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PATENT SPECIFICATION

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(54) PIEZO-ELECTRIC DEVICE

(71) We, EASTMAN KODAK COMPANY, a Company organised under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a piezo-electric device suitable for operating a flashlamp for a photographic camera.

It is known to provide for the ignition of a flash-lamp or an electronic flash unit by means of an electric pulse generated by impacting a piezo-electric crystal and to provide for the synchronization of such flash ignition with shutter operation of a camera. It is desirable that the impacting of the piezo-electric crystal should be consistent to provide electrical impulses of substantially constant magnitude and duration.

It is an object of the present invention to provide an improved device including a piezo-electric crystal, and a photographic camera including such a device.

According to the present invention there is provided a piezo-electric device comprising a piezo-electric crystal, an anvil at one end thereof, and a spring clip having an opening through which the anvil partially extends, the clip serving to press the anvil onto the crystal and to mount the latter to a support, the spring clip and the anvil providing an electrical connection to the crystal.

There is further provided a photographic camera including flash firing means comprising a piezo-electric crystal device as above.

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is an exploded view of a piezo-electric device of the present invention, prior to assembly;

Fig. 2 is a perspective view of the piezo-electric device shown in Fig. 1 after assembly;

Fig. 3 is a sectional view of the piezo-electric device along the line 3—3 of Figure 2;

Fig. 4 is an exploded view of a piezo-electric crystal assembly including the piezo-electric device of Figure 1; and

Fig. 5 is a perspective view of the piezo-electric assembly of Figure 4 after assembly including the piezo-electric device of Figure 2.

Because photographic apparatus is well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, the present invention. Elements not specifically shown or described herein are understood to be selectable from those known in the art.

Referring now to Figs. 1—3, a piezo-electric crystal generator 10 comprises an anvil 12, a piezo-electric crystal 14, and an anvil 16. Anvil 12 has a flange 18 and a cylindrical portion 20 forming cross-sections having different areas. The flange 18 and the cylinder 20 have flat end surfaces 22; and 24, respectively, which are nickel-plated. Piezo-electric crystal 14 is preferably a cuboid. The anvil 16 has a cylindrical portion 26 integrally formed with a frusto-conical portion 28 again forming cross-sections having different areas. The cylindrical portion 26 and the frusto-conical portion 28 have flat end surfaces 30 and 32, respectively, which are nickel plated.

A housing 40, of a single piece of an electrically-insulating material, such as nylon, prior to assembly consists of a tube 42 having a frusto-conical end 44 with a centre opening 46, and a reduced external diameter portion 48 having an end 50. During assembly, the anvil 16 is inserted into the housing 40. The anvil 16 and the housing 40 are so dimensioned that the end of frusto-conical portion 28 of anvil 16 extends through the centre opening 40. The piezo-electric crystal 14, which has been

polarised if the crystal is of a material requiring such a step, is inserted into the housing 40, to rest upon the surface 30 of the anvil 16. The anvil 12 is then inserted into the housing 40 with the surface 22 contacting the piezo-electric crystal 14. The piezo-electric crystal 14 is inserted so that an electric pulse will be produced between the surfaces thereof in contact with the surfaces 22 and 30, when impacted between the anvils 12, 16. The entire package is then heated, the temperature being kept below the Curie point, and the end 50 of the cylinder 48 formed, such as by being spun over the flange 18 of the anvil 12, to form a piezo-electric generator 10 as shown in Figures 2 and 3.

The assembly of the anvils 12 and 16 and the piezo-electric crystal 14 into the housing 40, as well as the forming operation, may be achieved by automatic assembly techniques. During assembly of a preferred embodiment of the generator 10, a fluid dielectric material is placed on either or both of the surfaces 22 and 30, to cover the entire surface of the piezo-electric crystal 14 in contact with the anvil surfaces 22, 30. Such a coating has been found to reduce sparking within the generator 10 and to reduce the breakage of piezo-electric crystals. A silicone grease, or an epoxy type fluid, are suitable fluid dielectric materials.

A mount 60, shown in Figs. 4 and 5, includes a plate 62, a base 64, first and second electrical connectors 66 and 68 and a spring clip 70. The plate 62 may be fixed within a camera (not shown) and may be a wall of the camera housing or affixed to such a wall. The plate 62 includes a generally rectangular recess 72. The plate 62 and the base 64 are formed of a mouldable material, such as polycarbonate. The base 64 is generally trapezoidal in cross-section and includes a cylindrical recess 74, to receive and hold the housing 40 with a part of the frusto-conical portion 28 projecting therefrom. The base 64 further has a slot 76, extending into the recess 74 from a side wall 75 of the base 64 for the length of recess 74. The base 64 is mounted to the plate 62 by a screw 78 and extends partially over the recess 72.

The first electrical connector 66 has a cylindrical contact portion 80, an arm 81 and a connector 82. The cylindrical contact portion 80 fits within the recess 74 with the arm 81 extending through the slot 76.

The second electrical connector 68 includes a leaf spring 84, having a V-shaped end 85. The leaf spring 84 is mounted on a wall of the camera.

The spring clip 70 includes a top wall 88, having a central aperture 90, and a pair of arcuate spring walls 92, extending from the

top wall 88 and each terminating in a retaining clip 94. The central aperture 90 allows the frusto-conical portion 28 of the anvil 16 in the housing 40 to project therethrough in contact with the top wall 88.

For assembly of the housing 40 in the mount 60, the first electrical connector 66 is inserted within the recess 74 with the arm 81 passing through the slot 76. The housing 40 is then inserted within the recess 74 with the anvil 12 being inserted first so that the surface 24 comes into contact with the cylindrical contact portion 80 of the first electrical connector 66, providing an electrical connection to the anvil 12. The spring clip 70 is then positioned with the frusto-conical portion 28 of the anvil 16 extending through the central aperture 90 while contacting top wall 88, and with the retaining clips 94 engaging the bottom of the base 64 within the recess 72. One spring wall 92 of the clip 70 comes into engagement with the end 85 of the second electrical connector 68, providing an electrical connection to the anvil 16. The spring clip 70 subjects the piezo-electric crystal 14 to a compressive force. The compressive force is preferably selected to be approximately equal to the force with which the piezo-electric generator 10 is to be struck during operation. Such prestressing of the piezo-electrical crystal 14 ensures that the piezo-electrical crystal 14 is always maintained in compression, even during initial recovery from a striking force, and reduces the possibility of crystal breakage.

WHAT WE CLAIM IS:—

1. A piezo-electric device comprising a piezo-electric crystal, an anvil at one end thereof, and a spring clip having an opening through which the anvil partially extends, the clip serving to press the anvil onto the crystal and to mount the latter to a support, the spring clip and the anvil providing an electrical connection to the crystal.

2. A piezo-electrical device as claimed in Claim 1, wherein the anvil is frusto-conical.

3. A piezo-electric device as claimed in Claim 1 or 2, including a further anvil, the piezo-electric crystal being between the anvils.

4. A piezo-electrical device as claimed in Claim 3, wherein the crystal and the anvils are held together by an insulating housing.

5. A piezo-electric device as claimed in Claim 3 or 4, wherein the further anvil has a first cross-sectional area and a second larger cross-sectional area.

6. A piezo-electric device as claimed in Claim 3, 4 or 5, wherein the surfaces of the anvils in contact with the crystal are nickel-plated.



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6. A piezo-electric device as claimed in Claim 3, 4 or 5, wherein the surfaces of the anvils in contact with the crystal are nickel-plated.

7. A piezo-electric device substantially as
hereinbefore described with reference to
and as illustrated in the accompanying
drawings.

firing means comprising a piezo-electric
device as claimed in any preceding claim.

5 8. A photographic camera including flash

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