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POWER SUPPLY

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FIG. 1.

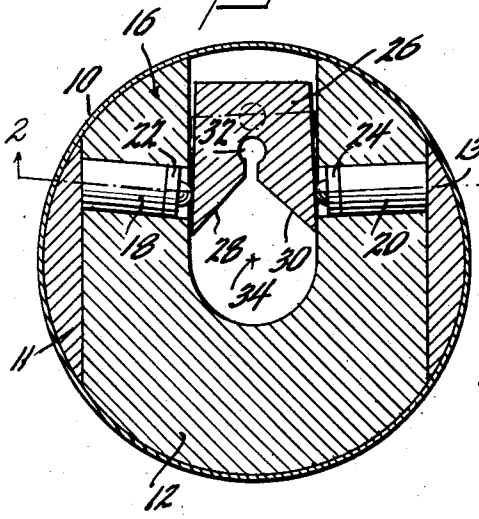


FIG. 2.

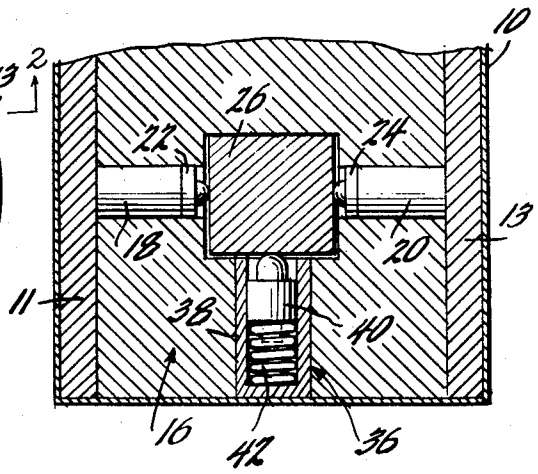
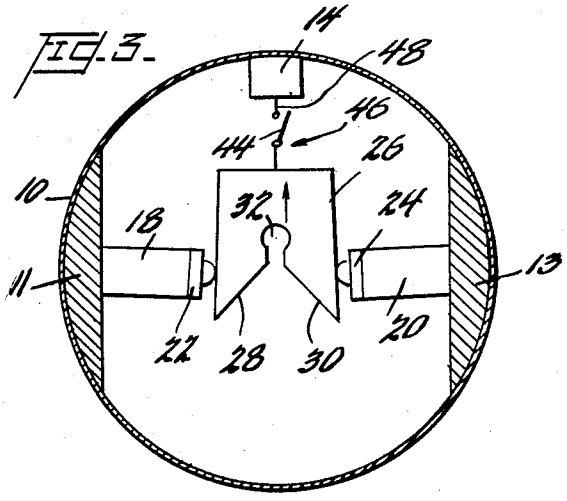


FIG. 3.



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POWER SUPPLY

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This invention relates to power supplies, and more particularly to a novel power supply suitable for detonating explosive missiles and like devices.

The power supply required to detonate an explosive device, particularly in military applications, must be such that the power supply does not hazard the safety of personnel handling the device with which it is associated. In addition, the power supply must be of such construction that it is reliable and positive in operation, rugged so that it requires little or no maintenance, and of such character that it may be stored for long periods of time without affecting the efficiency and reliability of its performance. The principal purpose of the present invention is to provide a power supply which meets all these requirements. It is a further object of the invention to provide a power supply of the described kind which is inexpensive to manufacture.

A power supply according to the present invention employs one or more piezo-electric crystals in combination with a pressure-applying means which is adapted to be actuated by movement in flight of the missile with which the power supply is associated, or by otherwise causing the pressure-applying means to move relatively to the crystal or crystals a comparatively short distance. It will be seen therefore that it is a further object of the invention to provide a power supply for detonating explosives which may be safely used and which lends itself to delaying the arming of the missile until it is in flight and no longer a hazard to the personnel handling it.

A further object of the invention is to provide a power supply of the kind described which is of such design and construction that it may be made small and compact without sacrificing the desired performance characteristics.

A further object of the invention is to provide a power supply of the kind described in which the arrangement of the piezo-electric crystals and the pressure-applying means is such that the chances of fracturing the crystals, in the course of applying to them the pressure required to develop the needed power, is entirely obviated.

Other advantages and objectives of the present invention will appear from the following description of an exemplary form of the invention which is shown in the accompanying drawings. It will be understood that this specific description of one embodiment of the invention is not intended to limit the invention in any way inconsistent with the broader terminology of the appended claims.

The principle of the instant invention can best be illustrated by an example of its application to an explosive missile of the kind which rotates when in flight, and such an embodiment is shown in the accompanying drawings.

In the accompanying drawings:

Figure 1 is a vertical sectional view through a missile embodying a power supply according to the present invention;

Figure 2 is a horizontal sectional view through the same missile taken on the line 2—2 of Figure 1; and

Figure 3 is a diagrammatic view illustrating a type of

electrical circuit which may be conveniently employed with the instant power supply when it is used to furnish power to the detonator of such a missile.

Referring to the drawings, it may be seen that the missile comprises a casing **10** which encloses an explosive material **12** as well as the detonator **14** (illustrated diagrammatically in Figure 3). Also within the casing is the power supply for the detonator which is generally indicated at **16**. The power supply consists of the piezo-electric crystals **18, 20** which may be barium-titanate. The crystals are mounted so that their outer ends are in electrical contact with the sectors **11, 13**, each of which is formed with a curved face which lies against the inner wall of the casing **10**, and a flat face which the outer end of one of the crystals contacts, as may be seen in all three figures of the drawings. The sectors **11, 13** are formed of electrically conductive material, such as brass, aluminum, or the like, and thus serve to electrically connect the outer end of the crystals with the casing **10**. Pads **22, 24** of electrically-conductive material are fixed to the distal ends of the crystals **18, 20** respectively which are mutually facing and spaced apart. Intermediate the distal ends of the crystals, and in sliding engagement therewith, is supported a wedge **26** which is also made of electrically-conductive material such as brass. It may be observed from Figure 1, that the wedge **26** converges upwardly in width at a relatively small angle, for example 4°, and that the wider, lower portion of the wedge is bifurcated to provide two spring legs **28, 30**. The bifurcation terminates in an aperture **32**, the center of which also coincides with the center of gravity of the wedge. It should also be observed that the rotational axis of the missile is at **34**, and that the center of gravity of the wedge is initially disposed radially outward from this axis.

The crystals **18, 20** are mounted, in the exemplary device, so that they subtend at a small angle beneath the horizontal, for example 2°, and thus are disposed normally with respect to the face of the wedge with which they are in sliding engagement. It may thus be seen that when the wedge **26** is caused to move radially outward that a pressure is applied to the crystals **18, 20**, along their longitudinal axes as the wider bifurcated portion of the wedge is forced between the distal ends of the crystals. The disposition of the crystals and the shape of the wedge result in the pressure being applied along the longitudinal axes of the crystals, without bending moments, and thus minimizing the chances of fracturing the crystals. Due to the bifurcated construction of the lower wider portion of the wedge, the spring legs **30, 28** may to a slight extent move towards one another as the wedge is forced between the crystals and thus a comparatively large radial displacement of the wedge may occur in the course of compressing the crystals axially to the relatively slight extent to which this can be done. As well understood in the art, straining the crystals **18, 20** by placing them under compression will develop a useful electric current, and the manner in which this is employed to arm and detonate the explosive will be later explained more fully with reference to Figure 3.

It has been previously pointed out that the center of gravity of the wedge **26** is radially outward of the rotational axis **34** of the missile. Consequently when the missile is impelled into flight and caused to rotate, the wedge **26**, being off-set from the rotational axis, will be acted upon by centrifugal force which causes it to move radially outward, and thus compress the piezo-electric crystals **18, 20** as described above.

There is also provided a latch mechanism indicated generally **36**, in Figure 2, which acts to engage and maintain the wedge in pressure-applying position when it has been moved radially outward a pre-determined distance. The latch means comprises a small casing **38** which is

mounted to the rear of the wedge **26**. Slidably supported in casing **38** is a latch pin **40** which is pressed towards wedge **26** by the spring **42** which at one end abuts the latch pin and at the other abuts the bottom of the casing. Initially, the latch pin rides against the upper back portion of the wedge, as indicated in dotted lines in Figure 1. As the wedge is moved radially outward a pre-determined extent, the latch pin snaps into the aperture **32** in the wedge and thus maintains it in its pressure-applying position. The piezo-electric crystals **18**, **20** are thus maintained under strain as required to produce the needed electrical current when the circuit in which they are included is completed.

A suitable circuit in employing the instant power supply in the detonation of an explosive missile such as illustrated in Figures 1 and 2 is shown in Figure 3. It will be observed that the outer ends of the crystals **18**, **20** are electrically connected with the casing **10** through the sectors **11**, **13**. The casing **10** is fabricated from a material capable of conducting electrical current. The distal, mutually-facing ends of the crystals are in electrical contact with the conductive wedge **26**, and the wedge is electrically connected to the terminal **44** of the detonating switch indicated generally at **46**. One lead to the detonator **14** is also in electrical contact with the casing **10**, and the other with the terminal **48** of the switch **46**. It will thus be seen that the crystals **18**, **20** are connected in parallel through the detonator by means of the wedge **26**, the sectors **11**, **13**, and the casing **10** and that the electrical current produced by the crystals as a result of being brought under pressure by the wedge will flow through the detonator, and explode it, when the switch **46** is closed. The switch **46** may be actuated by impact, by suitable timing devices, or other conventional means. The movement of the wedge into its pressure-applying position, as previously described, thus serves in the described example to arm the missile. It will be appreciated, however, that the instant power supply may be otherwise employed. For example, in connection with a non-rotating device, the switch **46** might be closed to accomplish arming of the device. The movement of the wedge would then result in the detonation of the device. Such movement would be provided by simply positioning the wedge so that the application of an external force on the device would provide the necessary movement. It will also be appreciated that the translation of the wedges in non-rotating missiles could be accomplished by means of gears or levers actuated by air or water screws or equivalent devices.

Having thus described the invention what is claimed is:

1. The combination of a missile of the kind which rotates when in flight and a power supply comprising a piezo-electric crystal and a wedge member supported in sliding engagement with said crystal to vary the pressure applied to said crystal when said wedge member is caused to slide with respect to said crystal, said crystal and wedge member being arranged to initially position the center of gravity of said wedge member radially outward from the axis of rotation of said missile, whereby, when the missile is in flight, the rotation of the missile causes said wedge member to slide with respect to said crystal.

2. The combination claimed in claim 1 which comprises two piezo-electric crystals and said wedge member is supported between said crystals and in sliding engagement therewith.

3. The combination claimed in claim 2 wherein said crystals have an elongated form and are arranged with respect to the wedge member so that pressure applied to the crystals is applied along the longitudinal axis thereof.

4. The combination claimed in claim 3 which comprises latch means positioned and arranged to operatively engage and retain said wedge member when it has been caused to slide a predetermined distance by the rotation of said missile.

5. The combination claimed in claim 3 wherein said wedge is bifurcated in its wider portion to thereby make the wider portion yieldable to compressive force, and thus permit substantial sliding movement of the wedge member between the crystals to accompany slight axial compression of the crystals between which the wedge member slides.

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