May 1, 1962 J. R. JASSE 3,031,967

FIN ARRANGEMENT FOR PROJECTILES

Filed Feb. 2, 1959 3 Sheets-Sheet 1

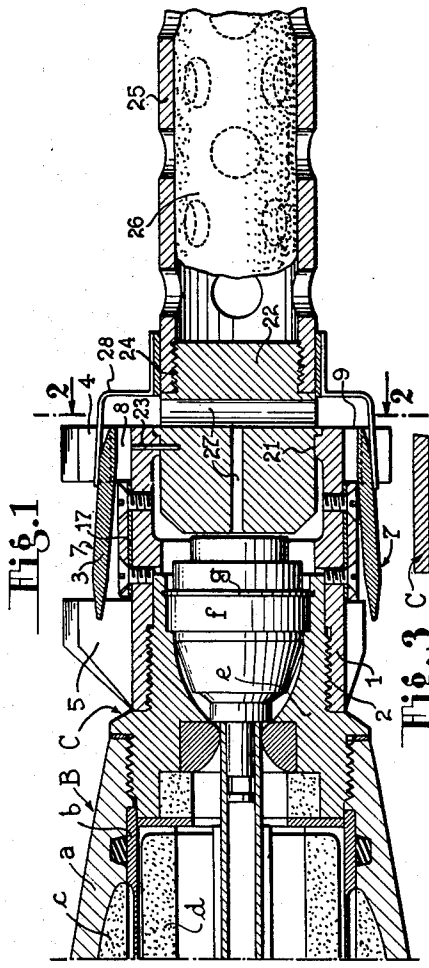


Fig. 1

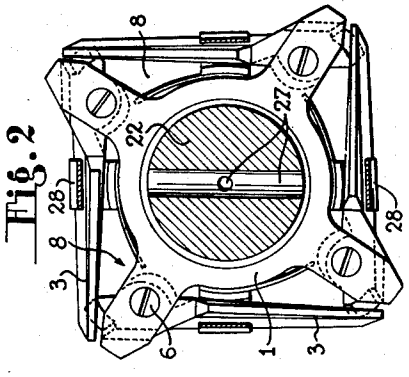


Fig. 2

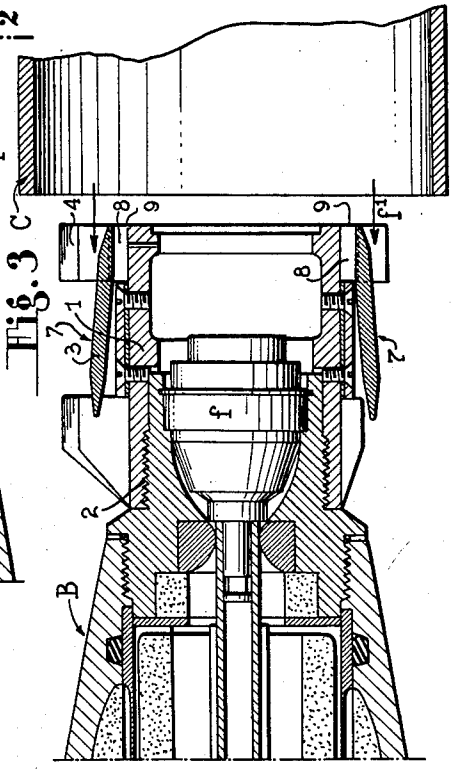


Fig. 3

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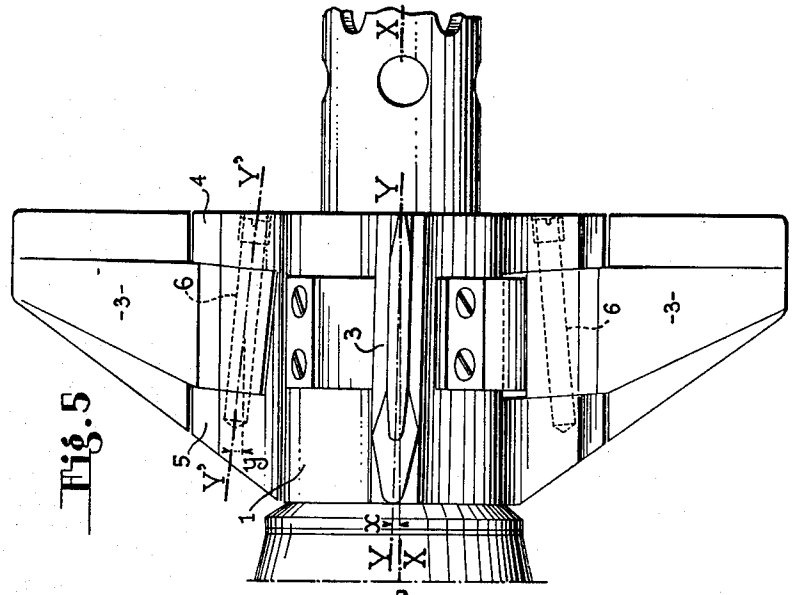


Fig. 5

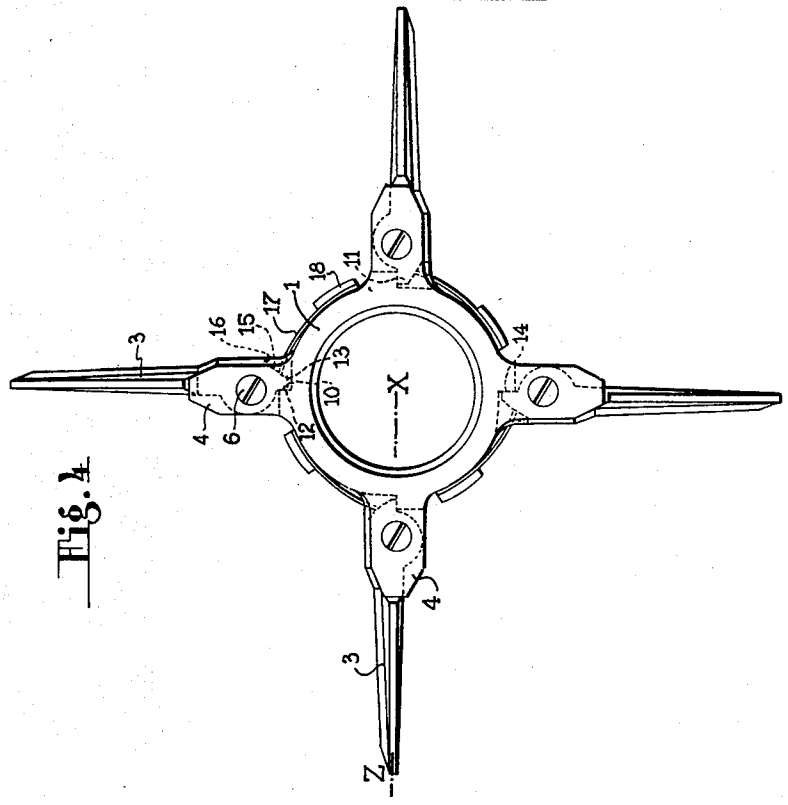


Fig. 4

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Fig. 7

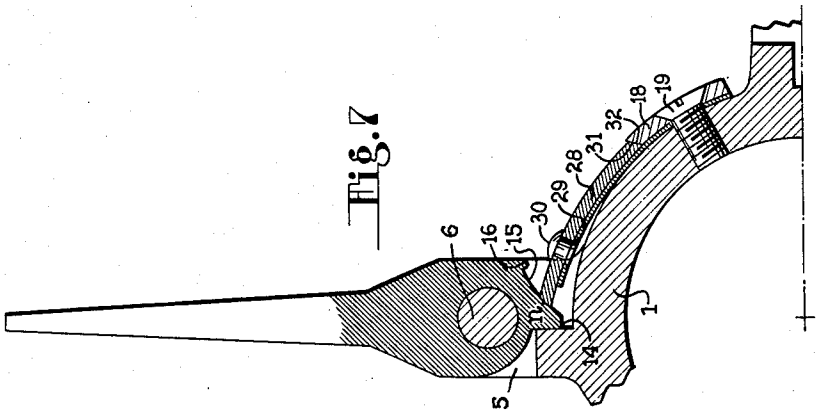
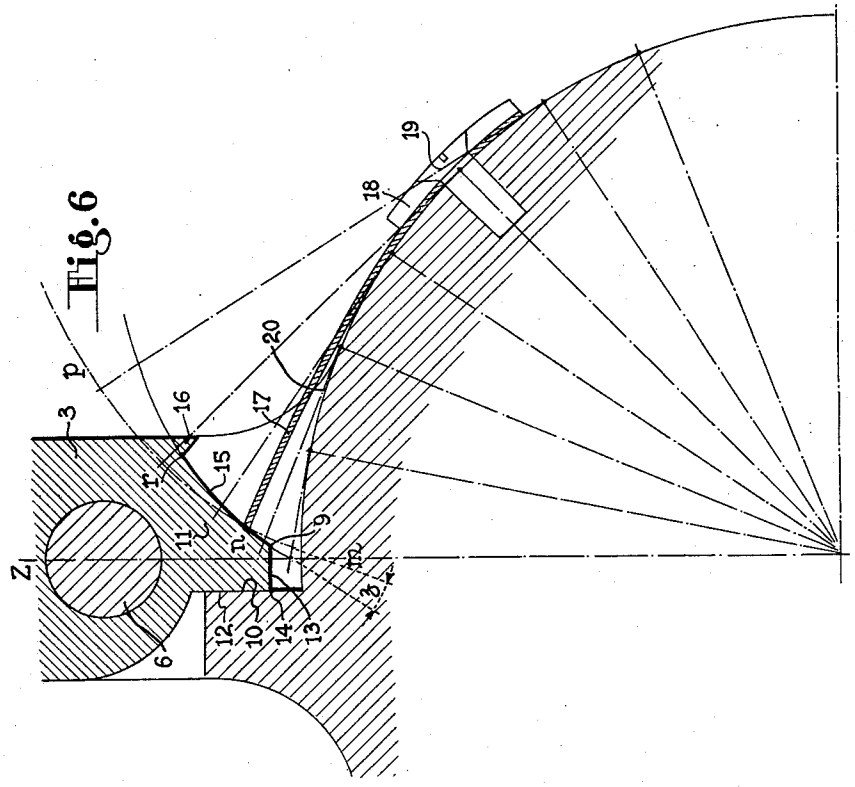


Fig. 6



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3,031,967

FIN ARRANGEMENT FOR PROJECTILES

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3 Claims. (Cl. 102—50)

The present invention relates to fin arrangements, the fin of which are adapted to open out for artillery projectiles launched by means of a launching powder charge, and more particularly projectiles fired by means of a mortar with high pressure launching gases at the nozzle of the gun barrel or tube and at high initial speed.

The opening out of the fins by a pivotal movement about axes parallel with the longitudinal axis of the fin arrangement is generally caused by springs which, however, complicate the assembly and increase the cost.

Further, in the aforementioned firing conditions, the gases of the launching charge exert on the fins of the fin arrangement large forces which could result, at the end of the opening of the fins, in violent shocks liable to deform the fins and impair the locking thereof in the opened out position.

Owing to the high launching velocity the fins are, moreover, subjected to large aerodynamic forces, which require the provision of locking means for the fins in their open position which are particularly strong and capable of ensuring a locking without play, which is essential to accurate firing.

The object of the invention is to provide a simpler construction in eliminating the usual fin opening springs and to remedy the aforementioned disadvantages due to the forces of the launching gases and the large aerodynamic forces.

The invention provides an improved fin arrangement for an artillery projectile and more particularly for projectiles fired by a mortar in which arrangement each fin is disposed in such manner that in its folded position it forms wtih the fin-carrying body a cavity which is widely open toward the rear to ensure an automatic opening of the fin as soon as it issues from the muzzle of the gun barrel or tube under the effect of the expansion of a fraction of the gases under pressure which emanate from the launching charge and are trapped in said cavity.

According to another feature of the invention, each fin is pivoted to the fin carrying body on a shaft which is inclined at a certain angle relative to the longitudinal axis of said body, toward which it is inclined in the rearward direction, so that the outer face of the closed fin has a slight incidence toward the rear.

Thus, a part of the gases from the launching charge which escape from the gun barrel or tube creates on the outer faces of the fins an aerodynamic thrust whose centripetal component, in acting in opposition to the expansion of the gases in the chambers formed under the fins, damps the suddenness of the opening out of said fins.

Another object of the invention is to provide a projectile provided with the improved fin arrangement defined hereinbefore.

Further features and advantages of the invention will be apparent from the ensuing description, with reference to the accompanying drawings, to which the invention is in no way limited.

In the drawings:

FIG. 1 is an axial sectional view of the rear part of a self-propelled projectile provided with a fin arrangement according to the invention, the fins being shown in their folded or closed position and this fin arrangement being extended by the conventional detachable tail unit adapted to receive the launching charge;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is partial view similar to FIG. 1, showing the projectile as it leaves the launching tube or barrel;

FIG. 4 is a rear view of the fin arrangement, the fins being in their opened out position;

FIG. 5 is a corresponding side elevational view of the fin arrangement shown in FIG. 4;

FIG. 6 is a diagram showing how the locking means for one of the fins is determined when the fin is in its opened position, and the corresponding portion of the heel of this fin, and

FIG. 7 is a partial cross-sectional view of a fin and a modification of locking means therefor.

In the embodiment shown in FIGS. 1 to 6, the fin arrangement A according to the invention is shown to be applied, by way of example, to a projectile B of known type, which is self-propelling after having been initially launched.

This projectile comprises (FIG. 1) a body *a* having a longitudinal axis XX within which a tubular sheath *b* forms an annular compartment in which is disposed the useful charge *c*, and an axial compartment in which is disposed the self-propelling charge *d* adapted to be ignited by the launching charge.

Screw-threadedly engaged in the rear of the body *a*, is a nozzle *e* for ejection of the self-propelling gases. This nozzle is obturated before firing by an obturating and firing device *f* held in position by a shearable ring *g*, which allows ejection of this device after ignition of the self-propelling charge.

Screw-threadedly engaged at **2** on the body of the nozzle *e*, is the annular fin-carrying body **1** for the fin arrangement according to the invention. The body **1** carries a number of fins **3**, in the presently-described embodiment four fins. Each fin is pivotably mounted between two bosses **4** and **5** forming a fork and protruding from the periphery of the body **1**, by means of a shaft **6**. Each shaft **6** is constituted by a screw which extends through the boss **5** and is screw-threadly engaged in a tapped hole in the boss **4**.

The axis YY of the shaft **6** is disposed in such manner that it makes a very slight angle *x* (FIG. 5) with a radial axial plane, such as the plane XZ (FIG. 4), so that when the fin is opened out it has a positive incidence substantially equal to *x* with respect to the relative wind, that is, facing the forward end of the projectile B. Further, the axis YY is such that the projection Y'Y' of this axis YY on said axial radial plane is slightly oblique relative to the axis XX toward which it converges rearwardly; said projection makes with the axis XX an angle *y* so that when the fin is in its closed position against the body **1**, its outer face **7** is also slightly oblique relative to the axis X—X toward which it converges rearwardly forming with said axis an angle substantially equal to *y*.

For example, the angles *x* and *y* could advantageously have the following values:

$$x = 1° \text{ to } 8°$$
$$y = 1° \text{ to } 10°$$

The arrangement is such that in the closed positions of the fins **3** (FIGS. 1 to 3), each fin forms with the body **1** a cavity **8** which is widely open at the rear at **9**.

Each fin **3** and the body **1** are arranged to ensure a practical resilient locking without play of the fin in its opened position.

To this end, the body **1** comprises, for example extending the full distance between the two bosses **4** and **5**, a lug whose bearing face **10** (FIGS. 4 and 5) is parallel with the corresponding longitudinal radial plane XZ. The fin **3** comprises a portion **11** defined by two flat faces which are perpendicular to one another and form a

common edge 14 constituting a heel, a concave part-cylindrical locking face 15, and a projection 16 constituting a safety abutment.

The bearing face 12 is such that it is parallel with the face 10 against which it abuts when the fin is opened out.

The concave face 15 co-operates with a resilient locking strip 17 which is fixed with a reinforcing plate 18 by screws 19 to a cylindrical portion 20 of the outer wall of the body 1 (FIG. 6).

It will be understood that if the strip 17 is bent against or away from the face 20, its free end would describe an involute of a circle *mnp*. The directrix *qnr* of the face 15 of the fin is an arc having said involute *mnp* which has been swung through a certain angle *z* about an intermediate point, the angle is for example equal to about 10°.

The body 1 of the fin arrangement comprises in its bore coaxial with the axis XX (FIG. 1) a shoulder 21 for centering a plug 22, held in position by one or two shearable pins 23. Screw-threadedly engaged at 24 on this plug, which extends rearwardly beyond the body 1, is the conventional perforated tail unit 25 adapted to receive the launching powder charge 26. The plug 22 is provided with passageways 27 for ignition of the self-propelling charge by way of the obturating and firing device *f*.

The tail unit carries externally and toward its forward end a retaining member 28 which has as many cranked arms as there are fins to be held in their closed position.

The fin arrangement operates in the following manner:

Before use, the fins 3 are held in their folded positions by the retaining member 28 (FIGS. 1 and 2) which is connected to the tail unit 25 which is held in position in the body 1 by the pin or pins 23.

When the projectile is fired and before it has left the launching tube C (FIG. 3), the tail unit 25 separates from the projectile under the effect of its inertia by shearing the shear pin or pins, so that when the projectile finally issues from the tub C (FIG. 3), the fins are no longer held in position by the retaining member 28.

At this moment, the gases which emanate from the launching powder and fill the cavities 8 open at 9 and whose pressure is equal to that prevailing in the muzzle of the tube, have a tendency to expand, and, owing to their centrifugal pressure on the fins, they cause the latter to open out.

The suddenness of the opening, particularly with heavy launching charges, that is, when the pressure at the muzzle of the launching tube is high, is damped owing to the fact that the fins 3 (FIGS. 1 and 3) have in their closed position a certain inclination substantially equal to *y* relative to the axis XX of the projectile. Indeed, the gas stream of the launching powder acting in the direction of arrows f^1 (FIG. 3) on the outer faces of the fins exerts on the latter an aerodynamic pressure having a centripetal component which partly compensates the pressure exerted on the inner face of the fin by the expansion of the gases contained in the cavity 8. By suitably selecting the angle of inclination *y* of the pivot axis of the fins, a rather gentle opening of the fins can be obtained which avoids their deformation or damage at high pressures.

It will be understood that in the opened position, the median plane of the fin is inclined at the angle *x* (FIG. 5) relative to the corresponding plane XZ containing the axis of the fin arrangement.

This inclination *x* causes a rotation of the projectile on its trajectory, which rotation improves the firing accuracy, since it compensates for the irregularities in construction and the reaction of the jet in the case of a self-propelled projectile, such as that illustrated.

In the course of opening out of the fin, the heel 14 (FIGS. 4 and 6) of the portion 11 of each fin 3 puts the spring 17 under stress, and the free end of this spring after the heel 14 has travelled past this end, finally comes into contact with the concave face 15.

The end of the spring describes at the moment of locking the fin the involute *mnp* of a circle (FIG. 6), and as the shape of the face 15 is given by the same involute which has been swung round through the angle *z* about the point *n* situated about midway along said face, in rising after passage of the heel 14, the end of the spring thus becomes wedged against said face 15 at *n* and maintains the fin in the opened position, the face 12 being urged resiliently against the face 10 of the fin-carrying body.

Owing to this wedging effect, the fin is maintained in its opened position without play.

If it is desired to fire the projectile with launching charges which vary within wide limits, it could occur that when using a low launching charge the spring selected for withstanding the maximum launching charge would be too strong to permit the heel 14 to pass by the end of the spring in the course of the opening of the fin.

When using a low launching charge, to remedy this disadvantage there could be provided according to the invention the locking element shown in FIG. 7 which comprises a rigid member 28 and a resilient member 29. The latter member is fixed in the same manner as the spring 17 described in the last embodiment but its function is restricted to the shifting of the rigid locking member 28 in the course of the opening of the fin, the abutting locking means being constituted by the rigid member 28 riveted at 30 to the spring 29. In the opened position, the fin is locked by the plate 28 which is urged against the face 15 at *n* by the spring 29. The rear end 31 of the plate 28 is then substantially forced or wedged against the adjacent edge 32 of the fixing plate 18. The end 31 and said adjacent edge 32 are chamfered so as to prevent escape of the plate 28.

Although specific embodiments of the invention have been described, many modifications and changes may be made therein without departing from the scope of the invention as defined in the appended claims.

The projectile can be of the self-propelled type or otherwise, and in the case of a self-propelled projectile, the obturating and firing device *f* could comprise an adjustable obturator disposed behind the device *f* which allows or prevents, depending on its position, ignition of the self-propelling charge through the device *f*.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a fin arrangement for an artillery projectile adapted to be fired in a tube, a body having a longitudinal axis, a launching charge at the rear of said body, fins pivoted to the body so that each fin is capable of occupying successively a closed position against the body and an operative opened position in which latter position the fin is substantially in an axial radial plane of the body; and a locking device for each fin in the opened position, said device comprising, on the one hand, two conjugate abutment faces provided respectively by the fin and the body, and, on the other hand, a resilient means having one end fixed to the body and another end which is free to move to describe a first involute of a circle and co-operates with a wedging face which is provided on the fin and has the shape of a second involute of a circle which is identical to the first involute, said first involute forming an angle with and intersecting said second involute toward the mid-point of its length so that, when the fins are in the operative opened position, said resilient means is jammed against said wedging face to lock the fins in said opened position with said abutment faces maintained in mutual contact.

2. A fin arrangement as claimed in claim 1, wherein said resilient means is in the form of a single flexible resilient strip one end of which is rigidly fixed to said body the other end being free to describe the first involute of a circle.

3. A fin arrangement as claimed in claim 1, wherein said resilient means comprises in combination a flexible

resilient strip rigidly secured by one end to said body, a rigid element fixed rigidly to said strip so that one of its ends is adapted to form said free end of the resilient means, and a reinforcing member reinforcing the attachment of the strip to the body, the rigid element and the reinforcing member being so shaped and placed that, in the position for locking the fin in its open position, the rigid element is wedged against the reinforcing member.

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