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CRYSTAL CONTACT

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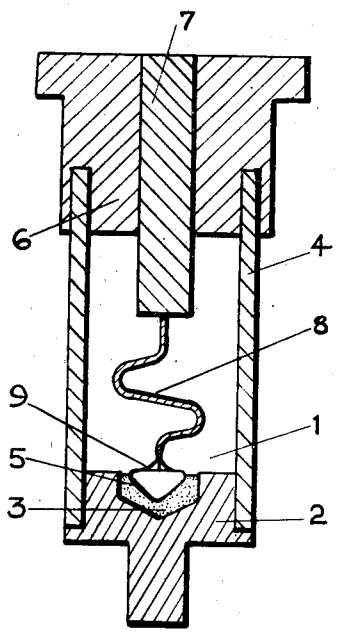

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CRYSTAL CONTACT

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This invention relates to crystal contacts of the type in which one element is a semi-conducting crystal and the other element is the end of a metal wire which presses resiliently against a surface of the crystal; the resilience may arise from flexibility of the metal wire or resilient mounting either of the crystal or of the wire or both. The invention relates also to the manufacture of crystal contacts of this type.

In crystal contacts of the type specified it is usually important, in order that the electrical characteristics of the contact should remain constant, that the position of the end of the wire, which is usually pointed, on the surface of the crystal should not vary during handling or use of the contact, and particularly should not be altered if the contact is accidentally dropped or is subjected to vibration. In view of the aforesaid resilience the end of the wire pressing against the surface of the crystal is liable to lateral displacement in contacts of the type specified.

For this reason it has been proposed to fix the wire in the position to which it is adjusted during manufacture of the contact by filling with wax or like substance an enclosure, often a ceramic tube, within which the wire and crystal are contained. It has also been proposed, to guard against ambient temperature variations and humidity, to seal the end of the wire in position on the surface of the crystal by means of a mass of an insulating solid applied to the surface of the crystal round the wire; thus it has been proposed to apply a mass of thermoplastic material, such as polystyrene, to the surface of the crystal, to apply the wire through the material whilst hot and plastic and adjust the end of the wire to the optimum position on the surface of the crystal, and subsequently to cool and harden the thermo-plastic material so as to form a solid mass.

But we have discovered that another difficulty arising from variations in the ambient temperature may be caused by variations in the expansion of the mass of insulating solid, which may markedly effect the pressure with which the end of the wire presses against the surface of the crystal, and hence, especially when used at high frequency, may cause the characteristics of the contact to vary with the ambient temperature; in particular, contraction at low temperatures may cause the contact to fail altogether. We have discovered that this difficulty of expansion of the sealing solid may be substantially avoided by using as the solid, a thin layer of polymerized n-butyl methacrylate; this substance has the unique property of remaining soft and sufficiently

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plastic over a wide range of ambient temperature variations to permit relative movement along the wire; when used in the form of a thin layer it can readily be secured that the solid does not grip the wire so tightly as to carry the wire with it when expanding or contracting; the substance is however sufficiently hard and solid to prevent lateral displacement of the end of the wire and moreover has a low dielectric loss up to frequencies exceeding 3000 mc./s.

The layer of polymerized n-butyl methacrylate should preferably be so thin that it does not extend along the wire appreciably beyond the actual pointed tip.

According therefore to the invention in a crystal contact in which one element is a semi-conducting crystal and the other element is the end of a metal wire which presses resiliently against a surface of the crystal, the surface of the crystal round the end of the metal wire is covered by a thin layer of polymerized n-butyl methacrylate which layer closely surrounds the wire so as to prevent lateral displacement of the said end of the wire relative to the surface of the crystal.

In the manufacture of the contact in this way, the layer of heat polymerisable liquid n-butyl methacrylate is preferably first applied to the surface of the crystal, the end of the wire is then applied to the surface of the crystal through the layer of liquid and is adjusted to its final position, and the liquid is thereafter polymerized by heat to form the said thin layer solid of n-butyl methacrylate.

In one example of this method of manufacture the crystal was located in a metal cap at one end of a hollow ceramic tube of diameter about 3 mms. and length about 7 mms.; the area of the contact surface of the crystal was about 0.75 mm. A single drop of n-butyl methacrylate was then dropped down the tube on to the surface of the crystal, the viscosity of the liquid being adjusted by suitable thinning with n-butyl methacrylate stabilised monomer to give a drop of size about 1 cubic millimeter.

The tungsten wire used was pointed at one end and welded at its other end to the end of a nickel rod passing loosely through a hole in a second cap; the diameter of the wire away from the point was 0.2 mm. and its length from point of support, i. e. the end of the nickel rod, to pointed tip was 3 mms.; an S-bend in the wire, provided for flexibility, reduced its effective length to about 1 mm. The rod and wire were inserted into the ceramic tube so that the pointed end of the wire

pressed through the liquid layer against the surface of the crystal and the second cap was secured to the ceramic tube; the pointed end of the wire was then adjusted to the required position on the surface of the crystal by adjustment of the end of the nickel rod protruding through the metal cap and the rod was secured by solder to the cap in this position. The whole capsule was then heated in an oven for about eight hours at 70–90° C. to polymerise the n-butyl methacrylate and form the solid layer fixing the pointed end of the wire in position on the surface of the crystal.

The accompanying drawing shows by way of example an enlarged section, not to scale, through the axis of a capsule-type contact in accordance with the invention.

In this contact the silicon crystal 1 is held in a recess in a metal cap 2 by means of easily fusible metal 3 which is effectively soldered to the walls of the recess and to the lower surface of the crystal, which is metallised.

The cap 2 is united to one end of a ceramic tube 4 by soldering to a metallised surface of the ceramic tube so that the contact surface 5 of the crystal is presented to the interior of the tube.

The other end of the tube is closed by a second metal cap 6 which is suitably united to the tube by soldering to metallised surfaces of the tube; a tungsten rod 7 is soldered into an axial hole in the cap 6 and one end of the rod projects within the tube; to this projecting end is welded one end of an S-shaped tungsten wire whisker 8 the other end of which is pointed and abuts against the contact surface of the crystal.

In accordance with the invention the pointed end of the wire is fixed in position on the contact surface of the crystal by the layer 9 of polymerised n-butyl methacrylate which covers the contact surface and encloses the tip of the tungsten wire whisker.

I claim:

1. In a crystal contact in which a semi-conducting crystal constitutes one contact element and in which the other contact element constitutes the end of a metal wire pressing resiliently against a surface of the crystal, a thin layer of solid polymerised n-butyl methacrylate covering the surface of the crystal around the end of the metal wire, said layer closely surrounding the wire so as to prevent lateral displacement of said end of the wire relative to the surface of the crystal.

2. A crystal contact capsule comprising a hollow insulating tube, a first metal cap disposed to close off one end of said tube, a second metal cap disposed to close off the second end of said tube, means to fix each said metal cap to the tube, a semi-conducting crystal, means to support said crystal in said first cap, a metal rod, means to support said metal rod in said second cap, a metal wire whisker having one end thereof attached to said metal rod, said whisker being bent for resiliency, the other end of said whisker abutting against a surface of the crystal, a thin layer of solid polymerised n-butyl methacrylate covering said surface of the crystal around the end of the wire whisker, said layer closely surrounding the wire so as to prevent lateral displacement of said end of the wire relative to the surface of the crystal.

3. In a method of manufacturing a crystal contact, that improvement comprising the steps of applying a thin layer of heat polymerisable n-butyl methacrylate to the surface of a semi-conducting crystal, applying the end of a metal wire whisker to said surface of the crystal through said layer of n-butyl methacrylate, adjusting said whisker to its final position, and thereafter polymerising said n-butyl methacrylate to form a thin layer of solid polymerised n-butyl methacrylate covering the surface of the crystal around the end of the metal wire whisker so as to closely surround said wire whisker with said layer and thereby prevent lateral displacement of said end of the wire whisker relative to the surface of the crystal.

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