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[54] **PIEZOELECTRIC FLASH LAMP IGNITION**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 330,557, Feb. 8, 1973, abandoned.

[52] **U.S. Cl.** **431/98;** 310/8.7; 317/DIG. 11; 431/255

[51] **Int. Cl.** **H01v 7/00**

[58] **Field of Search** . 431/98, 255; 317/81, DIG. 11; 310/8.3, 8.7; 240/1.3; 354/135

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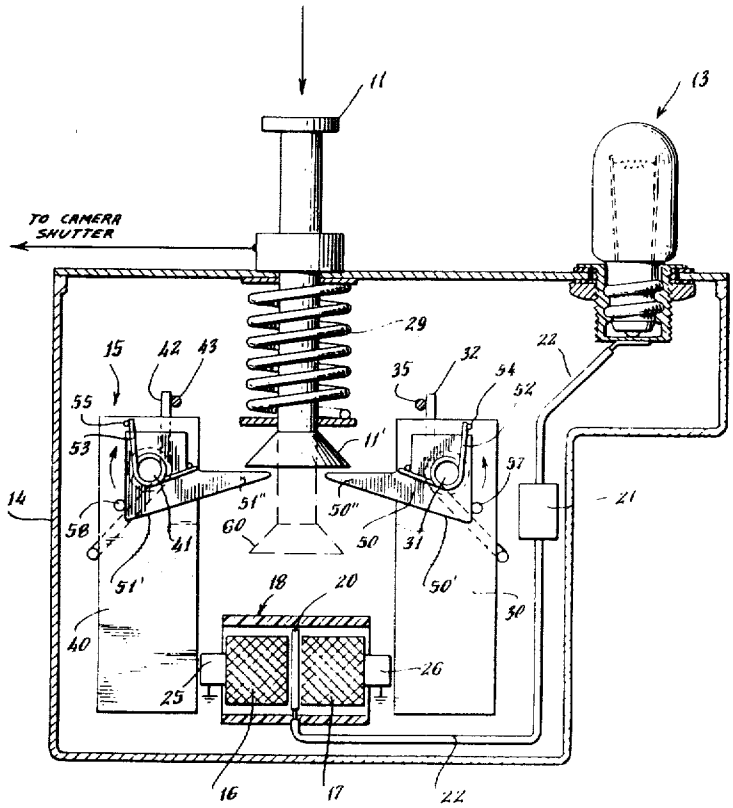
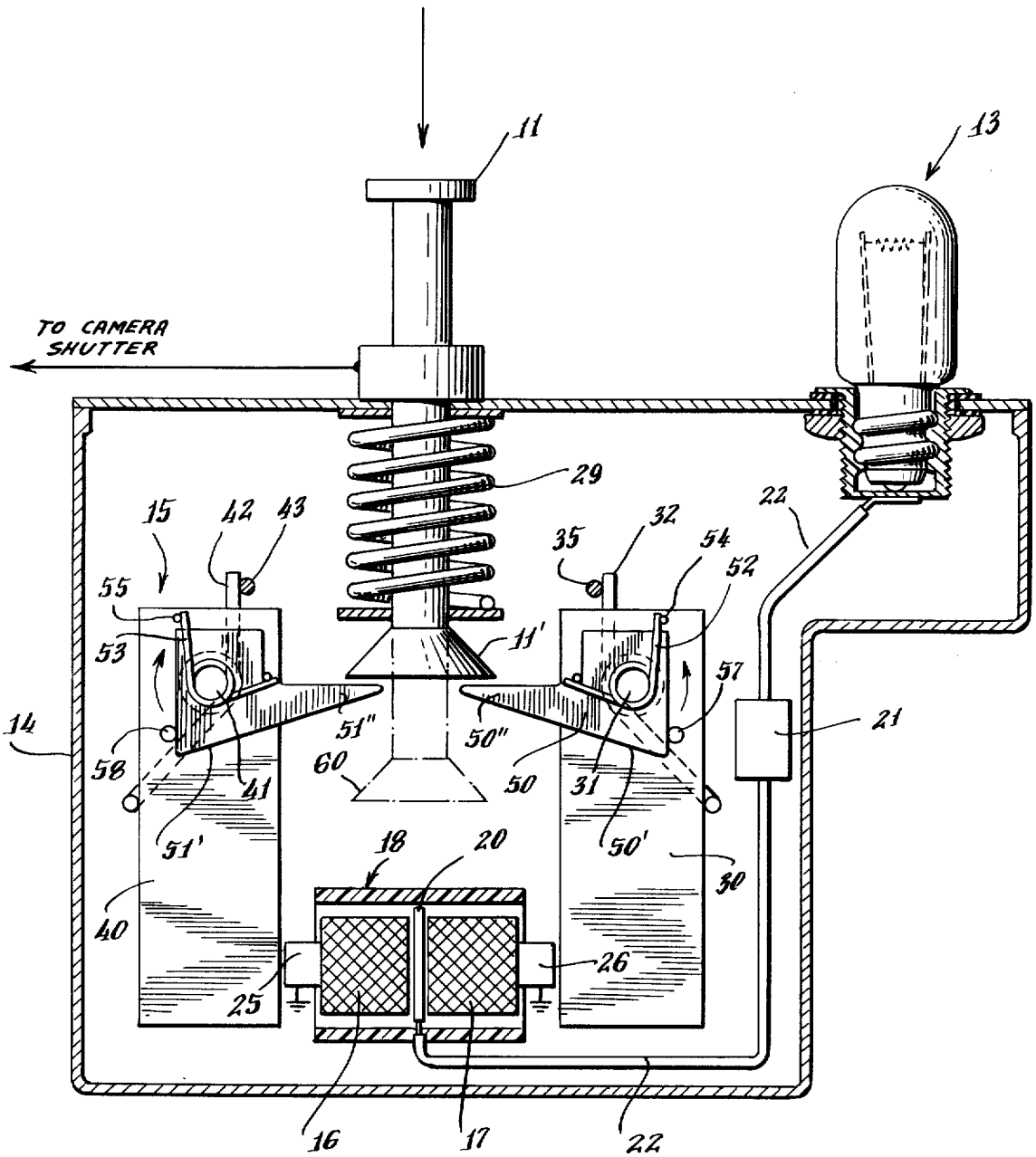
[57] **ABSTRACT**

A photographic flash lamp igniter utilizing piezoelectric elements as high voltage generating means comprisises two parallel piezoelectric elements, impact caps and mechanical linkage. In synchronization with the shutter of a camera, striking hammers hit two impact caps which activate two piezoelectric elements arranged in parallel. The electrical energy created by the piezoelectric crystals is transferred efficiently to ignite a photographic flash lamp electrically connected across the piezoelectric elements. However, the net kinetic energy seen by the supporting structure is essentially zero.

5 Claims, 1 Drawing Figure

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PIEZOELECTRIC FLASH LAMP IGNITION

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our earlier application, Ser. No. 330,557, filed Feb. 8, 1973, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to piezoelectric voltage generators and, in particular, to a piezoelectric generator for igniting photographic flash lamps.

Conventionally, the energy for ignition of photographic flash lamps used in portable photographic equipment is obtained from batteries installed in the flashgun or camera. However, batteries are not entirely satisfactory since they deteriorate with use and time, and must be replaced at relatively frequent intervals. Piezoelectric generators have been proposed as a replacement for batteries since they are capable of producing a large amount of energy, have a life commensurate with the rest of the camera and remain relatively stable in performance without significant loss of voltage or electrical capacity.

In one system disclosed by the prior art, a piezoelectric element is mechanically stressed and the electrical energy generated thereby stored in a capacitor. The charge in the capacitor is then discharged into a photographic flash lamp by connecting the capacitor directly across the lamp. This system is disadvantageous in that it requires a capacitor, which must be charged before lamp ignition can take place.

Another known method involves using sheets of piezoelectric material arranged as a flexible cantilevered beam structure. When the unsupported end of the beam is displaced and released, the beam rebounds momentarily, touching an electrical contact at the point of maximum beam displacement. The piezoelectric material is delivered to the lamp when the beam rebounds and contacts the lamp terminals. This method requires a large, bulky enclosure to permit the movement of the beam.

Accordingly, we have invented a piezoelectric flash lamp igniter which does not employ a capacitor or other external storage elements yet transfers energy efficiently into the photographic flash lamp. Furthermore, the present invention is compact and does not require a large container to enclose and activate the piezoelectric elements.

SUMMARY OF THE INVENTION

In the present invention, two small piezoelectric crystals are arranged end to end and electrically connected in parallel. When a mechanical mechanism such as a shutter release is initiated, two striking members or hammers fall in unison and the force of the impact created thereby is delivered simultaneously to both piezoelectric elements. The hammers strike two impact caps or impact receiving members which contact and distort the piezoelectric crystal elements arranged therebetween. The other end of the piezoelectric crystals are in common relation to an electrode. When the impact receiving member is struck by the hammer in the above manner, the piezoelectric elements are distorted to generate a high voltage between the confronting positive ends of these elements. The thus generated high voltage is transmitted through the common conducting metal plate electrode and a resistor of conductive coupling to an anode terminal in a photographic flash lamp socket. The cathode of said flash lamp socket is connected to a common ground potential; therefore, when the voltage is generated by the piezoelectric crystal, it is delivered immediately through the socket of the flash lamp, thereby igniting the photographic flash lamp. As previously indicated, the sequence is initiated by a mechanical mechanism such as a shutter release, which may be synchronized with the flash lamp ignition for proper photographic exposure. The use of two piezoelectric crystals being struck simultaneously at opposite ends creates no net force to be transferred to the camera body. This avoids shaking the camera and the possibility of blurring the photograph.

The features of the present invention which are believed to be novel are set forth with particularity in the attendant claims. The invention, together with further advantages thereof, may best be understood by reference to the following description taken in connection with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

The FIGURE is a cross-sectional view of the flash lamp igniter in accordance with the present invention.

PREFERRED EMBODIMENT OF THE INVENTION

The present invention will now be described referring to the accompanying drawing in which a preferred embodiment of the piezoelectric photographic flash lamp igniter in accordance with the present invention is illustrated.

The piezoelectric ignition system, **15**, in accordance with the present invention, is shown in detail in the FIGURE. This system may be located within a camera (not shown) or in a separate unit associated with flash lamp **13** (as shown in the FIGURE). The ignition system includes a pair of piezoelectric elements such as polarized lead-zirconate-titanate ceramic in a horizontally aligned relation in a horizontally extending hollow cylindrically insulative member **18**. The pair of piezoelectric elements **16** and **17** are horizontally aligned having the adjacent positive ends thereof facing each other with a conductive metal plate **20** extending through the adjacent wall of the cylindrical member **18** and longitudinally along the outside of cylindrical member **18**. The metal plate **29** is electrically connected in series to a conductive connector or ballast resistor **21** which is connected to the anode of the photographic flash lamp **13** by an insulated wire **22**. The cathode of the photographic flash lamp **13** is electrically connected to the casing **14**. An impact receiving cap **25** is secured to the left side of the left element **16** and the cap is adapted to receive an impact from an impact device which will be described hereinafter. A second impact receiving cap **26** is secured to right side of the right element **17** and the second cap is adapted to receive an impact from an impact device which will be described hereinafter.

The impact device may be actuated by an actuating member or a camera shutter release button **11** having a shaft and flanged end **11'**. A cylindrical spiral return spring **29** is anchored to the base of the shaft of the bottom **11** near the flanged end **11'**. The other end of spring **29** is mounted to the casing **14**, normally urging the release button **11** upwardly. Thus a portion of the release button **11** is normally disposed outside of the casing **14**. A right striking member **30** is pivotably sup-

ported on the transverse shaft **31** extending between opposite side walls of casing **14** and secured at the opposite ends to the interior of the casing. A tension spring **32** is disposed on the transverse shaft **31** with one end abutting against a laterally extending pin (not shown) on the striking member **30** and the other end secured to the interior of the casing **14** by a transverse pin **35** fixedly mounted on the inside of the casing. Therefore, the right striking member **30** is adapted to pivot about transverse shaft **31** toward and away from the above-mentioned impact receiving member **26.** A left striking member **40** is pivotably supported on the transverse shaft **41** extending between opposite side walls of the casing **14** and secured at the opposite ends to the interior of the casing. A tension spring **42** is disposed on the transverse shaft **41** with one end abutting against a laterally extending pin (not shown) on the striking member **40** and the other end secured to the interior of the casing **14** by a transverse pin **43** fixedly mounted on the inside of the casing. Therefore, the left striking member **40** is adapted to pivot about transverse shaft **41** toward and away from the above-mentioned impact receiving member **25.** Two angulated stop arms **50** and **51** having elbows **50'** and **51'** and fingers **50''** and **51''** are pivotably supported on transverse shafts **31** and **41** respectively. The outer portion of the elbows **50'** and **51'** contact transverse tripping pins **57** and **58** respectively which are fixedly mounted on the striking members **30** and **40** respectively.

Therefore, when activating member **11** is depressed downward, the stop arms are pivoted outwardly forcing the striking members outwardly also. When the member **11** reaches its lower limit of travel, as represented by the dotted position **60,** the fingers **50''** and **51''** no longer are engaged by the lower surface of member **11.** Springs **52** and **53** operate to quickly rotate stop arms **50** and **51** back toward the original position. Since the elbows no longer engage the tripping pins, the striking members **30** and **40** are released and fall against the impact receiving members **26** adn **25,** respectively. After the downward pressure is removed from member **11,** spring **29** urges the member **11** upward. When the release approaches an upright rest position, the stop arms re-engage their respective tripping pins. In operation, when the shutter release button or actuating member **11** is first manually pushed downward in the arrow direction (shown in the FIGURE) against the force of the spring **29,** the spring **29** having one end anchored to the inside of the case **14** and the other end thereof anchored to the flanged end of the actuating member, the spring **29** is stretched so as to store the moving or pushing energy of the member **11** in the spring **29.** The movement of a member **11** actuates the shutter of a camera (not shown) in a conventional manner as well as synchronously actuating the flash lamp igniter which is described hereinafter. As the member **11** is pushed further in the above arrow direction, the flanged portion thereof forces the pivot arms **50** and **51** about shafts **31** and **41** respectively in the arrow directions (shown in the FIGURE). The elbow portions of the pivot arms **50** and **51** engage stop pins **57** and **58** respectively and thereby force the striking members **30** and **40,** respectively, to pivot about shafts **31** and **41,** respectively, against the force of tension springs **32** and **42,** respectively, until the elbow disengages from stopping pins upon release by member **11** whereupon the striking members **30** and **40** are allowed to rapidly descend inwardly to strike against the impact receiving members **26** and **25,** respectively. In the above manner, the piezoelectric elements **16** and **17** are distorted to generate a high voltage between the confronting positive ends of these elements. The thus generated high voltage is transmitted through the conductive metal plate **20,** resistor or conductive coupling **21,** and insulated wire **22** to the anode of photographic flash lamp **13** which is ignited thereby. AS the actuating member **11** is returned to its normal position in the manner as mentioned above, the pivot arms **50** and **51** are also allowed to pivot about transverse shafts **31** and **41** contra to the arrow direction (shown in the FIGURE) to the extent necessary for the member **11** to return to its normal position.

The various features and advantages of the invention are thought to be clear from the foregoing description. Various other features and advantages not specifically enumerated will undoubtedly occur to those versed in the art, as likewise will many variations and mofifications of the preferred embodiment illustrated, all of which may be achieved without departing from the spirit and scope of the invention as defined by the following claims.

What is claimed is:

1. A piezoelectric photographic flash lamp igniter comprising

an outer casing,

a socket having a pair of electrodes for receiving a photographic flash lamp therein being attached to and insulated from the outer casing,

a piezoelectric high voltage generating device disposed within and attached to the outer casing, the device comprising

a pair of substantially identical piezoelectric elements positioned end to end, the abutting ends being of a like polarity and being commonly electrically connected to a first one of the pair of electrodes, and

a pair of conductive impact receiving caps being in mechanical and electrical engagement with the other opposing end of each of the piezoelectric elements, the caps being electrically coupled to the other of the pair of electrodes,

means for simultaneously impacting each of the impact receiving caps on the piezoelectric elements with a force which is equal to and in the opposite direction of the force applied to the other impact receiving cap so that a high voltage signal is applied across the photographic flash lamp to cause ignition thereof, and the net kinetic energy transferred to the outer casing is substantially zero, and

means for actuating the impacting means.

2. A piezoelectric photographic flash lamp igniter according to claim **1,** wherein the means for impacting comprises an opposed pair of substantially identical force generating assemblies each of which comprises

a shaft affixed to the outer casing,

an elongated striking member pivotably positioned on the shaft so as to reach the respective impact receiving cap,

means for rotating the striking members away from the impact receiving cap,

an impact force storing spring engaging the striking member so that as the striking member is rotated away from the impact receiving cap energy is stored in the spring, and

means for releasing the striking member so that it is rapidly counterrotated toward and against the impact receiving cap to cause a high voltage to be applied across the photographic flash lamp.

3. A piezoelectric photographic flash lamp igniter according to claim 2, wherein the means for actuating the impacting means comprises an outwardly spring biased, extended release member slidably mounted through the outer casing and having an outwardly flared portion at the internal end forming a cam surface at the internal end thereof, and

wherein each striking member has a protuberant generally pointed follower thereon which engages the flared cam surface on the release members so that as the release member is slid inwardly the cam surface forces the striking members to rotate away from the impact receiving caps until the continued inward travel of the release member causes the cam surface-follower engagement to terminate thereby releasing the striking members.

4. A piezoelectric flash lamp igniter according to claim 3, wherein the piezoelectric high voltage generating device further includes an insulative hollow cylindrical member in which the pair of piezoelectric elements are arranged with the positive ends thereof abutting each other and having a conductive metal plate disposed therebetween.

5. A piezoelectric photographic flash lamp igniter according to claim 4, which further includes a ballast resistor connected in series with the piezoelectric elements.

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