March 6, 1962 P. J. DAWSON ETAL 3,023,704

PROJECTILES FOR MORTARS AND LIKE PROJECTORS

Filed July 22, 1958 2 Sheets-Sheet 1

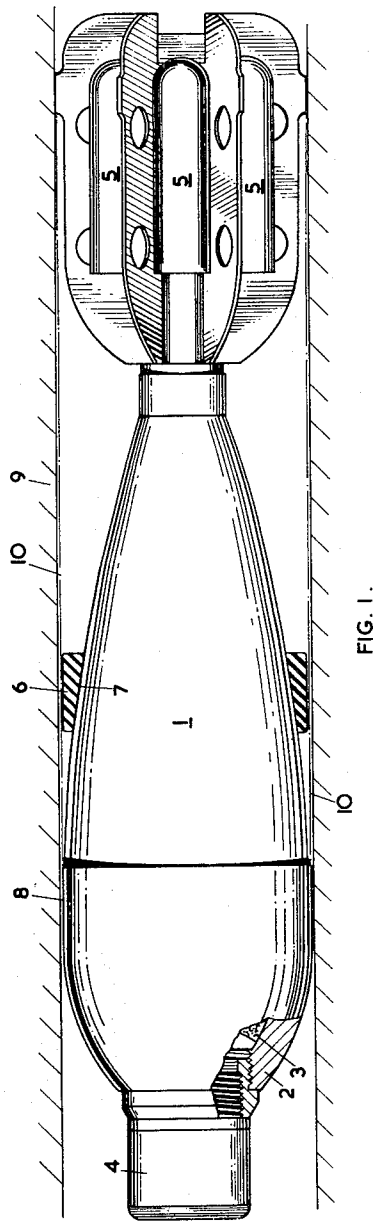



FIG. 1.

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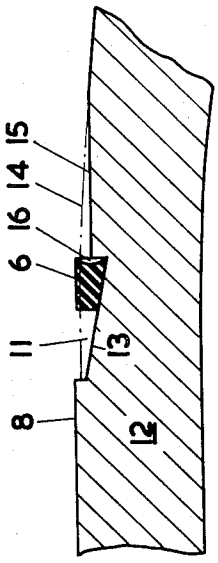



FIG. 3.

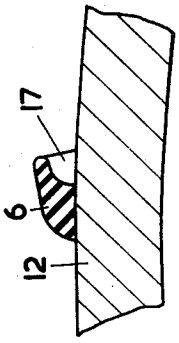



FIG. 5.

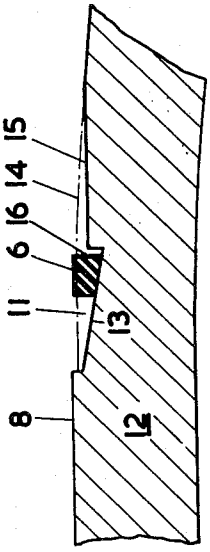



FIG. 2.

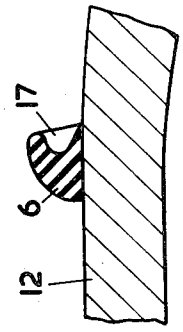



FIG. 4.

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# PROJECTILES FOR MORTARS AND LIKE PROJECTORS

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1 Claim. (Cl. 102—94)

This invention relates to projectiles for muzzle loading projectors such as mortars having unrifled barrels.

In order that the projectile shall load easily and slide rapidly down the barrel of such weapons a comparatively large clearance is necessary between the largest circumference of the projectile and the barrel wall. This clearance leads to a loss of propellent energy on firing due to escape of some of the expanding gases through the gap. Round to round variation in velocity may also be due in part to this energy loss which is not necessarily constant, nor is the flow of the escaping gases necessarily symmetrical and it may therefore contribute to unsteadiness of the projectile.

The object of the present invention is to reduce the energy loss due to leakage of propellent gases through the clearance gap between the projectile and the barrel wall and thereby to increase, for a given weight of propellant, both the velocity of projection and range of the projectile and reduce the round to round variation in velocity and hence the size of the dispersion zone within which a succession of projectiles fired under identical conditions will fall.

With this object in view there is provided in a mortar bomb or like projectile, a resilient annular ring of lightweight material so positioned rearward of the greatest diameter of the projectile that a clearance gap is provided between its outer surface and the projector barrel when loaded, the whole or part of which ring is arranged to be moved by the thrust of expanding propellent gases to such a position that the clearance gap between the ring on the projectile and the barrel is sealed to prevent the escape of propellent gases therethrough.

The ring may be of such shape and dimensions that it will distort under the resultant thrust of the gases and thereby seal the gap, but in its preferred form the ring is arranged to move bodily forward and at the same time to expand radially until the gap is tightly sealed.

In its preferred form therefore the resilient ring is arranged to seat on a substantially conical surface on, and coaxial with, the projectile rearward of its greatest diameter in which position a clearance is provided between the outer surface of the ring and the internal wall of the projector barrel, when loaded; and arranged on firing, to be driven by the thrust of expanding propellent gases, forward along the conical surface and to be expanded radially thereby until the outer surface of the ring is forced into sealing contact with the barrel wall.

The seating for the ring in its preferred form may be an existing part of the projectile surface or a conical portion formed on that surface. Preferably, however, an annular groove is provided in the projectile wall the base of the groove forming the conical surface. The slope of the base of the groove may, if desired, be steeper than the slope of the projectile surface so that the required amount of radial expansion of the ring takes place during a relatively small amount of forward movement. If such a groove is used the ring must project sufficiently above the projectile surface to provide an adequate rear surface on which gas pressure may act to provide the necessary forward movement of the ring.

The resilient ring may be of any suitable lightweight material having adequate elasticity such as, for example neoprene-ebonite or polyethylene. It must be light enough to be accelerated relative to the projectile by the resultant thrust acting upon the ring and sufficiently elastic to be capable of expanding to seal against the projector barrel without breaking.



The dimensions of the ring must be such that in its initial position, before firing, a clearance is provided between the ring and the barrel wall and preferably such that the outer surface of the ring lies wholly within a cone containing the greatest circumferences of the body and tail of the projectile. The ring must be sufficiently large that when expanded by the forward movement it will fit tightly between the projectile and the barrel wall without danger of being extruded through the clearance gap. The danger of extrusion may be lessened by providing a stepped portion on the projectile to limit the forward movement of the ring.

Some forms of resilient ring in accordance with the invention will now be particularly described with reference to the accompanying drawings in which

FIGURE 1 is a view of a mortar bomb with a ring seated on its existing surface, in position in a portion of the projector barrel and

FIGURES 2 to 5 are sections of parts of a bomb wall with alternative designs of ring and seating.

In FIGURE 1 a mortar bomb generally designated by the numeral **1** comprises a casing **2**, an explosive charge **3**, a fuze **4**, a propellent charge **5** and a sealing ring **6** seated on the existing surface of the bomb casing **2** and is shown within a portion of the projector barrel **9**. The ring **6** has a tapered bore so that its inner surface **7** conforms approximately to the slope of the surface of the bomb casing **2**. The ring **6** is positioned some distance rearward of the greatest diameter **8** of the bomb in order to accommodate a ring sufficiently large that when moved forward by pressure of the propellent gases it will seal the gap between the bomb **1** and the barrel wall **9** without danger of extrusion past the greatest diameter **8** of the bomb **1**. The outer diameter of the ring **6** is such that before firing a clearance is provided between the ring **6** and the barrel wall **9** for ease of loading, and is preferably such that the ring **6** lies wholly within a cone containing the greatest circumferences of the body and tail of the bomb **1** which cone is indicated by the broken line **10**.

As shown in FIGURES 2 and 3 a modified form of the ring **6** is seated in a groove **11** formed in the surface of the bomb wall **12** immediately rearward of the greatest diameter **8** of the bomb. The bottom surface **13** of the groove **11** has a steeper slope than the original surface of the bomb which is indicated by the chain dotted line **14**. The required radial expansion of the ring **6** is thus obtained by a smaller forward movement than would be required for a ring seated on the original surface. The bomb surface **15** immediately rearward of the groove **11** is reduced in diameter in order to expose a greater part of the rear surface **16** of the ring **6** to the thrust of the propellent gases. The ring **6** shown in FIGURE 3 has a concave rear surface **16**. The forward face of the groove provides a step to aid in avoiding extrusion of the ring **6** past the greatest diameter **8** of the bomb.

Alternatively the resilient ring **6** could be of U-shaped or part U-shaped cross-section as shown in FIGURES 4 and 5 respectively, and attached to the projectile in such a manner as to form a rearwardly facing channel **17** around the projectile wall **12**. The inner wall of the channel would be formed by the inner arm of the U in the case of the U-shaped cross-section shown in FIGURE 4 and by the projectile wall in the case of the part U-shaped cross-section shown in FIGURE 5. The expanding gases, in addition to driving the ring forward,

would exert pressure inside the channel to force its outer wall radially outward into contact with the wall of the projector barrel to assist in sealing the clearance gap between projectile and barrel wall. The outer arm of the U must be thick enough to avoid excessive distortion before sealing occurs.

On ejection from the muzzle of the projector the ring is freed from the restraint applied by the projector wall so that it may either break or expand further as it is forced forward beyond the greatest diameter of the projectile and blown clear of the projectile by the propellent gases which at that point travel faster than the projectile. Once clear of the thrust of propellent gas the light ring or pieces thereof are subjected to air drag forces and are rapidly retarded and fall away from the trajectory of the projectile which, freed from the ring, has a good ballistic shape. The ring or fragments thereof travel only a short distance and, owing to their lightness and low velocity, constitute very little danger to personnel or equipment.

Trials have shown that mortar bombs modified to incorporate this invention are more accurate and have a considerably higher projection velocity and longer range than unmodified bombs fired under the same conditions.

We claim:

The combination comprising an unrifled mortar barrel, a projectile to be fired in said barrel, said projectile including a rearwardly tapering body, an explosive charge in said body and a tail assembly attached rearwardly to said body, there being a circumferential groove formed on the tapering portion of said body, said groove being disposed substantially rearwardly from the largest diameter of said body and having spaced forward and rearward vertical walls and a rearwardly inclining bottom surface, said rearward vertical wall rising to a height less than said outer tapering surface whereby a rearwardly and upwardly inclining surface is formed on said tapering body of said projectile, and a resilient ring having a width substantially less than the length of said groove, said ring also having a conical bore and an outer surface parallel to the longitudinal axis of said barrel, said ring being normally seated at the rearward end of said groove, at which point the outer circumference of said ring assumes a smaller diameter than the largest diameter of said body to provide a clearance gap between said ring and the inner surface of said barrel, said ring adapted to move forward in said groove and upward in said conical bottom surface thereof upon escape of propellent gases of said charge and pressure thereof against the rearward face of said ring to expand the latter against the inner surface of said barrel and seal said clearance gap.



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