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Squiers

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[54] **SHELL CONSTRUCTION SEALING WASHER**

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[52] **U.S. Cl.** ..... **102/38;** 102/49.3; 60/270 S

[51] **Int. Cl.**[2] **F42B 9/10**

[58] **Field of Search** 102/49, 92.5, 38, 49.3; 60/270

[56] **References Cited**

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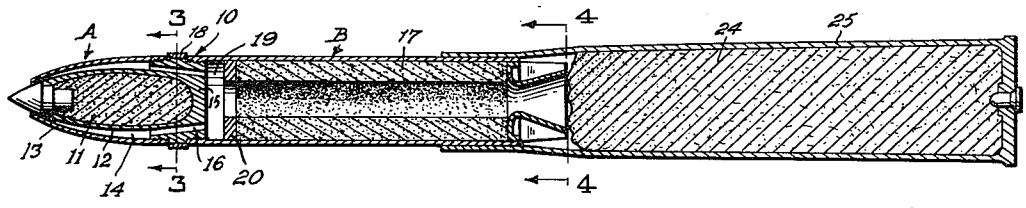
[57] **ABSTRACT**

1. A gun launched ram jet projectile having a warhead assembly and an attached shell structure mounted within a cartridge casing, the combination comprising an explosive charge within an inner casing supported centrally within an outer casing and spaced therefrom to provide an air passage therebetween, a tubular solid fuel grain fitted in the inner wall of said shell structure and axially spaced from said inner casing, said grain defining a combustion chamber, an aluminium ring having a central opening substantially the same diameter as the central longitudinal bore of said tubular grain cemented to said inner casing and axially spaced therefrom when in a closed position, said ring when in said closed position sealing said air passage to prevent escape of fuel gases while said shell is in a gun barrel, and to move axially to an open position against said grain in response to air pressure during free flight of said projectile to provide passage of said air to said combustion chamber.

6 Claims, 5 Drawing Figures



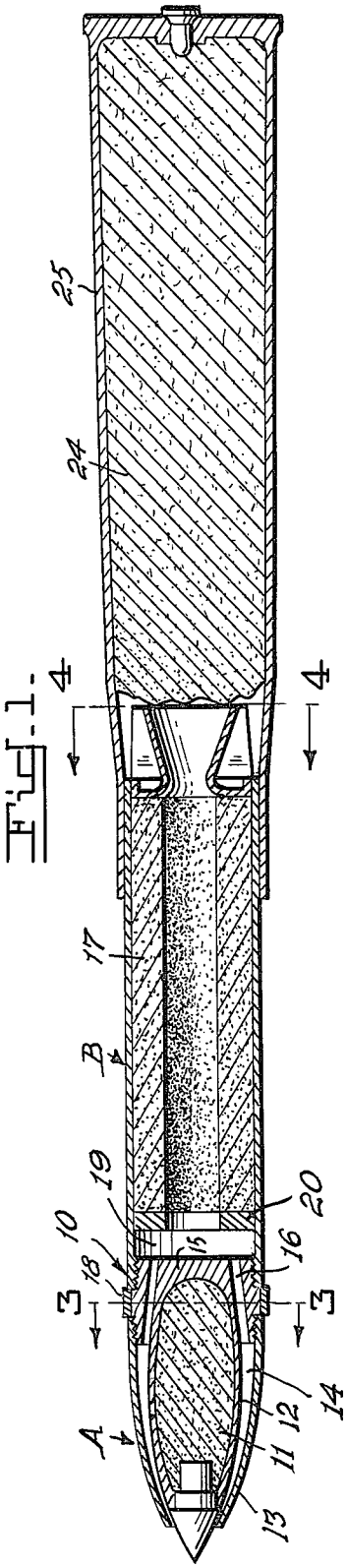


Fig. 1.

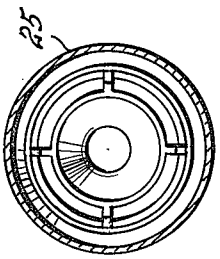


Fig. 4.

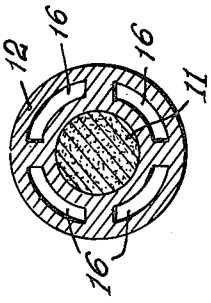


Fig. 3.

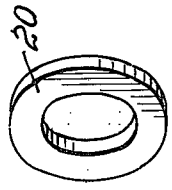


Fig. 5.

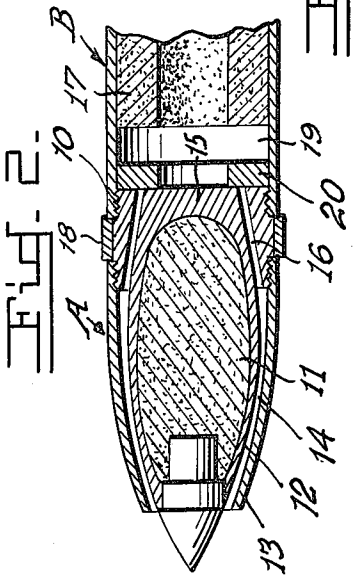


Fig. 2.

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SHELL CONSTRUCTION SEALING WASHER

This invention relates to anti-aircraft projectiles having a shorter time of flight and higher striking velocity than heretofore and in particular to a gun-launched solid-fuel ram-jet-propelled projectile.

Much difficulty has been experienced in sealing off the projectile fuel and the front-entering air passages in ram jet projectiles until after the projectile is in flight and in particular preventing escape of propellant gases while the projectile is in the gun barrel. When the projectile has left the gun barrel the air passages must be opened to allow air to reach the fuel. Heretofore, due to the complex nature of the valves used for this purpose they have not performed satisfactorily in that they did not respond quickly enough to flight condition of the projectile and because of a time lag in readily supplying air for the fuel upon launching of the projectile.

Therefore, it is one object of this invention to provide a simple and efficient air sealing aluminum ring cemented to the rear wall of the warhead which requires no adjustment and which operates in response to air pressure created by the flight of the projectile to instantaneously allow air, in sufficient quantity, to reach the fuel for combustion.

It is another object of this invention to provide a simple air sealing aluminum washer for a ram jet projectile which in "open" position allows air to reach the fuel without travelling an unduly tortuous path.

Another object of this invention is to provide a simple air sealing mechanism which requires no adjustment for a ram jet projectile in which the propellant is ignited by the gun blast, thus eliminating the need of a separate igniter.

Another object of this invention is to provide a ram jet projectile that does not require other than normal handling precautions, has a simple air sealing mechanism and utilizes a solid fuel as a propellant.

Another object of this invention is to provide a ram jet fuel which burns uniformly, produces higher thrusts and lower burning rate than the simple magnesium fuels.

Another object of this invention is to provide a projectile of the ram jet type in which the fuel is in the shape of a hollow cylinder cemented to the shell body. This allows the shell walls to be insulated by the fuel until the fuel is burned, thus precluding the possibility of the tailpipe of the shell burning off during flight.

A further object of this invention is to provide a ram jet projectile in which the explosive charge is carried forward in the center section of a supersonic diffuser and in which a point detonating fuze is built into the point of the diffuser.

For a more detailed understanding of the invention reference may be had to the accompanying drawing illustrating a preferred embodiment thereof in which like characters refer to like parts throughout the several views and in which,

FIG. 1 is a longitudinal sectional view of the ram jet projectile showing the sealing ring in "open" position.

FIG. 2 is a somewhat enlarged detailed sectional view of the warhead assembly showing the washer cemented to the rear wall of said warhead and closing the internal air passages thereof.

FIG. 3 is a traverse sectional view taken on line 3—3 of FIG. 1,

FIG. 4 is a traverse sectional view taken on line 4—4 of FIG. 1, and

FIG. 5 is a detail perspective view of the aluminum sealing ring or washer.

The gun-launched ram-jet projectile as hereinafter described comprises a warhead assembly A and a shell structure B which is permanently attached or otherwise secured to the warhead assembly, preferrably by means of a screw threaded joint as at **10.** The warhead carries an explosive charge **11** within a casing **12** supported within the outer casing **13** of the warhead assembly in such a way as to provide air passage **14.** The rear wall **15** of said warhead assembly solidly secures the outer casing **13** to the casing **12** and is provided with air passages **16** communicating with passage **14.** The rear wall **15** is also provided with a rotating ring **18** at the periphery thereof.

The shell structure B has cemented to the interior wall thereof a hollow cylindrical solid fuel grain **17** and the forward end or upstream end of this grain terminates short of the rear wall **15** of the warhead as shown in FIGS. **1** and **2** which provides a cylindrical space **19** of an axial length greater than the axial thickness of the sealing ring **20** which is located in such space **19.** Preferably this space **19** is about two or three times longer than the axial thickness of the sealing ring. It will be observed in FIG. **1** that the central opening in the sealing ring is approximately the same diameter as the internal bore diameter in the solid fuel grain and that the combustion chamber is defined by the fuel grain.

A suitable rubber cement is utilized to cement one face of the sealing ring to the rear wall **15** of the warhead (see FIG. **2**) and thus the interior of the shell is effectively sealed as the sealing ring or washer **20** closes the openings or air passages **16.**

The gun blast charge **24** used to launch the projectile is contained in the cartridge **25.** The gun blast is also utilized to act as an igniter for the propellant by heating it to a sufficient temperature.

The solid fuel grains utilized as the propellant are simple magnesium fuels containing magnesium, oxidizer and binder to which has been added small amounts of stearic acid or magnesium stearate as an internal lubricant when the fuel was pressed. By adding the stearic acid a more uniform burning with higher thrusts is obtained over simple magnesium fuels. In addition the stearic acid fuels have a lower burning rate than the simple magnesium fuels.

In operation the projectile is ejected from the casing **25** by the gun blast **24** and at the same time the propellant **17** is heated to ignition temperature. The high pressures built up within the bore of the grain and chamber **19** by the gun blast is rapidly dissipated when the projectile leaves the gun barrel. Due to this pressure the sealing ring is firmly held in place against the high initial force of acceleration, and upon the projectiles emergence from the gun bore at muzzle velocity and rapid dissipation of gun blast pressure the ram air pressure on the forward side of the sealing ring is sufficient to snap the ring back against the forward end of the grain, allowing instantaneous and full air flow to the propellant which is already at ignition temperature. The sealing washer is held in its open position by ram air pressure, the force of acceleration as well as pressures generated by the burning fuel since the sealing ring is up against the grain prior to or simultaneously with air being supplied to the fuel. As a result all the gas

pressures built up in chamber **19** tend to force the sealing ring against the grain and hold it there.

It will be apparent to those skilled in the art to which this invention relates that various changes and modifications may be made herein without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A gun launched ram jet projectile having a warhead assembly and an attached shell structure mounted within a cartridge casing, the combination comprising an explosive charge within an inner casing supported centrally within an outer casing and spaced therefrom to provide an air passage therebetween, a tubular solid fuel grain fitted in the inner wall of said shell structure and axially spaced from said inner casing, said grain defining a combustion chamber, an aluminium ring having a central opening substantially the same diameter as the center longitudinal bore of said tubular grain cemented to said inner casing and axially spaced therefrom when in a closed position, said ring when in said closed position sealing said air passage to prevent escape of fuel gases while said shell is in a gun barrel, and to move axially to an open position against said grain in response to air pressure during free flight of said projectile to provide passage of said air to said combustion chamber.

2. In a gun launched ram jet projectile comprising a warhead assembly provided with longitudinally extended air passages, a shell structure attached to said warhead assembly and carrying a hollow cylindrical shaped solid fuel grain cemented to the interior shell surface, said fuel grain longitudinally spaced from the rear wall of said warhead assembly, and a sealing washer displaceably disposed in the shell structure in the space between said fuel grain and the rear wall of said warhead assembly, said sealing washer initially cemented to the said rear wall of the warhead assembly to close said air passages, the space between the fuel grain and the rear wall of the warhead assembly being greater than the axial thickness of said sealing washer, whereby upon launching of said projectile, the increase of air pressure in said warhead air passages displaces said sealing washer and opens said air passages to provide air for the burning of the fuel in said shell structure.

3. In a gun launched ram jet projectile comprising a warhead assembly provided with longitudinally extended air passages, a shell structure attached to said warhead assembly and carrying a hollow cylindrically shaped solid fuel grain cemented to the interior shell surface, said fuel grain longitudinally spaced from the rear wall of said warhead assembly and a sealing washer displacably disposed in the shell structure in the space between said fuel grain and the rear wall of said warhead assembly, said sealing washer initially cemented to the said rear wall of the warhead assembly to close said air passages, the space between the fuel grain and the rear wall of the warhead assembly being greater than the axial thickness of said sealing washer, whereby upon launching of said projectile the increase of air pressure in said warhead air passages displaces said sealing washer and opens said air passages to provide air for the burning of the fuel in said shell structure, said sealing washer comprising an aluminum ring structure having a central opening substantially the same diameter as the central longitudinal opening in said hollow cylindrically shaped solid fuel grain.

4. The device as in claim **3** in which the space between said fuel grain and rear wall of said warhead assembly is two to three times longer than the axial thickness of said sealing washer.

5. In a gun launched ram jet projectile comprising a warhead assembly provided with longitudinally extended air passages, a shell structure attached to said warhead and carrying a hollow cylindrically shaped solid fuel grain cemented to the interior shell surface, said fuel grain longitudinally spaced from the rear wall of said warhead assembly, and a sealing washer disposed in the shell structure in the space between said full grain and the rear wall of said warhead assembly, said sealing washer initially cemented to the said rear wall of the warhead assembly to close said air passages, the space between the fuel grain and the rear wall of the warhead assembly being greater than the axial thickness of said sealing washer, whereby upon launching of said projectile, the increase of air pressure in said warhead air passages displaces said sealing washer and opens said air passages to provide air for the burning of the fuel in said shell structure, said sealing washer cemented to the rear wall warhead structure by a rubber cement permitting same to be detached in response to a relatively slight pressure rise in said air passages of about 25 pounds per square inch.

6. In a gun launched ram jet projectile the combination of a warhead assembly, a shell structure attached to and spaced from said warhead assembly, said shell structure being mounted within a cartridge casing, said warhead assembly comprising an explosive charge within an inner casing supported centrally within an outer casing and spaced therefrom to provide an air passage therebetween, a point detonating fuze mounted on the forward end of said inner casing and an aluminum sealing ring cemented to the rear wall of said inner casing to seal off said air passages, a cylindrical stearic acid magnesium fuel grain cemented to the inner wall of said shell structure and spaced from the rear wall of said inner casing, defining a sealing ring cylinder within which said sealing ring moves from a closed position in which it is cemented to the rear wall of the inner casing to an open position in which it rests against said grain, said grain defining a combustion chamber within the central bore thereof which is supplied with air under pressure from said air passages when said sealing ring is in said open position in response to ram air pressure, a gun blast charge within said cartridge casing to launch said warhead assembly and attached shell structure.

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