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APPARATUS FOR MEASURING TRANSVERSE ACCELERATIONS

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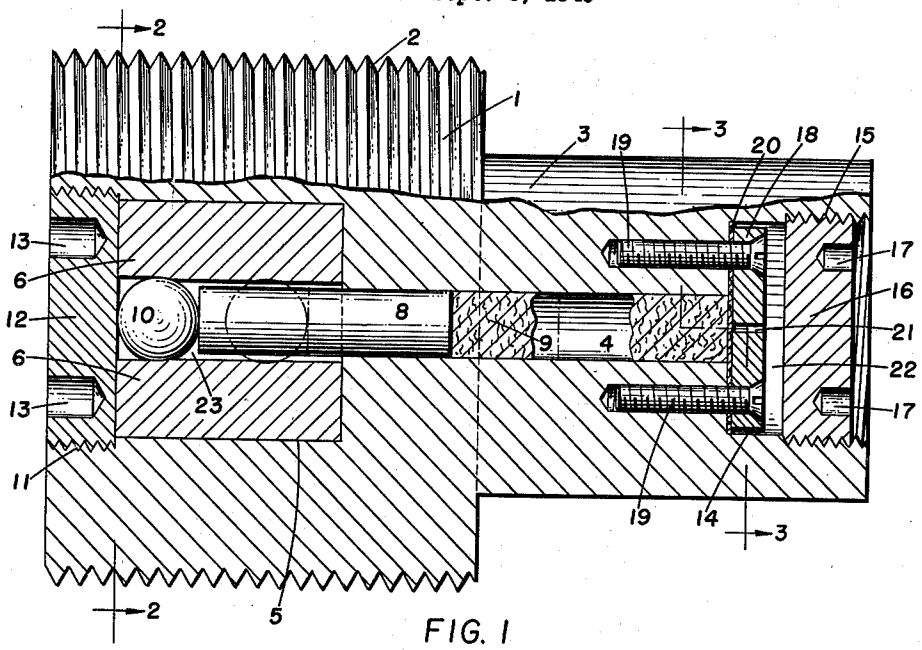



FIG. 1

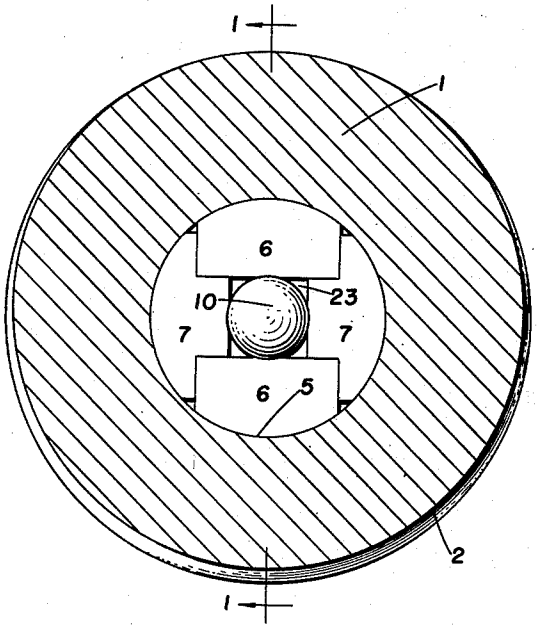



FIG. 2

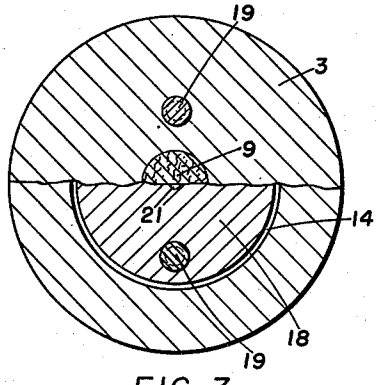



FIG. 3

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## APPARATUS FOR MEASURING TRANSVERSE ACCELERATIONS

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8 Claims. (Cl. 73—167)

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The present invention relates to an improved apparatus for measuring and recording the transverse acceleration given to a projectile while being fired through the barrel of a gun.

While it is highly desirable to know the transverse or radial accelerations to which a projectile is subjected on firing it through the barrel of a gun, heretofore no simple and satisfactory way of determining such accelerations has been available. The difficulties to be overcome arise mainly from two important causes, first, the forces developed in firing a projectile are very large, and second, the time during which such forces exist is extremely short, due to the high velocity of the projectile.

An object of the invention therefore is to provide apparatus sufficiently rugged to withstand the stresses developed in firing the projectile, which will produce records of transverse or radial accelerations by indentations or tracks made in smooth blocks of suitable material, such as a soft metal, for example, said records showing not only the amount of the acceleration, but also the positions attained by the projectile in the gun barrel when the respective accelerations existed.

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

Fig. 1 is a side elevation of the apparatus, partly broken away and in axial section on plane 1—1 of Fig. 2;

Fig. 2 is a section on plane 2—2 of Fig. 1; and

Fig. 3 is a section on planes 3—3 of Fig. 1.

The device comprises, in general, a hardened metal or other ball which is placed in a guide of regular prismatic form, that is, a prism whose section, normal to its axis, is a regular polygon, having its axis coincident with the axis of the projectile, said guide being just a trifle too small to admit the ball, which consequently must deform the guide in moving through it. To permit this, the guide is made of relatively soft metal, and to permit easy manufacture and assembly of the guide, it is preferably made of four pieces, although more or fewer pieces may be used, if desired.

The ball moves backward in the guide in response to the inertial forces generated by the set-back, and suitable damping means are provided to control and steady the motion, as will now be described in detail.

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The apparatus consists of a metal cylinder 1 having external threads 2 thereon, whereby it may be secured into a test projectile. At one end, which will be called the rear, there is a continuation 3, which is also a cylinder but is of reduced diameter, and not externally threaded.

A small axial bore 4 extends through the central portion of the apparatus, and receives a closely fitting piston 8. The piston 8 is somewhat shorter than the bore 4 and moreover extends forward from the front end of said bore, thus leaving room for a filling of grease 9 back of the piston.

This grease 9 is retained in the rear end of bore 4 by a disk 20 of paper or similar material, which in turn is held in place by the orifice plate 18 and screws 19. This orifice plate is accommodated in a bore 14 in the small end 3 of the device. It has a tiny bore 21 therein.

The bore 14 has threads 15 at its rear end, to receive the plug or cover 16. This plug has holes 17 therein to receive a spanner wrench, whereby the plug may be screwed in tightly, to define a chamber 22 between its inner face and the outer face of the orifice plate 18.

In the front end of the apparatus there is a large bore 5 into which fit closely four slugs of soft metal, 6, 6 and 7, 7. Each slug has its outer surface shaped as part of a cylinder, and has its inner surface plane, as shown best in Fig. 2.

A ball 10 made of steel or other hard material, and slightly larger in diameter than the spacing between the plane faces of the pairs of slugs 6, 6 and 7, 7 is forced into the square-prismatic bore formed by said slugs. This may be done by screwing a plug 12 into threads 11 provided at the front end of the portion 1 of the apparatus. This plug may be turned by a spanner wrench engaged in the holes 13, and preferably is of such thickness that it just will fill the allotted space when the ball 10 has been forced fully into the square bore 23.

The operation is as follows:

The bore 4 is filled with grease, and the piston 8 is then forced into the front end of said bore. The ball 10 is next positioned between the ends of the slugs 6, 6 and 7, 7 and the plug 12 screwed down to its seat on the ends of said lugs.

This will force the ball 10 into the square bore 23, in contact with the front end of the piston 8 and the rear surface of the plug 12, where it will be held firmly and without play in any direction.

By the motion of the piston 8 in thus positioning the ball 10, some of the grease 9 will be forced

out of the rear end of the bore 4. This grease is cut off flush with the inner end or bottom of bore 14, and the paper disk 20 is next applied and held in place firmly by the orifice plate 18 and screws 19. Then the plug 16 is screwed into place to close the rear end of the apparatus.

The inner surfaces of the square bore 23 are finished to mirror-smoothness and made truly plane to a high degree of precision. As already stated, the diameter of the ball 10 exceeds the side of the square by a few ten-thousandths of one inch, so that if the ball progresses down the square bore axially it will produce straight tracks of uniform depth in all four slugs.

However, if transverse of radial accelerations occur while the ball is traversing this square bore, the tracks will be deepened correspondingly in the face or faces which move toward the axis, and will be shallower or absent on the opposite face or faces.

The rearward motion of ball 10 is, of course, caused by the "set-back" when the test projectile is fired. The set-back acceleration causes the combined masses of ball 10, piston 8 and grease 9 to exert an inertial force, causing the grease to press against the paper 20. This immediately punctures the latter, and some of the grease is forced out through the orifice 21. Thus a damping effect is secured, and by proper choice of the masses of ball, piston and grease, the viscosity of the grease and the dimensions of the orifice 21, the ball 10 may be caused to traverse the desired range while the set-back continues, that is, while the projectile is traveling through the barrel of the gun.

By removing the slugs 6, 6 and 7, 7, and studying the grooves formed therein by the ball 10, it will then be possible to determine whether or not transverse accelerations existed, their directions and relative magnitudes, and the approximate location of the projectile in the gun barrel when the accelerations acted.

The slugs may be removed for study by tapping the front end of the apparatus against a relatively soft material, such as a block of wood, so that the apparatus will not be injured, and may be reloaded for repeated use by merely inserting a new set of slugs and replenishing the grease, etc., as above described.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A device to be carried by a projectile for measuring transverse acceleration of the projectile while traversing a gun barrel, said device comprising a member having a relatively soft plane surface which is parallel to the axis of the projectile, an inertia-responsive relatively hard element having its center of mass movable substantially along the axis of the projectile, means forcing said element against said soft surface with sufficient pressure to cause the hard element to make a track therein when the hard element moves, and means for damping the motion of said hard element.



2. A device as defined in claim 1, wherein the means forcing the hard element against the soft surface is another member having a soft plane surface, parallel to the first-mentioned one, the hard element thus being between said surfaces and making a track in each.

3. A device as defined in claim 1, wherein the means forcing the hard element against the soft surfaces comprises a plurality of other members, each having a soft plane surface, said surfaces jointly constituting a regular prismatic guide slightly too small to receive the hard element without deformation of all said surfaces.

4. A device to be mounted axially in a projectile, for making a record of the transverse acceleration of the projectile while traversing a gun barrel, said device having a central cavity, guide elements each having a soft plane record receiving surface, said elements being assembled in said cavity with the soft surfaces directed inwardly to form a regular prismatic guide, a hard record-making member formed as a solid of revolution, equatorially in forcible contact with all the record-receiving surfaces, and means damping the axial motion of said member which occurs in response to set-back.

5. A device as defined in claim 4, wherein the record-making member is a sphere.

6. A device as defined in claim 4, wherein the damping means is a dash pot containing a viscous fluid.

7. A device as defined in claim 4, wherein the guide elements are replaceable and are shaped to fit in the cavity in such way that their record-receiving surfaces automatically become positioned properly when the elements are placed in the said cavity.

8. A device to be mounted axially in a projectile, for making a record of transverse acceleration of the projectile while the latter is traversing a gun barrel, said device being substantially a cylinder and having means for mounting it firmly in the projectile, said cylinder having an axial bore therein, a piston fitting closely in said bore, an orifice plate across the rear end of said bore, said cylinder having a larger axial bore at its front end, slugs each having an outer cylindrical arcuate surface to fit against the wall of said last named bore, and a soft plane surface opposite the arcuate surface, said slugs when in place forming a regular prismatic guide coaxial with the bores, and large enough to clear the piston, a hard sphere of diameter slightly too large to enter the guide without forcing, and a filling of viscous fluid in the rear portion of the first-named bore, between the piston and the orifice plate, said plate having a small orifice therein to permit restricted escape of said viscous fluid.

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