Nov. 16, 1954 L. K. LILJEGREN 2,694,364

STREAMLINED MORTAR SHELL

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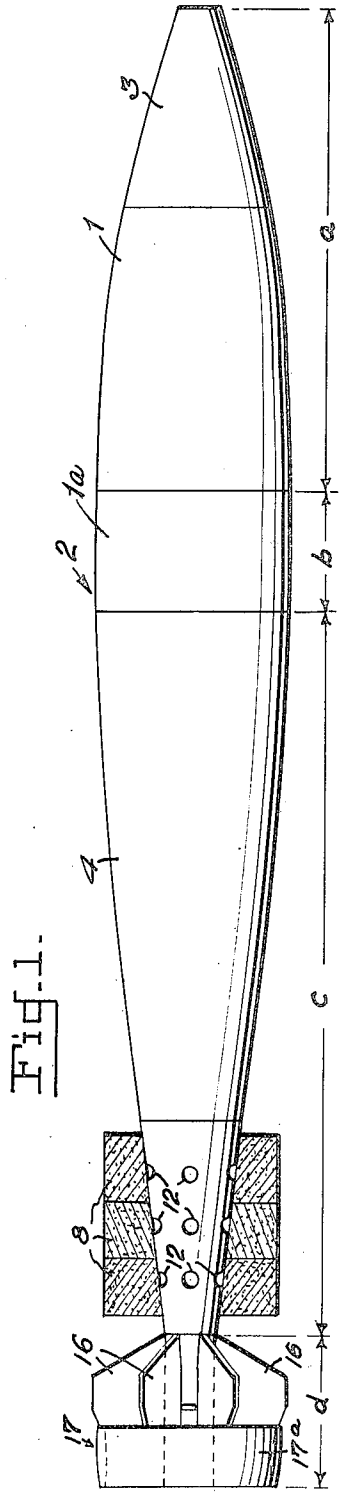


Fig. 1.

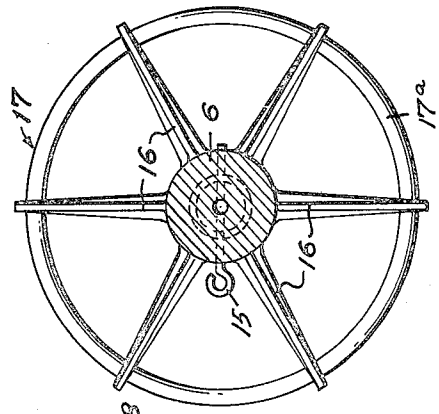


Fig. 3.

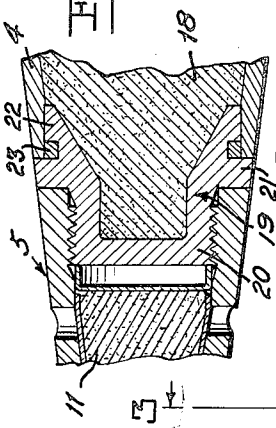


Fig. 5.

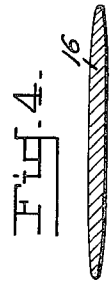


Fig. 4.

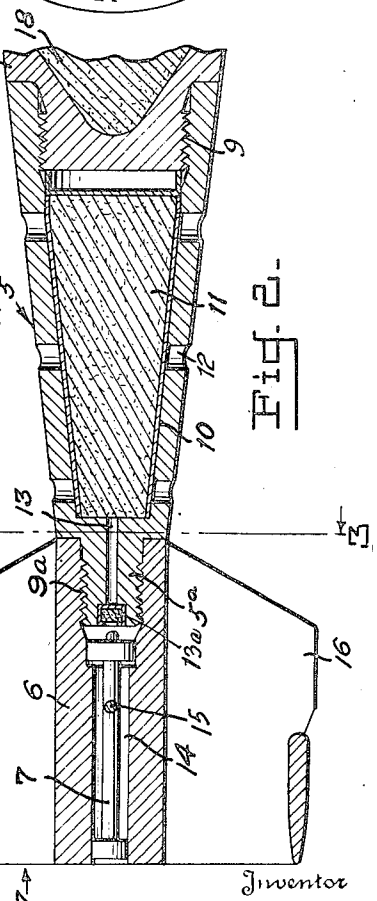


Fig. 2.

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Fig. 7.



Fig. 9.



Fig. 6.

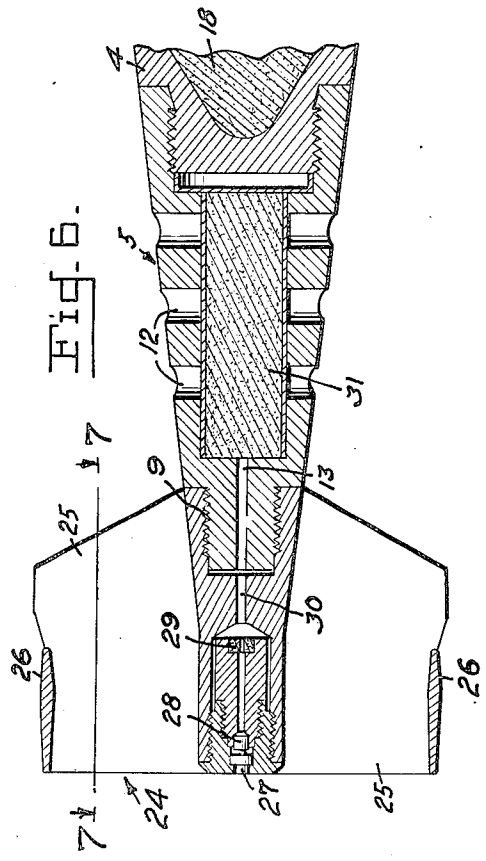
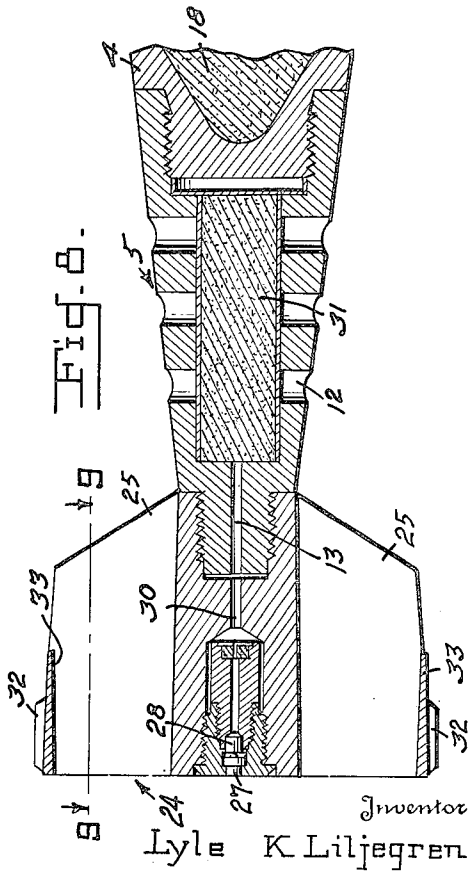


Fig. 8.



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STREAMLINED MORTAR SHELL

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Application January 18, 1949, Serial No. 71,521

4 Claims. (Cl. 102—49)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to improvements in mortar projectiles and more particularly to a streamlined mortar projectile. In the presently used mortar projectiles the fin assembly is attached to the shell portion by means of a cylindrical boom extension of the hub of the fin assembly. The hub contains the ignition cartridge which necessarily makes the diameter of the hub relatively great so that it does not lend to streamlining the projectile.

One object of this invention is to produce a completely streamlined mortar projectile having an aluminum cartridge container streamlined into the shell portion of the projectile and the diameter of the fin assembly hub reduced to a minimum thus obtaining maximum aerodynamic efficiency and an increase in stability and range.

Another object of this invention is to provide a streamlined mortar projectile with a streamlined fin assembly having a greatly reduced hub diameter containing a floating firing pin.

Another object of this invention is to produce a streamlined mortar projectile having its parts proportioned so that its center of gravity is within the bourrelet area and the center of pressure in definite relation aft of this area so that yaw is materially reduced.

Another object of this invention is to produce a streamlined mortar projectile designed to give the best compromise between two conflicting factors, namely, lowest drag and maximum volume resulting in increased range and increased target effectiveness.

Another object of this invention is to produce a streamlined mortar projectile the shape of which is an approximation using ogival and conical sections of a streamlined body having a hemiellipsoid forward portion and a hyperboloid rear portion.

Another characteristic of the invention is the reduction of yaw by the arrangement of parts whereby the center of gravity of the loaded projectile is located at a point falling within the limits of the bourrelet and approximately 2.88 calibers behind the forward extremity of the fuse, and the center of pressure located approximately 1.38 calibers behind the center of gravity.

Still another characteristic of this invention is that the fin assembly is releasably fixed to the rear end of the cartridge container making it possible for the fin assembly to become a standard part interchangeable on mortar projectiles of a given caliber. The fin assembly thus positioned places the blades to the rear of the cartridge container and propellent increments and eliminates flight irregularities due to fin distortion and container expansion experienced when the usual fin assembly is employed wherein the cartridge container forms the hub of the fin assembly and the propellent increments are placed between the blades of the fin assembly.

To these and other ends the invention consists in the construction, arrangement and combination of elements described hereinafter and pointed out in the claims forming a part of this specification.

A practical embodiment of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is a side elevational view of the streamlined mortar projectile,

Figure 2 is an enlarged fragmentary, sectional view of the cartridge container assembled to the fin assembly and shell,

Figure 3 is a sectional view taken along lines 3—3 of Figure 2,

Figure 4 is a sectional view of one of the streamlined blades taken along line 4—4 of Figure 2,

Figure 5 is a fragmentary, sectional view showing a modified assembly of the cartridge container to the shell,

Figure 6 is a fragmentary sectional view showing a modified firing arrangement and die cast fin,

Figure 7 is a sectional view of one of the streamlined fin blades taken along line 7—7 of Figure 6,

Figure 8 shows another modification of the fin assembly,

Figure 9 is a sectional view of one of the streamlined fin blades taken along line 9—9 of Figure 8.

Figure 1 of the drawings illustrates a streamlined mortar projectile of this invention which comprises a first ogival portion *a*, a second smooth cylindrical bourrelet portion *b*, a rearwardly tapering portion *c* and the tail fin assembly *d*. Sections *a*, *b* and *c* are joined together in any convenient manner to achieve a projectile which presents smooth faired lines offering a minimum amount of resistance to air and wind pressures. The following longitudinal dimensions expressed in calibers are suggested as a typical projectile which has proved effective in tests conducted to attain desired aero-dynamic characteristics, and accuracy in hitting a required target.

Ogival portion *a*	2.28
Bourrelet portion *b*	1.16
Rearwardly tapered portion *c*	3.53
Length of fin assembly *d*	0.77
Total length	7.74

More specifically the projectile includes a first fuze portion **3** merging into a main body portion **2** having a forwardly tapering portion **1**, a smooth cylindrical portion **1***a* and a rearwardly tapering portion **4**. The smooth cylindrical bourrelet is of a diameter substantially equal to the inner diameter of the bore to make contact with the wall of the bore of the mortar. The rearwardly tapered portion **4** of the body **2** is in threaded engagement with the tapered aluminum ignition cartridge container **5** as indicated by reference numeral **9**. The ignition cartridge container **5** is affixed to the die-cast aluminum fin assembly **17** having a hub **6** of a diameter equal to the minimum diameter of the tapered portion of cartridge container **5**. Propelling charge increments **8** are mounted on the cartridge container adjacent the fin assembly.

As best shown in Figure 2 the cartridge container **5** is designed to form a continuation of the tapered portion **4** of the body **2** containing high explosive **18** and tapers down to the diameter of the hub **6**. The larger end of the cartridge container is affixed to the tapered portion **4** as previously indicated by the reference numeral **9**. The opposite end is provided with a reduced threaded member **5***a* engaging complementary threads in the hub of the fin assembly as at **9***a*. Intermediate the ends of the cartridge container is a conically shaped cavity **10** within which is housed an ignition cartridge **11** of usual composition. The walls forming the cavity **10** are provided with a plurality of longitudinally spaced radial passages **12** through which the hot gases of the ignition cartridge escape to ignite the propelling increments **8**. The reduced threaded member **5***a* is provided with a rearwardly and centrally disposed recess to receive a detonator or primer **13***a* and is provided with a longitudinal bore forming a flash passage **13** in communication at its after end with the detonator **13***a* and at its forward end with the ignition cartridge **11**. The bore **14** of the fin assembly is in axial alignment with the flash passage **13** and slidably supports a firing pin **7** in alignment with the detonator **13***a*. The firing pin **7** is releasably secured in safe position by means of a cotter pin **15** as shown in Figures 2 and 3. The streamlined blades **16** of the fin assembly are provided with a circumferential shroud **17***a* which functions to materially stabilize the projectile aerodynamically.

In Figure 5 there is shown a modification disclosing another method of forming the closed end of tapered portion **4** of the body **2**. This method employs a plug **19** having a reduced threaded extension **20** for threadably

engaging aluminum cartridge container **5**, a peripheral flange **21** tapered so as to provide a continuation of the streamlined surfaces of the cartridge container **5** and the tapered portion **4**, and a cylindrical member **22** extending forwardly into the cavity of body portion **4** and brazed to said portion as at **23**.

The assembly shown in Figure 6 is a modification of the assembly illustrated in Figure 2. In this modification the shroud of the fin assembly **24** is streamlined as indicated by the reference numeral **26** and the blades as indicated by reference numeral **25** shown in Figure 7. The firing train consists of a firing pin **27** and a detonator or primer **28** in operable relationship in a bore in the base end of the hub of fin **24** and in communication with a relay **29** through flash passage **30** which in turn is in communication through flash passage **13** with the cylindrical ignition cartridge **31** in the cartridge container **5**.

Figure 8 illustrates a fin and ignition cartridge assembly substantially the same as shown in Figure 6 except that bore bearing edges **32** of the blades of the fin assembly are positioned at the rear extremity of the fin.

In this modification the cross section of the shroud is wedge shaped as indicated by reference numeral **33**. The cross section of the blades of the fin are also wedge shaped as indicated by reference numeral **34** shown in Figure 9.

I claim:

1. In a streamlined mortar projectile having a front ogival portion adapted to contain a fuse, a rearwardly tapering portion and a smooth cylindrical portion between said ogive and rear portion, said portions merging to form a projectile having a fair surface, a rearwardly tapering cartridge container threadably engaging, and merging with the taper of, said rearwardly tapering portion, a reduced section forming the back wall of said cartridge container and having external threads, a fin assembly having a hub threadably engaging said external threads and merging with the taper of said cartridge container, said fin assembly extending in its entirety rearwardly of said cartridge container, an ignition cartridge disposed in said cartridge container, said cartridge container having radial passages to permit the escape of hot gases of said ignition cartridge, said reduced section having a longitudinal bore forming a flash passage communicating with said cartridge at its forward end and a priming charge at its rearward end, said fin assembly hub having a longitudinal bore in axial alinement with said flash passage, and means in the bore of said hub for setting off said primer when said projectile is fired.

2. In a cartridge case and tail fin assembly for a mortar projectile, a hollow frusto-conical cartridge container forming a chamber to receive an ignition cartridge and having holes through its side wall for egress of ignition gases, a tail fin assembly including a hub of the same diameter as the minimum diameter of said container, a plurality of guide fins fixed on said hub radially thereof,

means rigidly joining the forward end of said hub to the rear end of said container, the rearward end of the chamber in said container terminating forwardly of said hub, there being a first coaxial bore in said hub adapted to receive a primer only for an ignition cartridge in said container, there also being a bore in said container placing said first bore in communication with said chamber.

3. In a cartridge case and tail fin assembly for a mortar projectile, a hollow frusto-conical cartridge container forming a chamber to receive a cartridge and having holes through its side walls for egress of ignition gases, said container being reduced at its rearward end to form a threaded boss extending rearwardly and axially, the rearward end of said chamber being positioned forwardly of said boss, a fin assembly comprising a hub of the same diameter as the minimum diameter of said container and having a first central axial bore, the forward end of said bore being enlarged and threaded to engage said boss, there being a second central bore in said boss opening forwardly into said chamber and in communication with said first bore, and guide vane means fixed radially on said hub.

4. A streamlined fusiform mortar projectile having a rearwardly tapering portion provided with a rearwardly extending externally threaded reduced portion, a rearwardly tapering ignition cartridge container having its forward end screw threadedly engaging said threaded reduced portion and presenting a fair surface with the peripheral surface of said rearwardly tapering portion, said cartridge container having holes through its side walls for egress of ignition gases, a fin assembly joined in coaxial relation to the rear end of said cartridge container and extending in its entirety rearwardly of said cartridge container, said fin assembly having a hub of external diameter equal to the minimum external diameter of said cartridge container, a primer for initiating a cartridge in said container and received within a recess in said hub, the rearward end of said cartridge container having an axial flash passage communicating at its rearward end with said recess and at its forward end with said cartridge container.

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