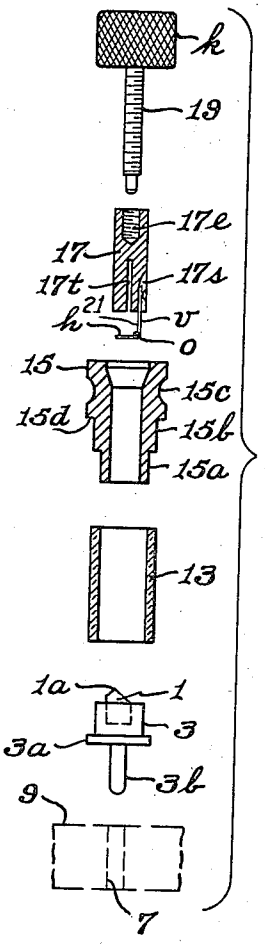


FIG. 4.

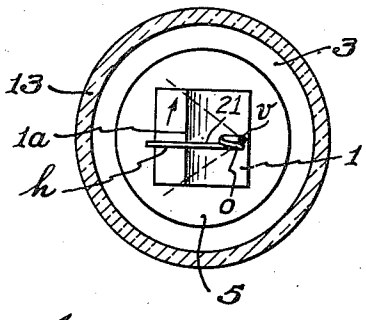
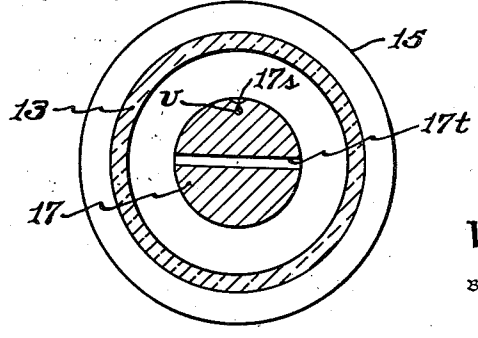


FIG. 5.



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Patented Dec. 24, 1946

2,413,186

UNITED STATES PATENT OFFICE

2,413,186

ART OF MOUNTING CRYSTAL DETECTORS

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Application February 28, 1942, Serial No. 432,818

5 Claims. (Cl. 250—31)

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This invention relates to the art of mounting silicon, galena and similar "detector" crystal elements for use in the rectification or demodulation of radio frequency oscillations.

The sensitivity of the usual crystal detector is confined to a number of unpredictable spots on its surface and, in order to locate these sensitive punctiform areas, it is customary to so mount the spring wire ("cat whisker") contact that it is susceptible of movement to any part of the surface of the crystal. Such mounts usually comprise an arm supported in a ball and socket joint which may be adjusted to vary the pressure of the contact on the crystal when a sensitive spot has been located. Though it is entirely possible to provide means for locking the joint and hence the supporting arm in a desired position, the force applied to the crystal through this contact will usually vary with time or with atmospheric conditions or by reason of shocks or tremors of external origin. Further, such mounts are cumbersome and usually require the use of auxiliary wires and binding posts which may inhibit their use in connection with circuits designed to transmit oscillations of ultra high frequencies.

Accordingly, the principal object of the present invention is to provide an extremely compact and trouble-free holder for a crystal of the general character described, and one incorporating a simple and reliable means for adjusting the position and pressure of the contact element upon the crystal.

Another object of the invention is to provide an improved crystal holder which may be connected without the use of auxiliary wires to modern high frequency apparatus such, for example, as a concentric transmission line.

Other objects and advantages, together with certain preferred details of construction, will be apparent and the invention itself will be best understood by reference to the following specification and to the accompanying drawing wherein:

Fig. 1 is a vertical sectional view, partly in elevation, showing a crystal holder constructed in accordance with the present invention and mounted for use;

Fig. 2 is a view similar to Fig. 1, but with the holder rotated 90°;

Fig. 3 is an exploded view, partly in section, of the crystal holder shown in Figs. 1 and 2 and including a separate adjusting tool;

Fig. 4 is an enlarged transverse section taken on the line 4—4 of Fig. 1; and

Fig. 5 is an enlarged transverse section taken on the line 5—5 of Fig. 2.

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In the drawing, wherein like reference characters designate the same parts in all figures, the invention is shown as applied to the mounting of a silicon crystal 1 which, in the instant case is provided with a cuneiform detector surface 1*a*. This wedge-shape crystal 1 is mounted in a small metal cup 3 with the crystal partly embedded in some soft metal 5, such as Wood's metal. The cup 3 is provided with an outwardly extending peripheral flange 3*a* and is here shown as terminating in a dependent prong 3*b* for engagement with a female socket element 7 which, for certain applications, may comprise a suitable apertured inner-conductor 9 of a transmission line or "tank" circuit whose other or "outer" conductor is indicated at 11 in Figs. 1 and 2.

The flange 3*a* on the cup 3, which holds the crystal 1, serves as a seat for a hollow cylinder or tube 13 which is preferably constituted of "Lucite" (methyl-methacrylate resin), glass, or other transparent material, to permit observation of the crystal 1 and its later described contact element 21. This tube 13 terminates at its other end in a metal sleeve or bushing 15 which has a "lower" end zone 15*a* of reduced thickness, which permits it to be seated snugly within the upper end of the tube, central zone 15*b* of a diameter corresponding to the diameter of the said tube, and an "upper" zone 15*c* which is provided with a circumferential shoulder 15*d* which, as shown in Figs. 1 and 2, may serve as a conductive seat for the holder when it is connected in circuit. Cement may be used at the ends of the transparent tube 13 to provide a hermetic seal between it and its oppositely located metal terminal members 3 and 15.

A solid metal piston or plug 17 which is provided at its upper end with a threaded bore 17*e* for engagement with a complementarily threaded adjusting tool 19, serves as a support for the spring wire "cat whisker" contact 21. This contact element 21 may be attached to the plug 17 as by staking its upper end within a slot 17*s*, provided for the purpose, adjacent the periphery of the plug.

The spring wire contact 21 is designed especially for use with the wedge-shape silicon crystal 1, here illustrated, that is to say, it comprises a vertical portion *v*, and a horizontal arm *h* which may be biased in the direction of the crystal by a connecting loop *o*. Since the upper end of this spring wire contact 21 is attached adjacent the periphery of the plug 17, it is obvious that when the plug is moved downwardly within its bushing 15, as by pressure applied to the knurled end *k* of the adjusting tool 19, to a position whereat the

horizontal contact arm *h* touches the crystal 1, the said arm may then be caused to "wipe" the ridge 1*a* of the crystal (to locate a sensitive area thereon) simply by rotating the said plug 17, and hence the said arm, by means of the adjusting tool 19.

Assuming that the adjusting tool 19 is provided with a right-hand thread, it is apparent that the plug 17 and the contact arm *h* can be moved only in a clockwise direction (as indicated by the arrow in Fig. 4) and that turning the tool 19 in a counter-clockwise direction will serve to unscrew and disengage it from its threaded seat 17*e* in the upper end of the plug 17.

It will be observed upon inspection of Figs. 1, 3 and 4 that the plug or piston 17 has a slot 17*t* therein, which extends axially from its inner extremity to a point say midway of its length. This axial slot 17*t* fulfills two important functions: (1) it serves to bias the bifurcated surface of the plug into engagement with the inner surface of the bushing 15 with sufficient force to prevent rotation of the contact element 21 when the removable adjusting tool 19 is screwed in the direction necessary to effect its removal and (2) since the said slot extends to the leading end of the plug and biases the said end into intimate contact with the bushing 15 adjacent that end, it serves to establish the shortest practical electrical path between the crystal 1 and the external circuit element 11. This latter feature is of especial significance when the crystal is employed in the rectification or demodulation of oscillations of extremely high frequencies, since it in no wise increases the effective inductance of the circuit.

As above indicated, the holder here illustrated is so constructed that the adjusting tool 19 may be withdrawn without disturbing the position of and/or the pressure exerted by the spring wire contact arm *h* on the beveled edge 1*a* of the crystal 1. Subsequent to the removal of the adjusting tool 19, the holder may be permanently sealed against dust and moisture by a filling 21 of a suitable cement or the like which may be capped, if desired, by a metal seal or identification disc 23.

Various modifications of the invention will suggest themselves to those skilled in the art. It is to be understood therefore that the foregoing is to be interpreted as illustrative and not in a limiting sense except as required by the prior art and the spirit of the appended claims.

What is claimed is:

1. A device of the character described comprising an envelope containing a detector crystal, a metal sleeve having a bore which communicates with the interior of said envelope, a piston in the bore of said sleeve, a contact element for said crystal mounted on said piston adjacent its inner end, means of low effective impedance for biasing the wall of said piston into engagement with the inner surface of said sleeve, and means for moving said piston and hence said contact element into engagement with a surface of said crystal against the force of said biasing means.

2. The invention as set forth in claim 1 wherein said metal sleeve extends to the exterior of said envelope and comprises means for connecting said device to an external circuit.

3. The invention as set forth in claim 1 and wherein the overall length of said piston and said contact element is less than the length of said sleeve and wherein the otherwise empty portion of the bore of said sleeve contains a sealing compound.

4. A device of the character described comprising an envelope containing a detector crystal, a metal sleeve having a bore which communicates with the interior of said envelope, a piston in the bore of said sleeve, a contact element for said crystal mounted on said piston adjacent the inner end thereof, means for adjustably moving said piston axially and rotationally within the bore of said sleeve to bring said contact element into engagement with a selected surface area of said crystal, and means of low effective impedance adjacent the inner end of said piston for inhibiting displacement of said piston and hence of said contact element when said adjusting movement ceases.

5. A device of the character described comprising an envelope containing a detector crystal, a hollow metal sleeve forming a portion of the wall of said envelope and having a bore which extends in a direction substantially normal to the surface of said crystal, a piston mounted to permit of both longitudinal and rotational movement within the bore of said sleeve, a dependent contact element for said crystal on said piston within said envelope and adapted to be moved into and out of engagement with said crystal surface as determined by the direction in which said piston is moved, said piston comprising a metal cylinder having a threaded socket on its outer end adapted to receive a complementarily threaded adjusting tool and having a bifurcated portion adjacent one of its ends, the bifurcated portion of said cylinder being biased to engage the inner surface of said sleeve whereby to inhibit relative movement therebetween when said adjusting tool is turned in a direction calculated to effect its removal from said threaded socket.

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