

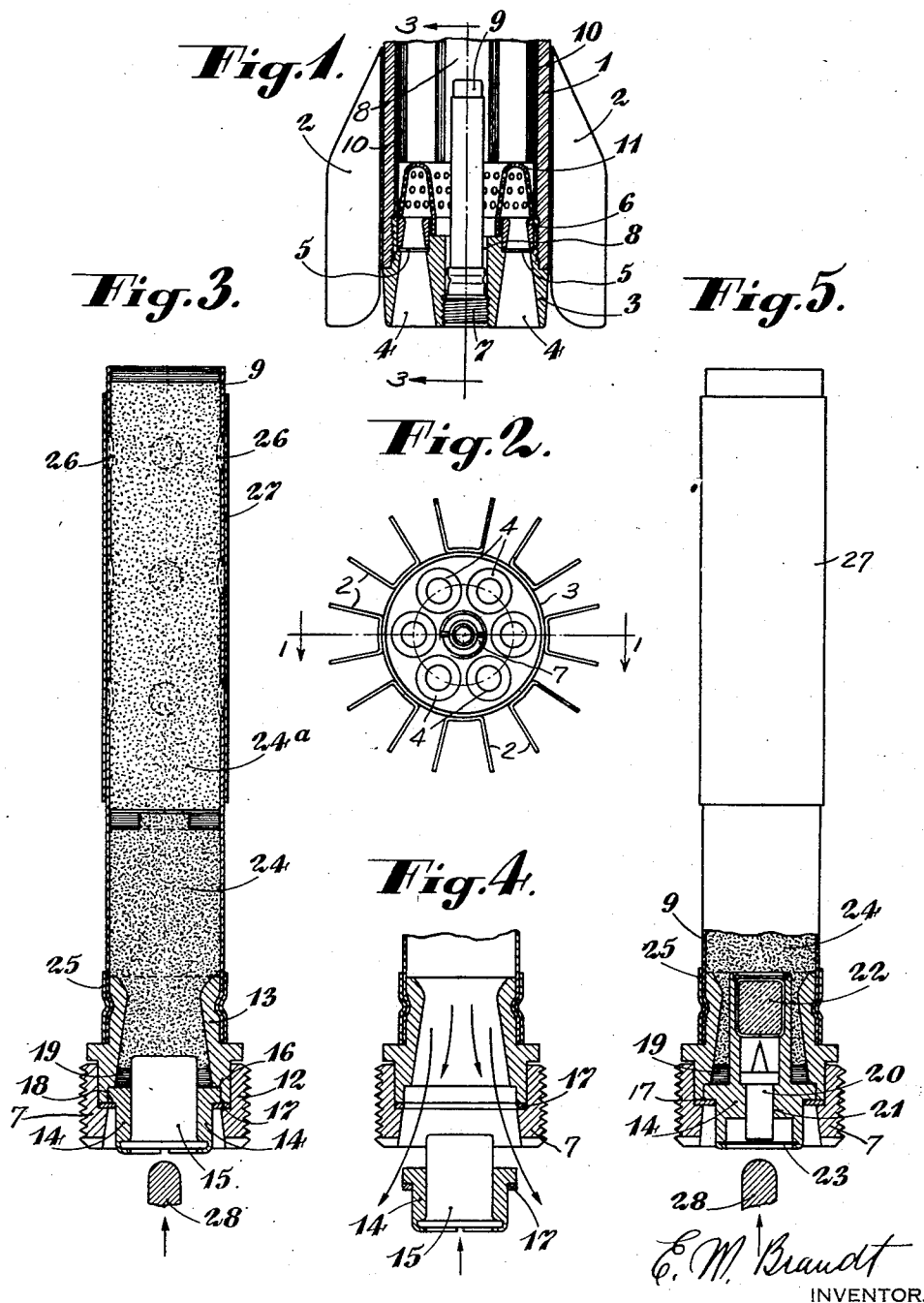
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SAFETY DEVICE FOR SELF-PROPELLED PROJECTILES

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SAFETY DEVICE FOR SELF-PROPELLED PROJECTILES

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This invention relates to a safety device for self-propelled or rocket projectiles.

Projectiles functioning by reaction generally comprise a charge of propellant powder in a combustion chamber provided with nozzles, through which the gases of combustion are expelled, to impart an increased velocity to the projectile.

Since the nature of the combustion of the powder is governed mainly by the pressure and temperature, to which the interior of the combustion chamber is raised, various means have been proposed for influencing and regulating these physical factors.

However, the choice of a given quantity of propellant powder for a predetermined volume and discharge of the nozzles is not sufficient to maintain the current combustion conditions of the powder. Combustion also depends upon the state of the batch of powder, its degree of dryness and atmospheric conditions (surrounding temperature, humidity, and so forth).

It is therefore necessary to endeavor to prevent as much as possible, the disadvantages which may arise from these variations, namely inaccuracy of shooting and the risk of explosion of the combustion chamber in the event of sudden excess pressure.

Various means have already been proposed for increasing the discharge of the nozzles, for example valve devices, but the latter are liable to be rendered inoperative by the very high pressures and temperatures to which they are subjected. Furthermore, when valves are used as safety devices, the additional propulsion effect of the discharge of the gases through convergent-divergent nozzles is not availed of.

The present invention aims at obviating the foregoing disadvantages and contemplates a safety device for the type of rocket projectile having a plurality of convergent-divergent nozzles at the end of the combustion chamber of the rocket projectile.

According to the present invention, at least one of the aforesaid nozzles, and preferably a centrally disposed one, is closed by an anvil or closure member, which also serves as a percussion cap carrier for a firing cap placed in contact with the igniting charge of the self-propulsion material. This anvil is held in place by a retaining member or element adapted to shear under the effect of a pressure greater than a normal operating pressure within the combustion chamber, but less than the pressure at which physical disruption of the chamber parts occurs, that is, this retaining member yields under the effect of a pressure greater than the pressure usually generated within the chamber and tolerated as a usual operating condition, whereby the anvil or closure member is freed to be ejected by the self-propulsion gases which are thereafter discharged through this additional nozzle.

In other words, if under normal conditions of temperature and pressure, the propulsion of the projectile is assured by a number of nozzles N , $N+1$ nozzles are, however, available in case of predetermined excessive pressure.

The closure member or anvil, acting as a valve, comprises in addition the cap for igniting the charge on percussion and is disposed in the interior of a central nozzle. Consequently when the anvil is ejected under the effect of an excessive pressure, the symmetry of the nozzles is not modified and the trajectory of the projectile is consequently not affected.

Furthermore, upon the functioning of the safety device, the cap-carrying anvil ejected rearwardly does not

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give rise to any danger, because the ejected part (anvil, cap and so forth) has a low mass and negligible inertia relatively to the thrust of the gases acting thereupon.

In order to provide a readily detachable unit, the igniting charge is preferably contained in a case fitted on the external face of the central nozzle hereinbefore referred to.

According to another feature of the present invention, the novel device includes an elastic element interposed between the anvil and the nozzle, thus providing a seal for the gases as long as the shear element has not yielded under the effect of the pressure.

Another embodiment of the invention comprises at the rear, in addition to an igniting cap, a firing pin sliding in a recess provided for the purpose and struck by the hammer of the weapon on firing.

Moreover when the anvil closes the central nozzle, the anvil or closure member rests, in accordance with the invention, on an annular support provided by an abutment shoulder in the interior of said nozzle such that the shear element is protected from external pressures and accidental shocks, and only a sufficient thrust acting from the interior of the combustion chamber will shear said element.

Other features of the invention will appear from the following description taken in conjunction with the accompanying drawings which illustrate diagrammatically and by way of example the preferred embodiments thereof, and in which:

Fig. 1 is a longitudinal sectional view of the rear of a self-propelled projectile equipped with the invention and taken on line 1—1 of Fig. 2;

Fig. 2 is a rear end view of the device shown in Fig. 1;

Fig. 3 is an enlarged sectional view taken on the longitudinal axis 3—3 in Fig. 1 and showing the device provided at the end with an igniting charge;

Fig. 4 is a fragmentary enlarged axial section, showing the operational detail of the device with the cap expelled; and

Fig. 5 is an axial section of a second embodiment of the invention.

The rear end of the combustion chamber 1 (Fig. 1), on the periphery of which stabilising fins 2 are provided, acts as support for the device according to the invention, which comprises a nozzle support 3 closing the rear end of the combustion chamber having the annularly disposed nozzles 4 which are closed at their rear ends by closure plates 5. Said plates are each held between an abutment provided on the inner face of the nozzle 4 and a collar 6 of said latter made of heat-resistant material.

A device 7 is screwed into a central duct or passage 8 of the nozzle support 3, and the casing 9, containing the igniting charge, forms an extension of said device. The propellant is shown in the form of solid rods 10 (for example a nitrocellulose and nitroglycerine powder), each resting with its end on the apex of a grid 11, the orifices of which are laterally oriented, so as to prevent projection of unburnt particles of powder through the nozzles 4.

Fig. 3 shows the constructional detail of the device 7, which comprises a screw-threaded annular part or collar 12, containing a nozzle 13 closed by a closure member or anvil 14 containing a cap 15, the latter being held in place by the flanging of the external edge of said anvil. The latter bears internally against an abutment 16 of the nozzle 13, and a washer 17 in contact with a shoulder 18 of the anvil 14 prevents the anvil or closure member from leaving its recess. A gas-tight plastic elastic packing element 19 (leather, wadding or the like) completes the gas-tight sealing of device 7. Finally, the striker-carrying hammer of the weapon is partly shown at 28 opposite the cap 15.

According to a modified embodiment of the invention shown in Fig. 5, the anvil 14 includes, at its rear, in place of the cap 15, a small firing pin 20 adapted to slide in a bore 21 arranged opposite a percussion cap 22 in front of said bore. In this embodiment, the rear opening of the anvil is closed by a plate 23. The casing 9 containing the igniting charge 24, is set on the external face of the nozzle 13 and in addition is retained by an

external ring 25. Finally and preferably, the igniting charge in addition includes a relay charge 24a (Fig. 3) of aluminothermic material e. g. Thermit having a high combustion temperature facilitating the ignition of the propellant 10, the flame of the said material passing through perforations 26 provided on the periphery of the casing 9 which in turn is covered with a thin sheath 27.

The hereinbefore described device operates as follows:

Before firing, the annularly disposed nozzles 4 are closed by the plates 5, and the hereinbefore described device hermetically seals the central duct 8.

When the firer presses the trigger of the weapon, the hammer 28 strikes the cap 15 (Fig. 3) or the plate 23 (Fig. 5) in contact with the collar equipped firing pin 20. The deflagration of the percussion cap is transmitted to the igniting charge 24, 24a and the jet of flame perforates the sheath 27 in passing through the openings 26 provided for this purpose. Ignition is finally transmitted to the propelling agent represented by the rods 10 symmetrically arranged around the igniting charge 24.

The gases of the self-propulsion combustion chamber attain a high pressure and temperature and in doing so shear the plates 5; the nozzles 4 begin to discharge simultaneously and the projectile commences its trajectory under the action of the initial velocity which it acquires.

If for any reason a predetermined pressure exceeds the limit tolerated by the strength of the combustion chamber walls, the regulating device then functions and, in accordance with the invention, the anvil 14 carrying the firing pin is ejected after shearing of the washer 17 (Fig. 4).

Thereafter, an additional nozzle 13 is available for the discharge of gases from the combustion chamber 1 through the grid 11 and the central duct 8. The pressure in the combustion chamber thereupon drops instantaneously below the danger limit.

The invention thus affords the advantage of permitting a greater efficiency of auto-propulsion, since there is no longer any fear of loading the container to the maximum.

Moreover the weight of the projectile is substantially reduced, since the wall of the container may be constructed of lesser thickness.

It is obvious that the invention has been described by way of example only and that numerous modifications may be made in it without departing from the scope thereof as defined by the appended claims.

What I claim is:

1. In a rocket projectile having a combustion chamber, closure means at the rear end thereof and having a plurality of main discharge passages and a central passage all in communication with the chamber during flight of the projectile, a safety device comprising a nozzle in said central passage, an elongated casing connected to the inner end of said safety nozzle and thereby supported in said central passage, an igniter charge in said casing, a closure member obturating the said nozzle, a primer cap carried by said closure member and in direct contact with the igniter charge, a retaining member, and an annular member holding said retaining member in position against said safety nozzle, said retaining member being constructed and arranged to resist normal operating pressure in said chamber and safety nozzle and to shear under the effect of an excessive pressure therein higher than a predetermined normal pressure whereby the closure member is released and expelled.

2. In combination: a rocket projectile having a combustion chamber, and closure means at the rear end thereof having a plurality of main discharge passages and a central passage in communication with said combustion chamber; a nozzle in said central passage, a collar adapted to engage the rear end of said closure means and having an interior transverse shoulder therein; the said nozzle having a convergent-divergent form with an enlargement in the divergent portion thereof to provide a shoulder; a closure member having a peripheral flange, the front shoulder of which flange is adapted to contact the said shoulder of said nozzle and the outer peripheral surface of which flange is adapted to contact the inner surface of said nozzle; and a washer engaging on one of its sides the shoulder of said collar and engaging on the other of its sides the rear end of said nozzle and the rear shoulder of said flange; said washer being constructed and arranged to resist pressure within the said nozzle up to a predetermined amount and to

shear under the effect of a pressure above the said predetermined amount whereby said closure member is released and expelled from said nozzle.

3. In combination: a rocket projectile having a combustion chamber, and closure means at the rear end thereof having a plurality of main discharge passages and a central passage in communication with said combustion chamber; a nozzle in said central passage, a collar adapted to engage the rear end of said closure means and having an interior transverse shoulder therein; the said nozzle having a convergent-divergent form with an enlargement in the divergent portion thereof to provide a shoulder; a closure member having a peripheral flange, the front shoulder of which flange is adapted to contact the said shoulder of said nozzle and the outer peripheral surface of which flange is adapted to contact the inner surface of said nozzle; an elastic packing element in said enlarged portion in compressed contact between said nozzle and said closure member, and a washer engaging on one of its sides the shoulder of said collar and engaging on the other of its sides the rear end of said nozzle and the rear shoulder of said flange; said washer being constructed and arranged to resist pressure within the said nozzle up to a predetermined amount and to shear under the effect of a pressure above the said predetermined amount whereby said closure member is released and expelled from said nozzle.

4. In combination: a rocket projectile having a combustion chamber and a support having a plurality of discharge passages in communication with said combustion chamber, one of which passages is in the central axis of said projectile and has a nozzle having a convergent-divergent form; a collar adapted to engage the rear end of said support and adapted to contact the outer surface of said nozzle and having an interior transverse shoulder therein; the said nozzle having an enlargement in the divergent portion thereof to provide an internal shoulder; an elongated perforated casing connected to and opening into the convergent end of said nozzle and extending into said combustion chamber; an ignition charge in said casing and said nozzle; a closure member having a peripheral flange adapted to contact the said shoulder of said nozzle and the inner surface of said nozzle; a primer cap in said closure member and in contact with said ignition charge; and a retaining member engaging the said shoulder of said collar and the rear end of said nozzle and the said flange; the said retaining member being constructed and arranged to resist a predetermined normal operating pressure in said chamber and to shear under the effect of a pressure therein higher than said predetermined pressure whereby the said closure member is released and expelled from said nozzle.

5. In combination: a rocket projectile having a combustion chamber and a support having a plurality of discharge passages in communication with said combustion chamber, one of which passages is in the central axis of said projectile and has a nozzle having a convergent-divergent form; a collar adapted to engage the rear end of said support and adapted to contact the outer surface of said nozzle and having an interior transverse shoulder therein; the said nozzle having an enlargement in the divergent portion thereof to provide an internal shoulder; an elongated perforated casing connected to and opening into the convergent end of said nozzle and extending into said combustion chamber; an igniting charge in said casing and said nozzle; a closure member having a peripheral flange adapted to contact the said shoulder of said nozzle and the inner surface of said nozzle; a firing pin and a primer cap in a central passage in said closure member and in contact with said igniting charge, the firing pin closing the area of the central passage; and a retaining member engaging the said shoulder of said collar and the rear end of said nozzle and the said flange; the said retaining member being constructed and arranged to resist a predetermined normal operating pressure in said chamber and to shear under the effect of a pressure therein higher than said predetermined pressure whereby the said closure member and firing pin is released and expelled from said nozzle.

6. In combination: a rocket projectile having a combustion chamber and a support having a plurality of main discharge passages and a centrally disposed passage terminating at its rear end in a convergent-divergent nozzle, said passages being in communication with said chamber; an elongated perforated casing in said passage

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and extending into said combustion chamber, an igniting charge in said casing and said nozzle; and a charge firing and safety device in said nozzle comprising a closure member obturating the divergent end of said nozzle, gas-tight packing means between said nozzle and said closure member, means for preventing said closure member moving forward in said nozzle, and a firing cap axially located in said closure member and in contact with said igniting charge and exposed at the rear of said device, safety releasing means for preventing said closure member moving rearward out of said nozzle, said safety releasing means including an element in normally supporting relation to said closure member and being subject to shear and breakage under the effect of a pressure in said nozzle higher than a predetermined pressure whereby the said closure member is released and expelled from said nozzle.

7. In combination: a rocket projectile having a combustion chamber and a support having a plurality of main discharge passages and a centrally disposed passage terminating at its rear end in a convergent-divergent nozzle, said passages being in communication with said chamber; an elongated perforated casing in said passage and extending into said combustion chamber, an igniting charge in said casing and said nozzle; and a charge firing and safety device in said nozzle comprising a closure member obturating the divergent end of said nozzle, gas-tight packing means between said nozzle and said closure member, means for preventing said closure member moving forward in said nozzle, a firing cap axially located in said closure member and in contact with said igniting charge, a firing pin in said closure member coaxial with said cap, and a closing plate in the exposed end of said device juxtaposed to the rear end of said firing pin, safety releasing means for preventing said closure member moving rearward out of said nozzle, said safety releasing means including an element in normally supporting relation to said closure member and being subject to shear and breakage under the effect of a pressure in said nozzle higher than a predetermined pressure whereby the said closure member is released and expelled from said nozzle.

8. In a rocket projectile having a combustion chamber, closure means at the rear end thereof and having a plurality of main discharge passages and a central passage all in communication with the chamber during flight of the

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projectile, a safety device comprising a nozzle in said central passage, a closure member obturating the said nozzle and having a central bore and an external shoulder, an annular retaining element engaged against said shoulder, an annular member holding said retaining element in position against said safety nozzle and shoulder, and a primer cap carried by the closure member in said bore and closing the same, said retaining element being constructed and arranged to resist normal operating pressure in said chamber and safety nozzle and to shear under the effect of an excessive pressure therein higher than a predetermined normal pressure whereby the closure member is released and expelled.

9. In combination: a rocket projectile having a combustion chamber and a support having a plurality of main discharge passages and a centrally disposed passage, a convergent-divergent nozzle terminating the rear end of the central passage, said passages being in communication with said chamber, and a safety device in said nozzle comprising a closure member obturating the divergent end of said nozzle and having a central bore and an external shoulder therein, a primer cap carried by the closure member in said bore and closing the same, means for preventing said closure member moving forward in said nozzle, and safety releasing means for preventing said closure member moving rearward out of said nozzle, said safety releasing means including an annular element in normally supporting relation to said closure member and engaged with the nozzle and subject to shear and breakage under the effect of a pressure in said nozzle higher than a predetermined pressure, whereby the said closure member is released and expelled from said nozzle, and means for holding said annular element against said closure member and nozzle.

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