Sept. 5, 1944. W. L. BOND 2,357,307

WORK SUPPORTING FIXTURE

Filed July 23, 1942

FIG. 2

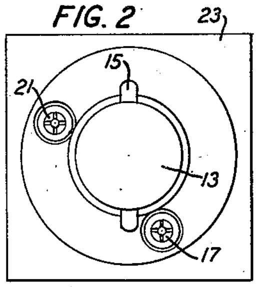


FIG. 1

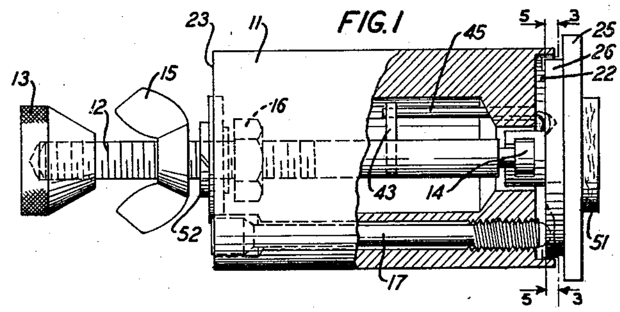


FIG. 3

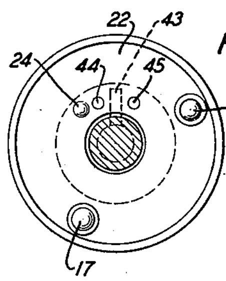


FIG. 5

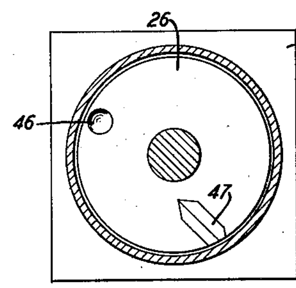


FIG. 6

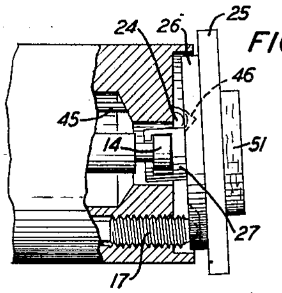


FIG. 8

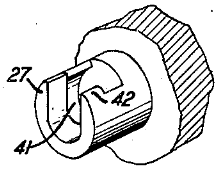


FIG. 7

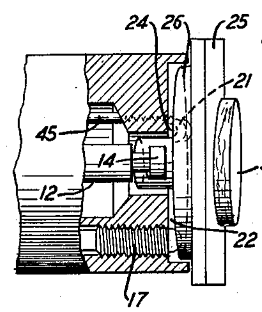


FIG. 9

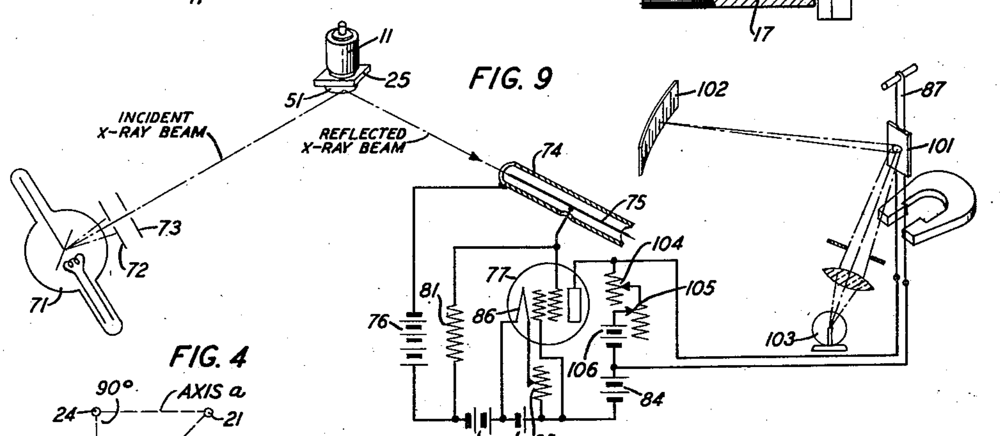
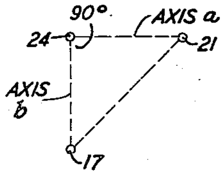


FIG. 4



INVENTOR
W. L. BOND

BY

E. V. Griggs

ATTORNEY

Patented Sept. 5, 1944

2,357,307

UNITED STATES PATENT OFFICE

2,357,307

WORK SUPPORTING FIXTURE

Walter L. Bond, Stewart Manor, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application July 23, 1942, Serial No. 452,031

5 Claims. (Cl. 171—327)

This invention relates to a work supporting fixture and particularly to a fixture for supporting a piezoelectric crystal during X-ray examination.

An object of the invention is to facilitate the production of piezoelectric crystal plates and to enhance the accuracy of certain of the important steps involved in such production.

Another object of the invention is to firmly support an object in either of two mutually related positions and to permit ready change from one position to the other.

In connection with the preparation of certain materials, it is often found desirable during one or more steps in the preparation to temporarily, but firmly, support the material in either one of two mutually related positions. For example at one particular stage in the preparation of quartz piezoelectric crystal plates, it is the usual practice of certain manufacturers to project X-rays against a selected plane or planes of the quartz crystal and observe whether or not the X-rays are reflected and, if so, to what extent. For example, a testing procedure of this general nature is described in Patent 2,151,736 issued March 28, 1939, to W. W. Broughton. In connection with tests of this general nature a convenient procedure may be to first set the quartz crystal at that angle with respect to the projected X-ray beam at which reflection might be expected to occur and to note whether or not such reflection actually does occur. If such reflection is not observed the position of the crystal may be adjusted slightly in order to see if reflection will then occur. This latter part of the test may involve observations at two adjusted positions of the quartz crystal which are achieved by relatively small angular rotations of the supporting plate about two mutually perpendicular axes. The fixture of the present invention is particularly adaptable to this step in the preparation of quartz piezoelectric plates and will be described herein in such connection.

In accordance with a specific embodiment of the present invention a novel work supporting fixture comprises a metal cylinder at one end of which is tiltably clamped a metal plate. The plate is tiltable about two mutually perpendicular axes and the desired angular position of the plate with respect to the longer axis of the cylinder is obtained by drawing the inner face of the plate into contact with the points of three screws or pins projecting from the end of the cylinder. The piezoelectric crystal, or other object to be observed or machined, is temporarily attached to the outer face of the plate.

A feature of the invention is the relative positioning of the three screws or pins in the cylinder whereby their projecting points form, on the face of the cylinder, the vertices of an imaginary right angle isosceles triangle, the screw at the 90 degree vertex being fixed with respect to projection from the face of the cylinder while the other two screws are adjustable in this respect.

Another feature of the invention is an adaption of the point-line-plane principle to permit tilting of the plate about two mutually perpendicular axes and, at the same time, prevent rotation of the plate in its own plane.

Appreciation of these and additional features of the invention as well as complete understanding of the arrangement and operation of the device contemplated thereby may be gained from consideration of the following detailed description and the annexed drawing in which:

Fig. 1 is a side elevational view of a holding fixture which embodies features of the present invention, a portion of the wall being broken away to show certain portions of the fixture more clearly;

Fig. 2 is an end view of the fixture illustrated in Fig. 1;

Fig. 3 is a view taken on line 3—3 of Fig. 1 showing particularly the relative positions of the adjusting screws of the fixture;

Fig. 4 is a schematic representation of the relative positioning of the adjusting screws;

Fig. 5 is a view taken on line 5—5 of Fig. 1;

Fig. 6 is a side elevation, in partial section, of a portion of the fixture of Fig. 1 showing the plate tilted about one axis;

Fig. 7 is a view similar to that of Fig. 6 but showing the plate tilted about another axis;

Fig. 8 is an enlarged perspective view of a portion of the tiltable plate showing the coupling means carried thereby; and

Fig. 9 is a schematic showing of the fixture utilized in X-ray examination of a piezoelectric crystal.

Referring now to the drawing, the fixture illustrated comprises as the main supporting element, cylinder 11 of suitable material, preferably steel. Pull-bolt 12 is axially positioned in cylinder 11, tapered grip 13 being attached to one end of the pull-bolt and shoulder 14 being provided on the other end. A portion of pull-bolt 12 is threaded, wing nut 15 being positioned on the normally exposed length of this threaded portion while stop nut 16 is positioned on the threaded portion of the pull-bolt which is within cylinder 11.

Pins 17 and 21, screw-threaded for a portion of their length, pass through cylinder 11 from one face to the other, their respective tips projecting from one of the faces. The amount of projection of these respective tips from face 22 of cylinder 11 may be adjusted by use of a suitable tool when positioned in the slotted faces of the pins exposed on face 23 of the cylinder. A third pin, 24, also projects from face 22 of cylinder 11, this pin being fixed with respect to the amount of projections from face 22.

By reference to Figs. 3 and 4, it will be evident that the relative positioning of pins 17, 21 and 24 is such that an imaginary right-angle isosceles triangle may be visualized on face 22 of cylinder 11, fixed pin 24 being the 90 degree vertex of the imaginary triangle and threaded adjustable pins 17 and 21, the other two vertices. This particular positioning of the projecting pins is a valuable feature of the invention as it results in an arrangement whereby plate 25 may be tilted about two mutually perpendicular axes, one axis being the side of the imaginary triangle joining the 90 degree vertex represented by fixed pin 24 and the vertex represented by pin 21 (axis *a* of Fig. 4) and the other axis being the side of the imaginary triangle joining the 90 degree vertex and the vertex represented by pin 17 (axis *b* of Fig. 4). This feature will be described further subsequently.

Plate 25, which is square in shape, is provided on one major face with a circular plate-like projection 26 which, in turn, is provided with projection 27. As shown clearly in Fig. 8, a shouldered groove 41 is provided in projection 27, shoulder 14 of pull-bolt 12 being adapted to be positioned in this groove back of shoulder 42. The coupling arrangement is such that plate 25 may readily be removed from the fixture so long as tension is not being applied by means of pull-bolt 12.

Pin 43, carried by pull-bolt 12, is positioned between pins 44 and 45 (Fig. 3) which are so anchored in the end of cylinder 11 (see Fig. 1) that their free ends project into the bore thereof; rotation of pull-bolt 12 is thereby limited to a very small amount.

As shown in Fig. 5, the exposed face of projection 26 of plate 25 is provided with conical depression 46 and V-shaped slot 47; when plate 25 is clamped in position on the fixture as in Fig. 1, the tip of adjustable pin 21 is adapted to be positioned in depression 46 and the tip of adjustable pin 17 in slot 47 while the tip of fixed pin 24 rests on the flat area of projection 26. This adaption of the point-line-plane principle permits tilting of plate 25 in the two desired directions and yet prevents rotation of the plate in its own plane.

It is believed that further description of the fixture can best be made by describing the actual operation thereof. Let us assume, therefore, that a portion 51 of a piezoelectric crystal be temporarily attached to the outer face of plate 25 by suitable means such as an adhesive. It is assumed further that plate 25 is not coupled to the fixture at this time. The shouldered end of pull-bolt 12 is now projected from the open end of cylinder 11, wing nut 15 being withdrawn on threaded portion 12 of the bolt. (It might be noted here that at such times as no plate is coupled to the pull-bolt, nut 16 will normally prevent accidental withdrawal of the bolt from cylinder 11.) Plate 25 is now coupled to the pull-bolt by engagement of shoulder 14 in groove 41 back of the shouldered portion 42 thereof.

Let us assume, first, that it be desired to achieve a fixed position of plate 25 with respect to the fixture wherein the plate is tilted about axis *a* of Fig. 4, i. e., the axis corresponding to the side of the imaginary triangle which joins the 90 degree vertex represented by pin 24 and the vertex represented by pin 21. (This is the position of Fig. 6.) It will be remembered that pin 24 is fixed with respect to projection from face 22 of cylinder 11. Pin 21 is first so adjusted that the amount of projection of its tip from face 22 is the same as that of pin 24 while pin 17 is so adjusted that its projection from face 22 is greater than that of the other pins by an amount dictated by the desired amount of tilt about the axis previously described.

The operator now grasps grip 13 and exerts sufficient pulling force on pull-bolt 12 to draw the inner face of plate projection 26 into firm engagement with the projecting tips of pins 17, 21 and 24. The operator now, while maintaining the pulling force on pull-bolt 12, locks the bolt in position by tightening w[illegible]g nut 15 to compress spring lock washer 52.

During the time pulling force is being exerted through pull-bolt 12, any substantial rotation thereof is prevented by engagement of pin 43 with either pin 44 or 45. Rotation of plate 25 in its own plane is prevented by the application of the point-line-plane principle referred to above.

Now in view of the fact that pin 17 was, as pointed out above, adjusted to project from face 22 a distance greater than the projection of pins 24 and 21, plate 25 will, as shown in Fig. 6, be tilted about the axis joining the tips of pins 24 and 21, the magnitude of this tilt being determined by the amount of projection of pin 17 compared to that of the other two screws. The arrangement is such that the plate is securely locked in this angular position so long as wing nut 15 is tightened down against the tension of lock washer 52; the plate may be readily released, however, simply by backing wing nut 15 a few turns to release the spring tension of the lock washer.

Let us assume now for further illustration that it be desired to obtain an angular adjustment of plate 25 whereby it is tilted about an axis at right angles to that described above, i. e., it is now desired to tilt plate 25 about axis *b* (Fig. 4) thereby resulting in the position of Fig. 7. Pin 17 is first adjusted so that its projection from face 22 of cylinder 11 is equal to that of fixed pin 24. Pin 21 is then adjusted so that it projects from face 22 a distance greater than the projection of the other two pins; the distance of projection of pin 21 is determined by the angle of tilt desired. Pull-bolt 12 is now again manipulated as described above and plate 25 is locked in the position of Fig. 7.

It will be understood, of course, that if desirable, we could have gone directly from the position of Fig. 6 to other positions by leaving pin 17 in the projected position of Fig. 6 and adjusting the pin 21 to project an amount dictated by the desired final position of the plate. In this way orientation about both axis *a* and axis *b* may be obtained.

It will be obvious from the description thus far that the fixture of the present invention permits a simple, fool-proof adjustment of the plate whereby it may be readily tilted about either of two mutually perpendicular axes, locked firmly in either adjusted position and yet readily released from locked position when desired. The absence of expensive, complicated moving members likely to break down and get out of adjustment should be particularly noted, lock washer 52 being the only spring member involved in the entire assembly.

Referring now to Fig. 9, use of the supporting fixture is schematically illustrated in connection with a circuit for X-ray examination of a quartz piezoelectric crystal. An X-ray tube 71 of ordinary type (provided with the usual shielding and mounting appliances and a source of power which it does not appear necessary to disclose or describe) is provided together with shields 72 and 73, apertures being provided in the latter through which an X-ray beam may be directed to the surface of piezoelectric crystal 51 which, as described above, is attached to tiltable plate 25 of the fixture. An ionization chamber 74 (shown in section) is set with its major axis parallel to the reflected X-ray beam and so positioned that the beam will enter the chamber. Collector plate 75 of the ionization chamber is connected in series with battery 76 and the input resistance of vacuum tube 77; tube 77 may be of a type commonly referred to as the "General Electric Co. Pliotron FP. 54." A relatively high resistance 81 is included in the input circuit of the vacuum tube while the usual voltage sources 82, 83 and 84 are connected in the conventional manner, rheostat 85 being provided for controlling the energization of cathode 86. The vibrating ribbon 87 of a galvanometer (shown schematically) is connected across the output of vacuum tube 77. Mirror 101, vibrated by ribbon 87, is adapted to reflect a beam of light onto scale 102, the light being projected onto mirror 101 from light source 103. By means of rheostats 104 and 105, which are connected in series with battery 106 across the output circuit of the vacuum tube, the galvanometer circuit may be so regulated that normally no current will pass through ribbon 87 and the beam of light reflected by mirror 101 will be stationary on scale 102. When an X-ray beam enters ionization chamber 74 and strikes collector plate 75, a current is produced along plate 75 and a potential is established across the input circuit of vacuum tube 77. As a result the plate resistance of the vacuum tube is changed and the output circuit is unbalanced causing a current to flow through galvanometer ribbon 87 which results in rotation of mirror 101; this, of course, causes movement of the light beam along scale 102 and indicates that the X-ray beam projected on a particular plane of crystal 51 has been reflected therefrom.

By use of fixture 11, the crystal may be first adjusted by tilting about an imaginary axis whereupon the incident X-ray beams will strike a particular portion of the crystal. For further tests, the crystal may then be quickly and easily adjusted to a second position by tilting about a second axis which is perpendicular to the first; the incident X-ray beams will then strike a different portion of the crystal as desired. After the X-ray tests, fixture 11, with plate 25 fixed in the desired position, may, for example, be placed in the chuck of a grinding machine and crystal 51 be ground at a particular predetermined angle. Spaced slots may be provided in the surface of the cylindrical member to facilitate positioning the fixture in the chuck.

While a specific embodiment and use of the invention have been selected for illustration and detailed description the invention is not, of course, limited in its application to such embodiment and use. The embodiment described should be taken as illustrative of the invention and not as restrictive thereof.

What is claimed is:

1. A fixture for supporting a piezoelectric crystal during working comprising a cylindrical member, three pins projecting from one end of said cylindrical member, the relative positions of the pins on the end surface of the cylinder being such that if they be joined by three imaginary straight lines, an imaginary right-angle isosceles triangle will be formed, the pin positioned at the 90 degree vertex of the imaginary triangle being fixed with respect to the extent of projection from the end surface of the cylinder and the other two pins being adjustable with respect to the extent of their respective projection from said end surface, a metal plate, means for drawing one major surface of said plate into engagement with the projecting ends of said pins, and means for attaching a piezoelectric crystal to the other major surface of said plate.

2. A fixture for supporting material to be worked comprising a cylindrical member, a plate, means for attaching said material to one major surface of said plate and means for establishing a desired angular relationship between said plate and said cylindrical member, said last-mentioned means including three pins projecting from one end face of said cylindrical member, said pins being so positioned on said end face as to form the three vertices of an imaginary right-angle isosceles triangle, the pin at the 90 degree vertex being fixed with respect to the extent of projection from said end face, means for adjusting the extent of projection of the other two pins from said end face, and means for drawing the other major surface of said plate into engagement with the projecting tips of said three pins.

3. A fixture for supporting a portion of material comprising a cylindrical member, a plate, means for attaching said portion of the material to a face of said plate, means for drawing said plate into close proximity to one end face of said cylindrical member and means for establishing desired angular relationships of said plate and said one end face, said last-mentioned means including three pins mounted in said cylindrical member with their respective tips projecting from said end face, the relative positions of said projecting tips on said end face being such that if they be joined by three imaginary straight lines, an imaginary right-angle isosceles triangle will be formed, the pin whose tip forms the 90 degree vertex of the imaginary triangle being fixed with respect to projection of its tip from said end face and the other two pins being adjustable with respect to such projection.

4. A fixture for supporting a portion of matetrial comprising a cylindrical member, a plate pivotally mounted at one end face of said cylindrical member, means for tipping said plate with respect to said end face of the cylindrical member about two mutually perpendicular axes, said last-mentioned means including three pins positioned in said cylindrical member with their respective tips projecting from said end face of the cylindrical member, said pins being so relatively positioned that their projecting tips form an imaginary right-angle isosceles triangle on said end face of the cylindrical member, the pin whose tip forms the 90 degree vertex of the imaginary triangle being fixed with respect to the amount of projection from said end face, means for adjusting the respective amount of projection from said end face of the tips of the other

two pins, means for attaching said portion of material to the outer face of said plate, and means for pulling said plate into position with respect to said end face of said cylindrical member wherein the inner face of said plate firmly engages the projecting tips of each of said pins.

5. A work supporting fixture comprising a cylindrical member, a plate adapted to be adjustably supported with the inner face thereof in close proximity to one end face of said cylindrical member and means for fixing the angular adjustment of said plate with respect to said one end face, said last-mentioned means including three spaced pins projecting from said one end face, said plate having a conical depression and a V-shaped groove in the inner surface thereof, said depression and said groove being so positioned on the inner surface of the plate that when said plate is in adjusted position adjacent to said one end face, the tip of one of said pins will be positioned in said conical depression, the tip of another of said pins will be positioned in said V-shaped groove, and the tip of the third of said pins will be in engagement with the flat area of the inner surface of said plate.

WALTER L. BOND.