

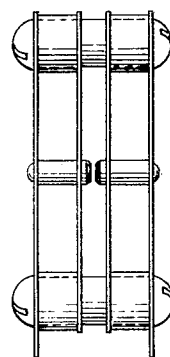
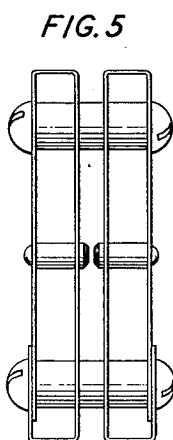
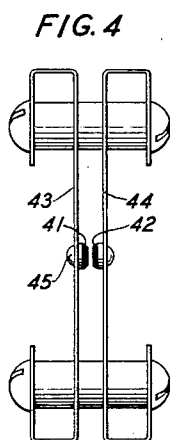
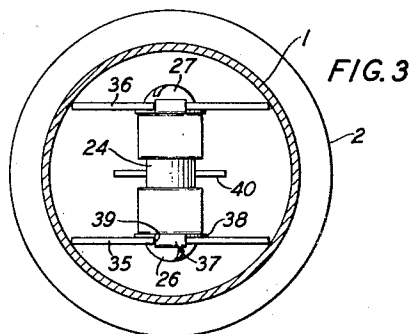
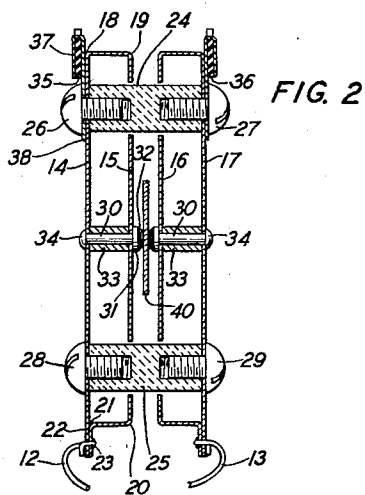
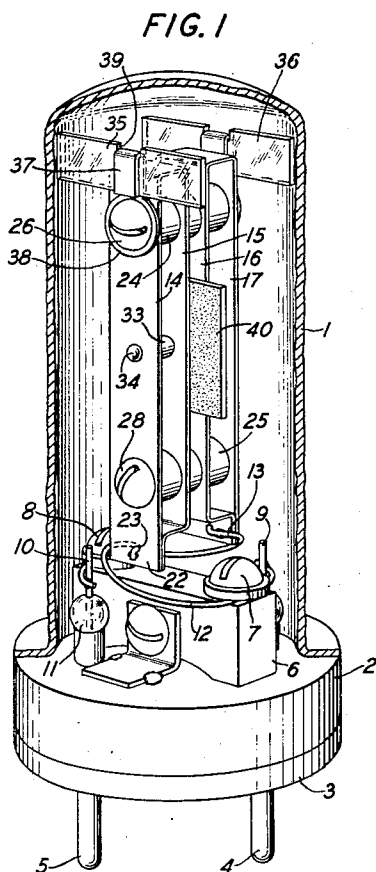
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W. L. BOND

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SUPPORTING MEANS FOR PIEZOELECTRIC PLATES

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INVENTOR
W. L. BOND
BY
E. V. Griggs
ATTORNEY

UNITED STATES PATENT OFFICE

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SUPPORTING MEANS FOR PIEZOELECTRIC PLATES

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

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This invention relates to supporting means for piezoelectric plates.

An object of the invention is to provide a holder for piezoelectric plates operating at very high frequencies under conditions of rough usage such as occur in radio transmitting apparatus for aircraft.

Another object of the invention is to provide a piezoelectric plate holder which will maintain a substantially invariable clamping pressure upon a piezoelectric plate thus eliminating the undesirable results occasioned by variation in clamping pressure and the likelihood of displacement of a plate under conditions of shock.

An additional object of the invention is to provide a piezoelectric holder which shall require no initial adjustment or setting to secure a supported piezoelectric plate with the proper clamping pressure.

In accordance with the invention a holder for a piezoelectric crystal plate is made of members having relatively small mass supported by the resilient conductor wires which serve to connect the holder to its electrical terminals. The holder may in one embodiment comprise two pairs of conducting leaves or metal strips fixed in their space relation to each other, the piezoelectric crystal plate being supported by a pair of anvil members each of which is mounted on a respective one of the pairs of metallic strips. The entire assemblage may be introduced within an evacuated tube to stabilize and to eliminate the effects of humidity and air damping.

The novel features of the invention are presented in the appended claims. The invention may be best understood by reference to the following description taken in connection with the accompanying drawing which illustrates certain specific embodiments of the invention.

In the drawing,

Fig. 1 shows in perspective an assembly of one form of piezoelectric plate holder with the outer shell or container partly broken away;

Fig. 2 is a vertical section of the piezoelectric plate supporting members of the holder;

Fig. 3 is a horizontal section of the device of Fig. 1 at a point just above the piezoelectric plate supporting members; and

Figs. 4, 5, and 6 illustrate modifications of the parallel spring leaf structure of Fig. 2.

Referring to Fig. 1, there is illustrated an evacuated container or enclosure for a piezoelectric plate holder comprising a metallic shell 1 preferably soldered to a metallic ring or annular disc 2 in a manner well known in the construction of

electron discharge tubes. The disc 2 is sealed at its end by an insulating member 3 through which pass and from which project terminal conducting pins 4 and 5 to enable electrical connections to be made between the terminals of the piezoelectric plate holder and an external circuit. Within the container is a block 6 of isolantite or other suitable insulating material in which are seated screws 7 and 8. Lead-in wires 9 and 10 surrounded by glass beads 11 are connected to the conducting pins 4 and 5. To the terminals of these lead-in wires are soldered phosphor-bronze conductors 12 and 13 which pass under and are secured in position by the heads of screws 7 and 8 respectively and serve both as conducting leads and resilient shock-absorbing supports for the structure which supports the piezoelectric crystal plate.

The piezoelectric plate supporting structure shown in perspective in Fig. 1 and in section in Fig. 2 consists essentially of two pairs of spring leaf members 14, 15 and 16, 17. As illustrated, the members 14 and 15 consist of a continuous strip of phosphor-bronze bent at points 18, 19, 20 and 21 to form the two flexible parallel leaves 14 and 15. The resilient conducting lead wire 12 is preferably soldered to the parallel leaves 14 and 15 at their tip ends 22 and may, if desired, pass through a small hole in these tip ends as illustrated at 23. The second pair of spring leaf members 16, 17 is constructed in identical fashion. The two pairs of spring leaf members are held in spaced relation from each other by insulating separators which may consist of cylindrical isolantite rods 24 and 25 which extend between the leaves 14 and 17 and pass through openings in the leaves 15 and 16 slightly larger in diameter than the isolantite rods. Screws 26, 27, 28 and 29 hold the leaves 14 and 17 firmly in engagement with the ends of the isolantite rods thus determining the fixed spacing of the outer leaves 14 and 17. Each pair of leaves accordingly forms a parallelogram structure as do also the two pairs of leaves.

Each pair of aligned spring leaf members as, for example, 14 and 15 serves to support a rod-like anvil supporting member 30 carrying on its inner end an enlarged portion 31 which forms the base of a pyramidal anvil or plate holding member 32, the rectangular plane end surface of which is adapted to firmly engage a piezoelectric plate to hold it in fixed position and to provide an electrically conductive contact with the metallic electrode coating on the surface of the piezoelectric plate. For this purpose the piezo-

electric plate engaging device comprising the member 30 with its integral enlarged portion 31 and anvil 32 may consist of any suitable conducting material as, for example, nickel-silver. The member 30 passes through aligned openings in leaf members 14 and 15 and is, accordingly, maintained in a fixed alignment with the corresponding member 30 which is similarly mounted in leaf members 16 and 17. A spacing collar 33 which may also consist of nickel-silver surrounds anvil supporting member 30 and maintains a fixed separation between spring leaf members 14 and 15 in their central area. The anvil supporting member 30 is preferably riveted over or otherwise secured at its outer end 34 to fix its relationship with respect to the leaf members 14 and 15. It will, therefore, be seen that the spacing between leaves 14 and 17 is maintained invariable as is that between leaves 15 and 16. The dimensions of the isolantite spacers 24, the members 30 and their portions 31 and 32 are made such as to leave slightly less separation between the faces of anvils 32 than is required by the thickness of the piezoelectric plate which is to be supported therebetween. Accordingly, a piezoelectric plate clamped between the anvils 32 is held in fixed position with a uniform pressure with the certainty that it will not become displaced after the holder has been sealed within the metallic container 1.

It has already been explained that the assemblage of parallel leaves 14, 15, 16, 17 together with the clamping members for the piezoelectric crystal plate is resiliently mounted at its lower end on the conducting phosphor-bronze lead-in wires 12 and 13. To prevent undue lateral displacement of the assemblage there are provided strips 35 and 36 of mica or other suitable insulating material held in place by retaining members 37 which are bent in U-shaped form to closely engage the mica strips at their central portions. The retaining members 37 which may comprise tinned brass strips of the types ordinarily used for terminal purposes each have a circular apertured end 38 through which one of the brass screws 26, 27 passes to clamp the retaining members in place. The mica strips 35, 36 are provided with recesses 39 at one margin of a width just sufficient to receive the respective retaining member 37. The mica strips 35 and 36, as indicated in Fig. 3, are of a length just sufficient to fit snugly within the container 1 when the assemblage of parallel leaves and clamping members is introduced therein. It will, accordingly, be apparent that the displacements which are occasioned by outside jars or by the inertia of the mounted assemblage at times of sudden accelerations are permitted to occur without direct shock or damage to the piezoelectric plate itself. The mica strips 35 and 36 together with the phosphor-bronze spring wires 12 and 13 effectively cushion all such shocks.

In the construction of the apparatus of Fig. 1, the piezoelectric plate holding structure illustrated in section, Fig. 2, is first assembled and is then electrically connected to the terminals 4 and 5 of the insulating base member 3 by soldering to the phosphor-bronze spring wires 12 and 13. The leaf members 15 and 16 are thereupon forced apart a distance sufficient to accommodate the piezoelectric plate 40 which is carefully placed so that the rectangular clamping faces of the anvils 32 will contact with the piezoelectric element at a nodal position for the mode of vibration for which the device is in-

tended to be used. The piezoelectric plate 40 may be of any well-known type as, for example, of a thin plate of quartz constructed in accordance with the teachings of the application of W. P. Mason, Serial No. 180,921 filed December 21, 1937, and coated on its principal parallel plane faces with a coating of conducting material as, for example, aluminum. After the piezoelectric plate 40 has been properly positioned the assemblage may be inserted in the container 1 and the container 1 may thereupon be soldered or otherwise hermetically sealed with respect to the metallic disc 2. Thereafter the container 1 may be exhausted through an opening in the base and sealed in a manner well known in the manufacture of evacuated electron discharge devices.

Fig. 4 discloses a modification of the structure of Fig. 2 in which the central portions of the outer parallel leaves 14 and 17 are omitted. The anvils 41 and 42 are supported by short pins 20 which pass respectively through the parallel leaves 43 and 44 and are riveted over at their outer ends as at 45. In other respects, the supporting and positioning features of the structure of Fig. 4 are identical with that of Fig. 2. While this structure is somewhat simpler from the constructional standpoint than is that of Fig. 2, it is not as effective in that it does not insure the accurate alignment of the anvils 41 and 42 that is afforded the anvils 32 by the four-leaf supporting structure of Fig. 2.

Fig. 5 illustrates another modification of the structure of Fig. 2, in which the feature of four parallel leaves is retained but the joint between the open ends of each pair of leaf members occurs opposite a holding screw 28 and, therefore, does not require soldering.

Fig. 6 illustrates still another modification of the structure of Fig. 2 differing in that the parallel leaves 14, 15 and 16, 17 consist of individual strips of material clamped together by the isolantite rods 24 and 25 with their holding screws 26, 27, 28 and 29.

It will be apparent that the structure is easy to manufacture in that it enables the use of metallic strips of relatively small dimensions. Moreover, the device is symmetrical so that parts are interchangeable thus reducing the number of different types of elements required. The four-leaf spring structure is particularly effective in holding the anvil faces parallel thus insuring against any bending action upon the piezoelectric plate or any tendency of the plate to slip.

What is claimed is:

1. A piezoelectric plate holder comprising a resilient support, a pair of flexible structural members mounted thereon, individual means mounted on said structural members extending towards each other and adapted to engage opposite sides of the piezoelectric plate, and means holding said structural members in a fixed spaced relationship with respect to each other whereby the clamping pressure exerted by the plate-engaging means is maintained substantially fixed.

2. A piezoelectric plate holder comprising two pairs of aligned leaves, means for holding the leaves of each pair in fixed spaced relationship with respect to each other, means for holding the pairs in fixed spaced relationship with respect to each other, an individual plate-engaging device supported by each pair, said plate-engaging device having an anvil adapted to engage one surface of a plate, and means whereby each device is held in such position with respect to the other that the anvils are in juxtaposed position.

3. A holder for a piezoelectric plate comprising two flexible supporting members, an individual anvil supported by each member having its central axis in the same line as the anvil supported by the other member, spacers at opposite sides of the anvils connected to the supporting members and holding them at fixed distances from each other whereby the separation between the contiguous ends of the anvils is maintained fixed, the separation between the anvils being slightly less than the thickness of the piezoelectric plate which it is intended to hold whereby the anvils may exert an unvarying clamping effect upon the piezoelectric plate inserted between them.

4. In combination, a pair of parallel flexible leaves, means adjacent the opposite ends of the leaves for maintaining a fixed separation between the leaves, anvil supporting means attached to each leaf and held in position thereby, a second pair of leaves similar to said first pair, and means for holding the two pairs of leaves in fixed relationship to maintain their respective anvils in axial alignment with a separation between the contiguous surfaces of the anvils sufficient to permit a piezoelectric plate to be inserted therebetween.

5. In combination, two pairs of resilient leaf members, two spacing devices connected to each pair near their opposite ends, the spacing devices being arranged in parallel position and serving to hold the pairs of resilient leaf members parallel to each other whereby the pairs and the spacing devices form a parallelogram, an anvil supporting member individual to each pair of leaf members, the anvil supporting members being held by their respective leaf members in axial alignment along one axis of the parallelogram whereby a piezoelectric plate clamped between the contiguous ends of the anvil supporting members may be held by a clamping pressure uniform in amount and constant in direction under conditions of shock to which the assemblage may be subjected.

6. A piezoelectric plate holder comprising a base, a pair of electrical conducting resilient supporting wires respectively connected to a pair of terminals on the base, a piezoelectric plate supporting frame comprising two pairs of resilient metallic leaves held fixed with respect to each other by insulating spacers, each pair of leaves being electrically connected to and physically supported by one of the said supporting wires, electrical conductive anvil supports individual to each pair of conductive leaves and supported thereby in axial alignment with each other with a separation at their contiguous ends slightly less than the thickness of a piezoelectric plate to be clamped therebetween whereby a piezoelectric plate may be supported protected against shock and subjected to an electromotive force impressed between the terminals on the base.

7. A piezoelectric plate holder comprising two pairs of parallel aligned structural elements, means for holding the elements of each pair in fixed spaced relationship with each other, means for holding the pairs in fixed spaced relationship with each other, each pair of elements carrying an individual plate-engaging device having a projection adapted to engage one surface of a plate and means whereby each device is held engaged with the two structural elements of its respective pair to be supported thereby with its plate holding projection juxtaposed to that of the holding device of the other pair.

8. A piezoelectric crystal holder comprising a resilient support, a pair of spring members mounted thereon, crystal engaging means on said spring members extending towards each other and adapted to clamp a piezoelectric plate therebetween, and means holding said spring members in a fixed relationship with respect to each other whereby the clamping pressure exerted by the crystal-engaging means is maintained substantially fixed.

WALTER L. BOND.