Safety and Arming Mechanism (SAM) for Mortar Fuze
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Abstract— This Paper contains introduction to safety and arming mechanism for Fuzes used in mortars. Presently this development process is carried out by using Reverse Engineering route. This invention relates to fuze having a mechanical delay device. The device also arms the ordnance section at the proper time through sensing that a predetermined set of conditions. The S&A device will provoke the explosives to initiate when the munitions senses that it has either hit or is in close proximity to the target. A safety and arming mechanism where in spinning as well as sliding member is held in an out-of-line position to align the explosive fuze train after the delay required. Actuator is activated when delay period is completed, arming the munition. An actuator releases the sliding member and moves the sliding member, which contains a stab detonator, to align and completing the fuze train towards a firing pin. Occurrence of arming and detonating occur instantly at same moment when the explosive train is completed and the stab detonator is impacted on the firing pin.

Key words: Fuze, actuator, detonator, explosive, firing pin

I. INTRODUCTION

Today’s world is full of safety and security. The countries round the globe are creating safer devices and systems in concern to the safety. These devices are used in our daily life, but the vast area where they are used is in conflicting fields such as army, navy, air-force etc. These devices were major in size when introduced and due to pioneering efforts these are now designed and assimilated in compact sizes. In artillery ammunition, setback force and spin is used to arm the fuze whereas, in mortar only setback force is available. Therefore in Mortar sustained acceleration, air velocity and sensing the exit of round from the launch tube can be used as second environment sensor to arm the fuze. Presently in mortar ammunition safety & arming mechanism connects the power source to the electronic circuit and aligns the explosive train.

Fig. 1: Assembly of Safety and Arming Mechanism

II. BACKGROUND OF THE INVENTION

Invention is relates to the Safety and Arming (S&A) devices for spin stabilized electronically fuzed projectiles containing a high explosive bursting charge such as are fired from a rapid fire gun. For the development of smaller caliber, within the minimum range, which are fired from guns mounted on aircrafts, helicopters, tanks, projectiles with such caliber which containing high explosive bursting charge which are located inside the casing of projectile have been developed. For the completion of firing train of projectile Electronic fuzing system have also been developed. Also such electronic fuzing systems have the capacity of sensing when any projectile strikes the target so that fuzing system produces firing signal to initiate detonator. When the projectile is subjected to such conditions it is essential that the firing train of projectile is manufactured such that it does not withstand the physical, electromagnetic, environmental and thermal forces. The fuzing system of the projectile produces an electrical arming signal, when the projectile is fired from gun.

III. SUMMARY OF INVENTION

An objective of the present invention is to provide a safety and arming mechanism in device that arms munitions depending on the weapon at variable distances. Another object of the present-invention is to provide a safe and arming device without the need for human adjustment that can be used in any number of munitions.

This mechanized device keeps the ordnance section of a munition from arming during shipping, handling, and storage. The device also arms the ordnance section at the proper time when predetermined set of conditions has been met through sensing. The S&A device will initiate the high explosives when the munition senses that, it is in a close proximity to the target either hit it.

Working with explosive devices is inherently hazardous, is key point to remember of all explosives. During the initiation of the explosives it is necessary to mitigate hazards associated with it. This is accomplished, when equipment or people are within the hazard area by, isolating the initiating stimuli from the insensitive secondary explosives during times. The heat, light, static electricity, shock or any other mechanism being initiating stimuli, can be to initiate the explosives.

To provide an improved and new safety and arming device in fuze, is an objective of the present invention in arming sector. Further object of the invention to provide a safety and arming device with an improved overhead safety. More reliable and less expensive is a further object of the present invention to provide a safety and arming device. Thus being a developing country it needs precise way to develop the mechanism used for fuzing for different defense equipment’s.
**IV. DESCRIPTION OF SAM**

The figure illustrates S&A Mechanisms for fuze which is generally designated on spinning explosive projectile.

1) Fuze S&A mechanism includes a base member, comprising of a cylindrical shape element with a circular cross-section, called housing.

2) The channel is formed in the base which does not touches the bottom wall. Two cuts are provided at both the ends of the channel and the gear is fixed in it.

3) A rod is inserted in the slot which is beside the channel, which holds the closing disc firmly and locks it with the housing and makes it a whole system.

4) There is a slot at one of the ends of the channel where the cylindrical shaped part is press fitted. This part is held by a rod within. This rod is very small in diameter and locks the cylindrical part in horizontal manner which is perpendicular to the axis of cylindrical part.

5) Beside this, there is a circular slot for a SAM detonator, in which it is placed. A washer is fixed above the detonator at the upper base level, which keeps the detonator stationary and in fixed and aligned position.

6) Another element, named detent is aligned below the plunger in a channel which is of square shaped. The plunger acts as the center element of the system. It is the main component of the assembly, as it rotates initially when the shaft of the turbo generator starts rotating.

7) Next is the locking plate in the series which has dual functions. Firstly, it holds plunger and secondly, it restricts the detent to bounce out of the assembly.

8) A rod is interposed in the channel which has two different types of gears at its ends. One of the end has spur gear and is engaged with the plunger, and the other end has helical gear which is is engaged with the pinion. The pinion has the internal threading which holds the locking pin. Locking pin is below the pinion and its upper end is externally threaded.

9) The complete assembly is tightly fixed in the cup.

10) The construction of the assembled SAM device completes and the housing has two completed drilled holes to reduce its weight.

**V. WORKING OF SAM**

Firstly, the fuze cover is removed & fuze is fired. The Turbo generator comprises of an electric generator assembly housed within a projectile. The assembly includes an air driven turbine and an electric generator. A common shaft carries the turbine and the permanent magnet of the electric generator. The generator rotor is a small permanent magnet and the stator is a series of coils. The turbo generator assembly is very compact and operates at substantial rotational speed. It provides safety when the shaft is engaged initially in the plunger of SAM which rest on detent and hold it up in housing by back support provided below the SAM.

Initially lock pin of pinion assembly remains engaged in the hole provided on the fuze body which does not allow the SAM to rotate. As shaft of turbo generator starts rotating it rotates the plunger, which further rotates the gear train, and subsequently un-locks the pin of pinion assembly. This is second safety.

Once the locking pin if pinion assembly is unlocked the SAM rotates 180 degree due to torsion spring of cover plate, and gets locked by the hard pin provided on the SAM body and by dropping down of detent in the groove provided on the fuze body. The dropping action of detent restricts the further rotation of the SAM assembly. The Turbo generator shaft gets disengaged with plunger and free to rotate for voltage generation. This completes the working of SAM arming and explosive train gets aligned. The alignment comprises of Micro detonator in Turbo generator, SAM detonator in SAM and Explosive n Fuze’s lower body.

**Fig. 2: Description of SAM**

**Fig. 3: Explosive Train Alignment**
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VII. CONCLUSION AND FUTURE SCOPE

A comprehensive study of all possible mechanisms available for the fuze was carried out. The focus of the research was on developing the Safety and Arming Mechanism by Reverse Engineering. Design and 3D drawings of the components are constructed and designed to understand the design and its functioning. Preliminary Design of Miniature SAM has been completed. Now a days we are implementing Micro Electro-Mechanical Systems (MEMS) which has high efficient performance. These are manufactured of several materials (semiconductors, plastics, ceramics, ferroelectric, etc.) and manufacturing methods, components range in size from a millionth of a meter to a thousandth of a meter.

REFERENCES