Oct. 18, 1955 M. L. KEMPTON 2,721,071

APPARATUS FOR MEASURING TRANSVERSE ACCELERATIONS

Filed April 14, 1952

FIG. 1.

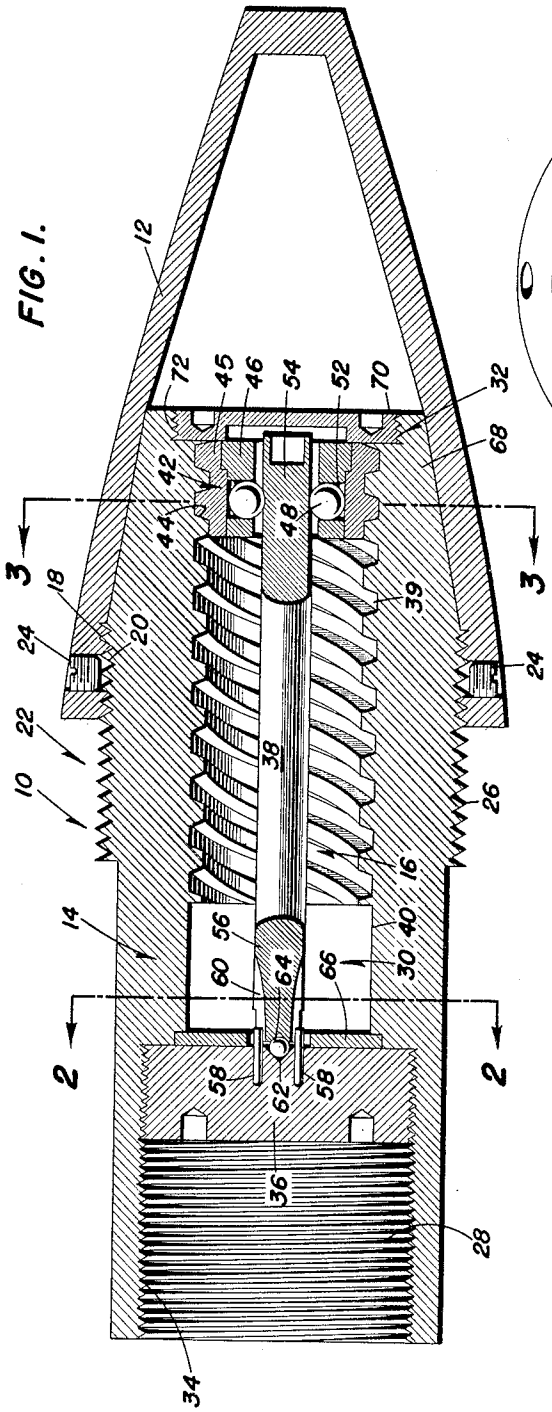


FIG. 3.

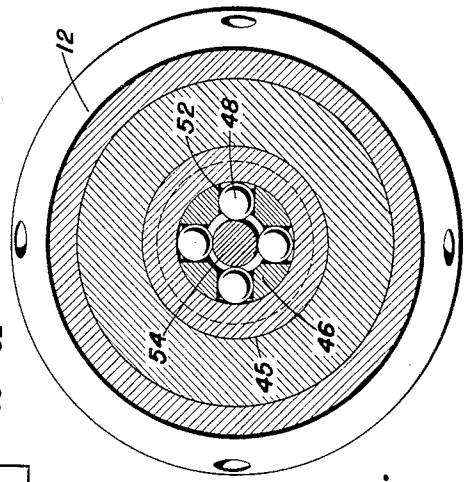
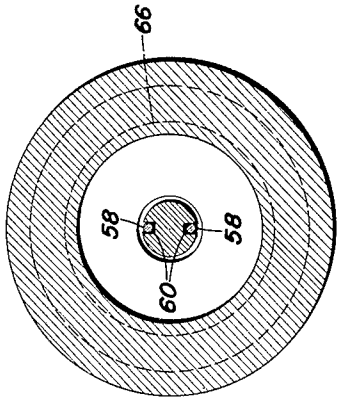


FIG. 2.



INVENTOR
MARVIN L. KEMPTON
BY G. D. O'Brien
Q. Baxter Warner
ATTORNEYS

United States Patent Office 2,721,071 Patented Oct. 18, 1955

2,721,071

APPARATUS FOR MEASURING TRANSVERSE ACCELERATIONS

Marvin L. Kempton, Socorro, N. Mex., assignor to the United States of America as represented by the Secretary of the Navy

Application April 14, 1952, Serial No. 282,145

7 Claims. (Cl. 264—1)

This invention relates to artillery weapons, and in particular to an arrangement for determining acceleration forces developed by a projectile in a gun barrel.

Upon acceleration of a projectile in a rifled gun barrel or tube, acceleration forces of large magnitude are developed by the projectile during the period that the projectile is traversing the gun tube. These forces are caused by the projectile striking the inner faces of the gun tube during rotation of the projectile.

It is of particular importance from a design standpoint to know the value and location of the acceleration forces generated so that certain fuze components, such as oscillator-detector tubes, amplifier tubes, and thyratron tubes of radio proximity fuzes, can be properly mounted in order to prevent them from being damaged during the critical period that the projectile is traversing the gun tube. The gun designer, likewise, is interested in the acceleration forces in designing tubes to withstand such large forces.

It is the principal object, therefore, of this invention to provide an arrangement for measuring ttransverse acceleration forces developed in a gun tube during the period that a projectile is traversing the gun tube.

Another object of the invention is to provide an arrangement for continually recording transverse acceleration forces during the entire period that the projectile is in the gun tube.

To provide a simple system for recording acceleration forces that can be readily mounted into a projectile fuze, is still another object of this invention.

Other objects and many of the attendant advantages of this invention will be more fully appreciated as the same becomes understood by reference to the following detailed description when considered in connection with the accompanying drawing, and in which:

Fig. 1 is a longitudinal sectional view of a projectile fuze, embodying the invention;

Fig. 2 is a cross-section along line 2—2 of Fig. 1; and

Fig. 3 is a cross-section along line 3—3 of Fig. 1.

In accordance with the invention, an acceleration gage is mounted in a projectile fuze to record the developed acceleration or side slap forces. This gage includes a carrier ring, which, upon longitudinal acceleration of the projectile, due to the effect of inertia, is caused to remain substantially without rotation. This carrier ring contains certain balls which move spirally down a casing and score a multi-spiral trace on the surface of a magnesium rod, for indicating the magnitude of side acceleration forces in a rifled gun, such as a howitzer or field artillery gun. The magnesium rod is limited against full rotation by a plurality of pins, but is caused to rock on a bearing by the side or transverse acceleration forces. The free end of the rod moves in accordance with the side acceleration forces developed by the projectile. The magnitudes of the side acceleration forces developed by the projectile in the gun barrel are then determined by measuring the depths of the score marks on the magnesium rod and then converting this data into acceleration forces, using other known information.

Referring now to the drawing for a more detailed description of the invention, there is shown in Fig. 1 an inert artillery fuze **10** having a nose **12** and a body **14**, which contains a gage arrangement **16** for recording the acceleration force data.

Nose **12** is internally threaded at **18** so that it can be screwed onto a portion **20** of the threaded section **22** of the fuze body **14**. Set screws **24** are utilized for preventing the nose **12** from moving relative to the fuze body **14**. Portion **26** of the threaded section **22** of the fuze body **14** is used for attaching the assembled fuze **10** to a projectile (not shown).

Fuze body **14** is internally bored, and has, therefore, three bore sections **28**, **30** and **32**. Bore section **28** is internally threaded throughout its length, as indicated at **34**, and into it is screwed a threaded plug element **36** which is used to support a rod member **38**, which will be described presently. Plug element **36** thus occupies a position usually occupied by the conventional detonator-booster arrangement (not shown) for igniting the main explosive charge carried by the projectile proper.

The acceleration gage arrangement **16**, with which this invention is particularly concerned, is located in bore section **30**. Bore section **30** is of smaller diameter than bore section **28**, and it has a threaded portion **39** and an unthreaded portion **40**. Threaded portion **39** is, in reality, a spiral groove having a quadruple "Acme" thread with a 1" lead.

A cylindrical carrier ring **42**, having an external threaded surface **44** corresponding to the threaded spiral groove portion **39**, is located within the bore section **30**. This carrier ring **42** is divided into two sections **45** and **46** in order that a plurality of balls **48**, usually four in number and $\frac{3}{16}$" in diameter can be mounted therein. These balls **48** are mounted adjacent to magnesium rod **38** and are spaced equally thereabout. Balls **48** are silver soldered in their mountings as indicated at **52**.

Magnesium rod **38** extends throughout the length of bore **30**, and it has one free end **54** and a pivoted end **56**.

Magnesium rod **38** is limited against full rotation by a plurality of pins **58** which are mounted in plug element **36**. These pins **58** extend into slots **60** cut into end **56** of rod **38**. A "V-notch" **62** formed in the center of plug element **36** receives a $\frac{1}{16}$" ball **64** upon which the pivoted end **56** of magnesium rod **38** is mounted. Ball **64** thus acts as a bearing for rod **38** so that the rod **38** can be caused to rock by the side acceleration forces since the other end **54** of the rod **38** is free to move. A washer **66** is located between the unthreaded portion **40** of bore **30**, and plug element **36**.

Rod **38**, together with carrier ring **42** and balls **48** are assembled through end **68** of fuze body **14**. A plug element **70** is located in bore section **32**, and is maintained in position by the threaded arrangement **72**.

In operation, upon acceleration of the projectile, the effect of inertia causes carrier ring **42** to remain substantially without rotation. Balls **48**, together with the carrier ring **42**, move spirally down bore section **30**, and the balls **48** score a quadruple spiral trace on the surface **72** of magnesium rod **38**, and thus indicate the magnitude of side acceleration forces in the rifled gun. The projectile can be recovered by "vertical firing."

Rod **38** is limited against full rotation by pins **58**, but is caused to rock, by the side or transverse acceleration forces, on bearing arrangement **64**.

The upper end of rod **38** is, as previously pointed out, free to move in accordance with the side acceleration forces. The amount of side acceleration of the projectile can then be determined by measuring the depth of the

score marks on the rod **38**, and then correlating these measurements with other known information.

It is to be understood that the foregoing detailed description of a preferred embodiment of the invention is intended by way of exemplification and should not be construed in any way as limiting upon the scope of the appended claims.

What is claimed is:

1. An arrangement for recording transverse acceleration forces developed by a projectile during the period that said projectile is traversing a gun tube, comprising, a substantially cylindrical and deformable record receiving blank having one end thereof pivotally mounted within said projectile, said record receiving blank being held axially of said projectile, and an inertia operated means surrounding said deformable blank for recording a permanent spiral record on said blank, whereby upon longitudinal acceleration of said projectile in said gun tube, said inertia operated means records said spiral record on said record receiving blank of the transverse acceleration forces developed during the time period that said projectile is traversing said gun tube.

2. An arrangement for recording transverse acceleration forces developed by a projectile during the period that said projectile is traversing a gun tube, comprising, a substantially cylindrical and deformable record receiving blank having one end thereof pivotally mounted within said projectile and the other end free, said record receiving blank being held axially of said projectile, and an inertia operated means surrounding said deformable blank for recording a permanent spiral record on said blank, whereby upon longitudinal acceleration of said projectile in said gun tube, said inertia operated means records said spiral record on said record receiving blank of the transverse acceleration forces developed during the time period that said projectile is traversing said gun tube.

3. An arrangement for recording transverse acceleration forces developed by a projectile during the period that said projectile is traversing a gun tube, comprising, a housing mounted within said projectile, a substantially cylindrical and deformable record receiving blank having one end thereof pivotally mounted within said housing and the other end free, said record receiving blank being held axially of said projectile, and an inertia operated means located between said housing and said deformable blank for recording a permanent spiral record on said blank, whereby upon longitudinal acceleration of said projectile in said gun tube, said inertia operated means records said spiral record on said record receiving blank of the transverse acceleration forces developed during the time period that said projectile is traversing said gun tube.

4. An arrangement for recording transverse acceleration forces developed by a projectile during the period that said projectile is traversing a gun tube, comprising, a housing mounted within said projectile, a substantially cylindrical and deformable record receiving blank having one end thereof pivotally mounted within said housing and the other end free, said record receiving blank being mounted axially of said projectile, and an inertia operated means located between said housing and said deformable blank for recording a permanent spiral record on said blank, whereby upon longitudinal acceleration of said projectile in said gun tube, said inertia operated means records said spiral record on said record receiving blank of the transverse acceleration forces developed during the time period that said projectile is traversing said gun tube.

5. An arrangement for recording transverse acceleration forces developed by a projectile during the period that said projectile is traversing a gun tube, comprising, a housing mounted within said projectile and having its principal axis parallel to the longitudinal axis of said projectile, said housing having a spiral groove threaded into its internal surface, a substantially cylindrical and deformable record receiving blank pivotally mounted at one end thereof within said housing and the other end free, said record receiving blank being mounted axially of said projectile, and an inertia operated means located between said housing and said deformable blank for recording a permanent spiral record on said blank, said inertia operated means having a threaded portion to cooperate with said spiral groove in said housing, whereby upon longitudinal acceleration of said projectile in said gun tube, said inertia operated means records said spiral record on said record receiving blank of the transverse acceleration forces developed during the time period that said projectile is traversing said gun tube.

6. An arrangement as set forth in claim 5, wherein said record receiving blank comprises a magnesium rod.

7. An arrangement as set forth in claim 6, wherein said inertia recording means comprises a carrier ring and a plurality of balls carried by said carrier ring, said balls indicating spiral records on said record receiving blank of the transverse acceleration forces developed while said projectile is traversing said gun tube.

References Cited in the file of this patent

UNITED STATES PATENTS

2,445,307	Mindlin	July 13, 1948
2,523,474	Mason	Sept. 26, 1950
2,575,973	Perry	Nov. 20, 1951
2,597,758	Sreb	May 20, 1952