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STABILIZED PROJECTILE.

APPLICATION FILED DEC. 13, 1915. RENEWED FEB. 1, 1918.

1,316,033.

Patented Sept. 16, 1919.

Fig. 1

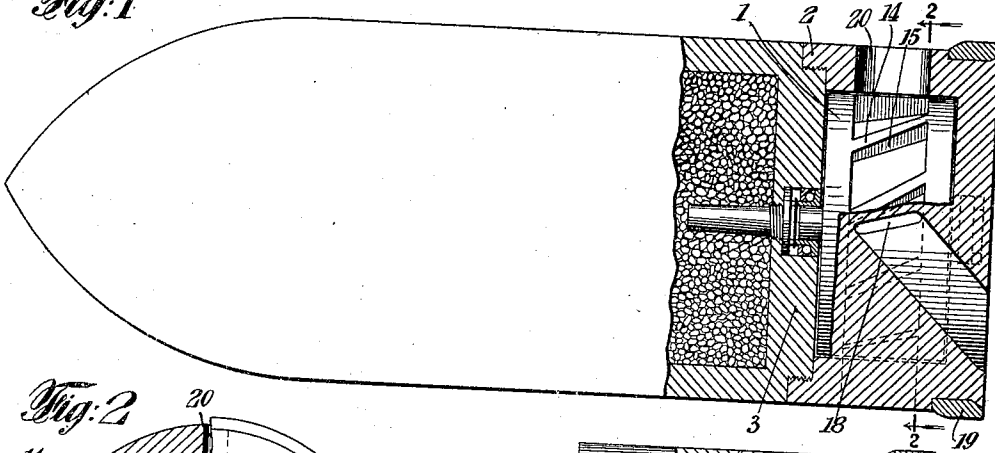


Fig. 2

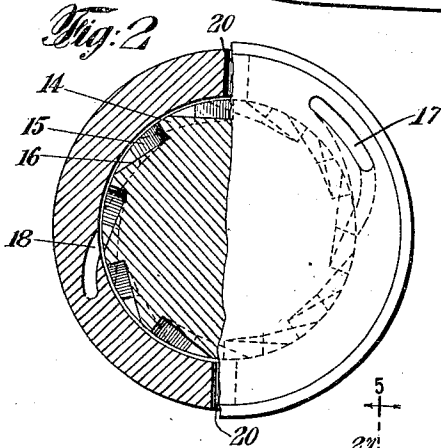


Fig. 3

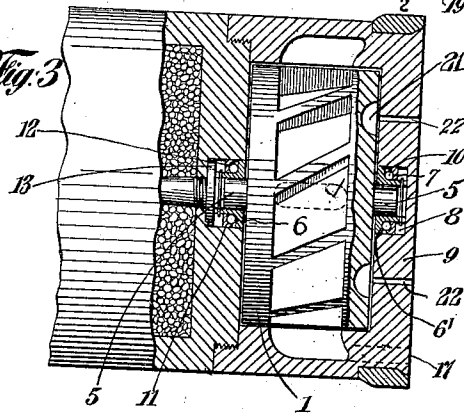


Fig. 4

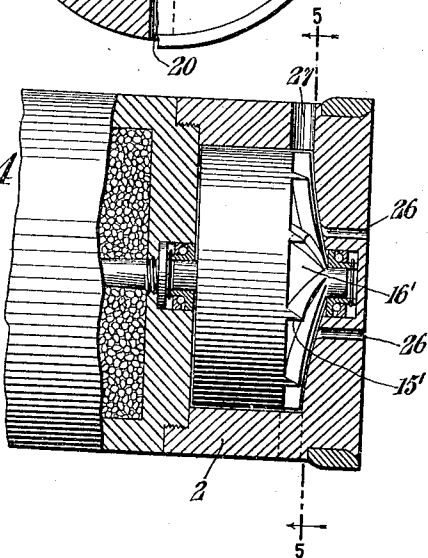
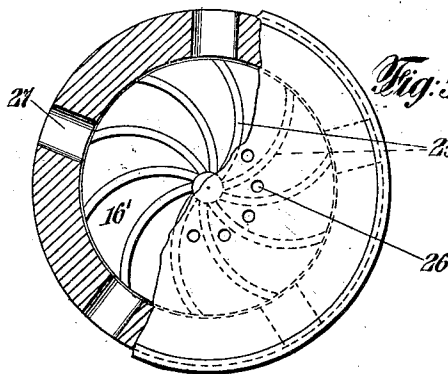


Fig. 5



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# UNITED STATES PATENT OFFICE.

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## STABILIZED PROJECTILE.

1,316,033.

Specification of Letters Patent. Patented Sept. 16, 1919.

Application filed December 13, 1915, Serial No. 66,470. Renewed February 1, 1918. Serial No. 214,984.

*To all whom it may concern:*

Be it known that I, JOHN H. HAYDEN, a citizen of the United States, and a resident of Pelham Manor, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Stabilized Projectiles, of which the following is a specification.

My invention relates to projectiles, and particularly to projectiles which include a stabilizing device mounted for free rotation relatively to the shell thereof.

Projectiles in which a stabilizing wheel is mounted for free rotation about an axis are shown in my co-pending applications for stabilized projectiles, Serial Number 10,677, filed February 26th, 1915, and Serial Number 58,116, filed October 27, 1915, together with means for putting the stabilizing wheel into operative condition. In the devices described and illustrated in the applications as being possible embodiments of my inventions, the stabilizing wheel is mounted in anti-friction bearings and a force is applied to the wheel to impart a rotation thereto. One object of this invention is to provide a projectile including a stabilizing wheel, wherein provision is made for applying forces to the stabilizing wheel to accelerate it axially.

Another object is to provide a projectile having a stabilizing wheel together with means for imparting rotation to the stabilizing wheel wherein forces are applied to the wheel which tend to impart axial movement thereto.

Another object is to provide a projectile having a stabilizing wheel, all so formed and arranged that forces applied to the wheel to put it in operative condition will tend to impart an axial velocity thereto.

Another object is to provide a projectile having a stabilizing wheel and a turbine for imparting rotation thereto and whereby an axial velocity is imparted to the wheel.

Other and further objects and advantages will appear from the following description taken in connection with the accompanying drawings forming part of this specification, and will be pointed out in the appended claims.

In the drawings, in which like reference characters indicate similar parts,

Figure 1 is a side view, partly in section and partly broken away, of a projectile embodying a preferred form of my invention;

Fig. 2 is a partial cross-section on the line 2—2 of Fig. 1;

Fig. 3 is a cross-section of a projectile, partly broken away, which embodies a modified form of my invention;

Fig. 4 is a cross-section, partly broken away, of a projectile embodying another modification of my invention; and

Fig. 5 is a partial section on the line 5—5 of Fig. 4.

It is now well known that, if a projectile is rotated about its own axis as it passes along the line of its flight through the air, it will be stabilized against the tendency to "tumble" which arises from the unbalanced pressure of the air against the lower front face of the projectile as it moves along its parabolic line of flight.

In the projectile which is disclosed by this specification as an embodiment of my invention, a stabilizing wheel 1 is mounted within a chamber 2, which is attached to the rear end wall 3 of the bursting charge container 4 of the projectile. The stabilizing wheel has its axis substantially coincident with the axis of the projectile. Axial trunnions 5 are formed upon or attached to opposite faces of the stabilizing wheel. The forward trunnion has fixed upon it an inner ball race 6, and the rear trunnion has fixed upon it an inner ball race 6'. One outer ball race 7 is mounted in an opening 8 in the rear wall 9 of the chamber 2, and it forms, with the balls 10 and the inner ball race 6', an anti-friction bearing. This bearing is designed to take up the axial thrust which might arise by reason of the fact that the force which imparts motion to the stabilizing wheel in the direction of the axis of the projectile may be transmitted from the propelling charge to the wheel through the back wall 9 of the chamber 2. It will be seen that the energy which must be imparted to the stabilizing wheel to accelerate it to the same speed as that to which the projectile is accelerated bears the same relation to the force which must be applied to the projectile to accelerate it to its desired speed as the weight of the stabilizing wheel is to the weight of the shell of the projectile. If this force were all transmitted through the bearing which supports the rear trunnion of the stabilizing wheel, it would place a very great burden upon this bearing, and the means whereby this burden is lightened is hereinafter disclosed.

The inner ball race 6, together with the balls 11 and the outer ball race 12, which is mounted in a recess 13 in the back wall 3 of the bursting charge container, forms an anti-friction bearing for the forward trunnion of the stabilizing wheel.

In order to impart to the stabilizing wheel a rotational velocity which will render it operative to stabilize the projectile, I attach to it, or form integral with it, turbine buckets 14. These buckets include a face 15, the elements of which lie substantially in radii from the axis of the stabilizing wheel, and a face 16, the elements of which are respectively substantially perpendicular to the elements of the face 15. The elements of the faces 15, in a direction perpendicular to a radial line passing through the face 15, are at an angle to the axis of the stabilizing wheel. In the embodiment of my invention herein disclosed, the stabilizing wheel is in general cylindrical, and the buckets are cut into the circumferential face thereof, and the faces which have their elements coincident with the radii of the wheel form an angle with the longitudinal elements of the surface of the cylinder.

Into the buckets of the turbine so formed, products of the explosion of the propulsive charge are led by means of ducts 17, which open at the rear end of the shell and pass forwardly through the shell at an angle to the longitudinal elements of the surface thereof, and discharge through the nozzles 18 into the bucket 14 of the turbine. The angle between the direction of the ducts 17 and the longitudinal elements of the surface of the projectile is intended to be approximately complementary to the angle between the direction of the buckets of the turbine and the longitudinal elements of the stabilizing wheel. It will be seen that the gases proceeding from the explosion chamber through the ducts 17 will impinge upon the buckets 14 in a direction forming an angle with the axis of the turbine. There will thereby be set up a force having one component tangential to the turbine, and one component parallel with the axis of the turbine. The component tangential to the turbine will impart the desired rotation to the stabilizing wheel, and the component parallel with the axis will impart a velocity to the stabilizing wheel in the direction of the axis of the projectile. This latter component will, therefore, decrease or render nil the force which might be imparted to the stabilizing wheel through the rear thrust bearing.

The projectile is provided with a soft metal lubricating band 19, and, as the projectile is designed to be used in connection with a smooth-bore gun, this band may be made of softer material than that band on a projectile intended to cooperate with the

rifling to twist the projectile, and a perfect sealing of the bore of the gun may be effected. This perfect sealing will confine the gases under high pressure behind the projectile, so that the gases led through the duct 17 to the turbine may freely exhaust through the exhaust openings 20, which extend radially through the walls of the chamber 2.

In the modification shown in Fig. 3, the stabilizing wheel is shown partly in section, so that the circular recess 21 in the back face thereof is illustrated. Through the back wall 9 of the chamber 2 small openings 22 are formed, so that they aline with the center line of the recess 21. Products from the explosion will pass through these openings and impinge upon the stabilizing wheel to impart motion to it independently of the motion which might be imparted to it from the projectile through the rear thrust bearing. These openings 22 might be used alone, or in conjunction with the form of turbine heretofore described.

In the modification shown in Figs. 4 and 5, the stabilizing wheel 1 has formed upon its rear face radial turbine blades 25, and the gases generated by the explosion pass through openings 26 arranged in a circle concentric with the axis of the projectile. The gases thus entering the chamber 2 spread radially and act upon the blades 25, and exhaust through radial openings 27 in the cylindrical wall of the chamber 2.

When the turbine blades are formed on one of the radial faces of the turbine, as in the embodiment herein disclosed, upon the rear face of the stabilizing wheel, the substantially flat portions 16' between the blades form, when considered together, a substantially conical surface. The blades have faces 15', the elements of which are substantially parallel to the axis of the turbine, and it is against these faces that the moving gases act.

It will be seen that when this form of turbine is used considerable axial thrust is imparted to the stabilizing wheel 1, and a force is, therefore, applied to it tending to give it a velocity in the direction of the axis of the projectile, which is substantially independent of any force in such direction which might be applied to the stabilizing wheel from the shell of the projectile itself as it moves through the bore of the gun under the action of the explosion of the propelling charge.

It is to be clearly understood that I do not intend to limit myself to any particular form of blades or any particular form of turbine generally, but that any form of blades of a turbine, together with any arrangement for directing gases thereto which will produce an axial thrust, as well as a rotational movement, shall fall within the scope of my invention.

While I have described with considerable detail specific embodiments of my invention, I do not intend that my invention shall be limited to the details thus set forth, but I do intend that my invention shall include all developments, modifications and adaptations which may occur to one skilled in the art, and that it shall be defined only by the hereunto appended claims.

10 Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

15 1. In combination with a projectile, a stabilizing wheel, and means for imparting rotation thereto and axial movement in the direction of the movement of the projectile.

20 2. In combination with a projectile, a stabilizing wheel, and means for imparting motion thereto in the direction of the movement of the projectile, said means acting substantially independently of forces in said direction applied to said wheel by the shell of the projectile.

25 3. In combination with a projectile, a stabilizing wheel, and means for imparting

rotational movement thereto and for imparting motion thereto in the direction of the movement of the projectile substantially independently of forces in said direction applied to said wheel by the shell of the projectile.

4. In combination with a projectile adapted to be projected from a gun by the force of an explosion within the gun, a stabilizing wheel, and means for applying to said wheel a force rendered available by the explosion to impart motion thereto in the direction of the axis of the projectile and substantially independent of forces in said direction applied to said wheel by the shell of the projectile.

5. In combination with a projectile, a stabilizing wheel, and a turbine for imparting rotation and an axial thrust to said wheel in the direction of the movement of said projectile.

In testimony whereof I have signed my name to this specification.

JOHN H. HAYDEN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."