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SETBACK GAUGE

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FIG. 1

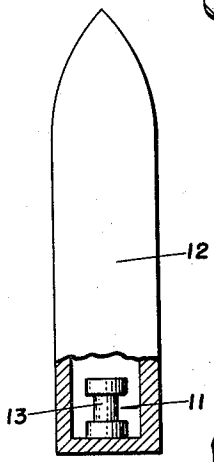

FIG. 2

FIG. 3

FIG. 4

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SETBACK GAUGE

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5 Claims. (Cl. 73—167)

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The present invention relates to an improved setback gage for use in projectiles to measure maximum force producing acceleration, or the accompanying setback reaction, developed by the propelling charge in a gun barrel as a projectile is discharged from the gun.

The gage is of the type designed to be mounted within the interior of a projectile with its axis or direction of operation disposed coincidently with the longitudinal axis of the projection or parallel to it.

It is an object of the invention to provide an improved gage, simple and economical and reliable in operation.

In the preferred practice a gun is pointed upwardly, a retrievable projectile equipped with a gage assembly in accordance with the invention is discharged from the gun, and the gage furnishes the desired data upon recovery of the projectile.

In the accompanying drawings:

Fig. 1 is an elevation of a projectile, partly broken away and in axial section, showing a setback gage in accordance with the invention installed therein;

Fig. 2 is an axial sectional view of the gage, on a much larger scale, showing it set for operation, with its bob member in detailed section to disclose its interior arrangement;

Fig. 3 is a corresponding fragmentary sectional view of the gage barrel member and the retrieved gage in registering conditions for indicating the desired measurement; and

Fig. 4 is a perspective view of the bob member, partly broken away, and detached from the gage.

Fig. 1 illustrates the relation of the gage generally shown at 11 to a projectile 12. In the particular embodiment illustrated in Fig. 1 the instrument is encased within a barrel or tubular holder 13, preferably of molded plastic material, with a central longitudinal open well 14, terminating at its forward end in an enlarged recess 15. At its rear end the well opens into a similar but preferably deeper recess 16 designed to be closed by the base 17 of the projectile, to form a chamber for the reception and retention of a bob 18. The bob is a mass of metal of predetermined size, shape and weight.

At its forward end the cylindrical interior wall of the well is internally threaded at 20 to receive the threaded shank 21 of a screw plug having a hexagonal head 22.

A rod 24, which projects into the well, is rigidly mounted in the screw plug by frictional insertion into a socket wherein it is made fast by a set

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screw 25. This arrangement permits adjustment of the position of the rod. The free end of the rod is fashioned with a reduced integral axial extension 26 forming an abutment or shoulder 27.

The principal component of the indicating means consists of a coil of relatively soft inelastic but ductile wire wound in the form of a tight helix, as shown at 28 in Fig. 2 mounted in the well and supported by the screw plug parallel with and adjacent rod 24. Indicating element 28 is essentially a tension spring but is formed of material which is capable of plastic deformation, or of taking a permanent set under the forces and at the temperature present during setback. The degree of such deformation is a measure of the maximum setback force.

One end of the wire indicator is fixed, as by welding or soldering in a socket of the screw plug, and the free end terminates in a hook 29. The intermediate portion of the wire, altho shown in the form of a helix, might of course be of other devious character. In its initial condition shown in Fig. 1 the indicator coil is located parallel with and adjacent the stem 24; and its hooked end projects rearwardly beyond shoulder 27. The indicator wire is sufficiently stiff to be self-sustaining and to resist distortion under the lesser forces to which it may be subjected prior to firing. The bob is automatically detached from the wire upon firing, as will presently be indicated in detail, and the wire is also stiff enough to resist further distortion due to the impact or landing of the projectile with the bob detached.

The indicator is held in its initial position by the attachment of the bob to the stem 26, and strained in operation by the setback force acting on the bob.

Rod 24 and bob 18 are of such dimensions that when the gage is initially set for operation, the indicator is under a slight but predetermined tension within its elastic limit, sufficient to provide a parameter for subsequent computations.

Bob 18 is formed as a cylinder having a longitudinally extending socket 30 designed slidably to receive extension 26. This socket opens into an interior transverse channel 31, which extends through the bob at 32 and communicates with a longitudinal channel 33. Channel 33 is designed to receive the hooked end 29 of the coil.

The bob is mounted on extension 26 and abuts shoulder 27. The bob is detachably secured to the hook 29 by a spring wire U-shaped latch 35, one end of which is firmly anchored at the rear end of the bob, and the other end of which terminates in a latch hook 36.

In setting the gage the latch hook **36** is first pressed through socket **30**, and through the transverse channel **31** into channel **33** of the bob, and then the bob is slipped onto extension **26** and up against shoulder **27**.

As the bob is slipped on extension **26** the engagement of the extension with the latch forces the latch hook **36** across channel **33** into aperture **32** and by frictional engagement of the bob, the extension and the latch, the bob is retained on the extension.

The hook **29** of the indicator is now inserted in channel **33** and manipulated into engagement with the latch hook **36**. The retracted indicator is thus set and held taut for the gaging operation.

The guide pin **26** acts as a keeper or detent for the latch **35**, which cooperates with hook **29** to connect the bob, through the coil, to the stationary screw plug as a support.

Under force of setback the bob is pulled rearwardly, thus stretching the coil indicator. Under continued pull of setback on the bob latch **35** is withdrawn from engagement with extension **26** thus releasing the latch from lateral pressure, but hook **36** still remains latched to hook **29** of the indicator. This frictional engagement of the hook is maintained, and the elongation of the spring continues, until the force of setback reaches its peak. The bob continues to hang on the hook until the setback force subsides to a low value. When a low predetermined value of force or acceleration is reached, spring **35** is enabled to overcome the frictional force between the hooks **36** and **29**, so that the latch becomes disengaged and the bob is freed from the extended indicator and deposited in the pocket **16**, as indicated by dotted lines in Fig. 2.

As a result of the setback force the indicator is strained from the condition shown in Fig. 2 to that illustrated in Fig. 3, and the drawn out condition is maintained, even under striking impact of the projectile.

The maximum force due to acceleration of the projectile or setback of the bob developed within the gun barrel is indicated by the increase in length of the indicator caused by movement of the bob. Since strain is a function of stress this elongation may be translated into force units.

Before loading the gage into a projectile, a measurement of distance is made between any fixed stationary reference point as for instance a point on rod **24** and the hook **29**. The wire is elongated during setback of the projectile. After firing and recovery of the projectile the distance between the previously measured points is again measured. The difference between the two measurements gives the elongation of the coil. From a calibration curve of elongation or strain verus force or stress is determined the force that must have acted on the coil during setback of the projectile. The ratio of the peak acceleration of the projectile, to the acceleration of gravity, is obtained by dividing the value of force corresponding to the measured elongation, by the weight of the bob. This factor is commonly designated as the "number of g" acting on the projectile.

While there has been shown and described what is at present considered to be the preferred embodiment of the invention it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit of the invention, and therefore the scope of the invention is defined solely in and by the following claims.

I claim:

1. In a setback gage for use in a missile, the combination of a support member, a deformable indicating member secured at one end to said support member, said indicating member being made of material that has a small elastic limit, an inertia member releasably held by said support member and transferrable to the remaining end of said indicating member, when setback occurs, whereupon said inertia member imposes upon said deformable indicating member stresses very greatly exceeding its elastic limit, thereby permanently deforming said indicating member, releasable means retaining the inertia member resiliently in engagement with the deformable member before and during the setback period, and means coacting with the support member and the inertia member for initially preventing the release of said releasable means.

2. The combination defined in claim 1, wherein the deformable indicating member is initially a closely-wound helix made of metal wire.

3. The combination defined in claim 1, wherein additionally guide means are provided on the support member, for guiding the inertia member while under the influence of the setback force.

4. The combination defined in claim 1, wherein the support member has a portion that constitutes a guide for the inertia member, said inertia member being slidably mounted on said portion.

5. The combination defined in claim 1, wherein the deformable indicating member has its unsecured end formed as a hook and wherein the inertia member is provided with a latch that frictionally engages said hook, and means coacting with the support member and the inertia member are provided, for initially retaining the latch in engagement with said hook.

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