April 1, 1958 R. O. WEBSTER 2,828,691

IGNITER

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Fig. 1.

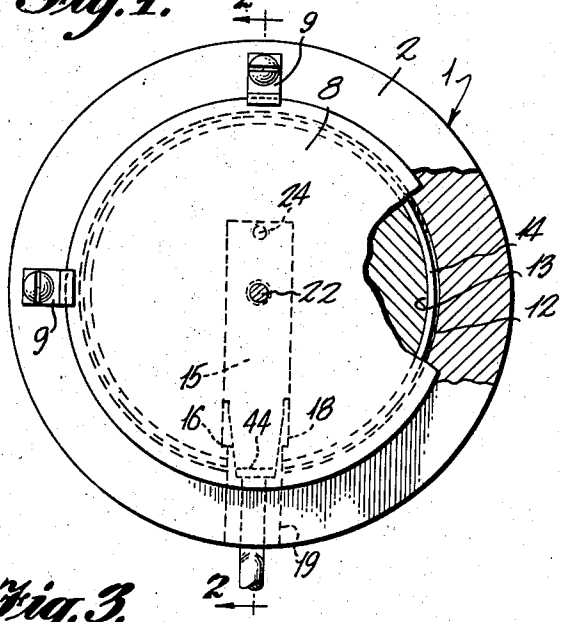


Fig. 2.

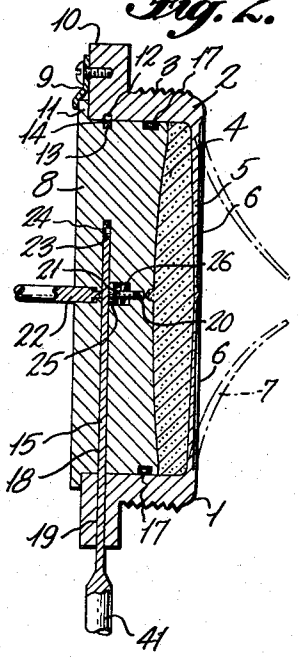


Fig. 3.

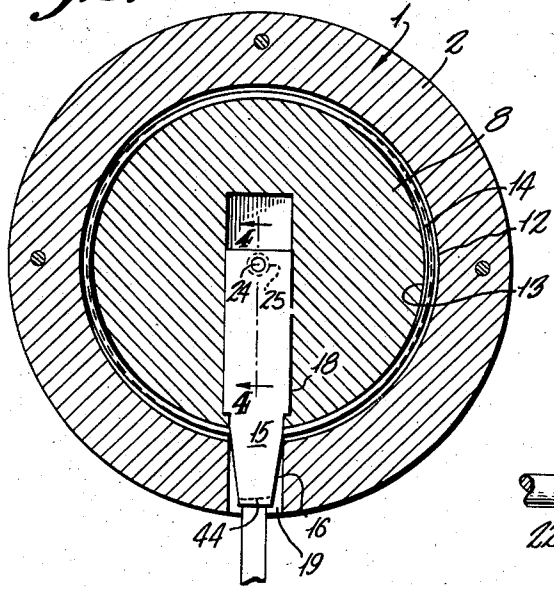
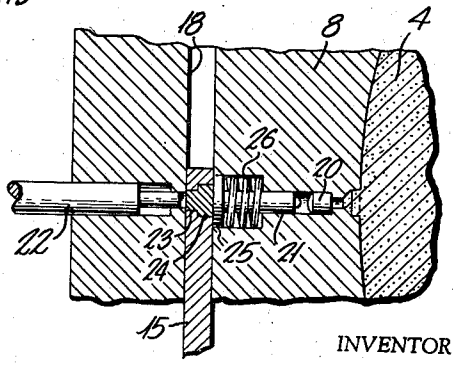


Fig. 4.



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Fig. 5.

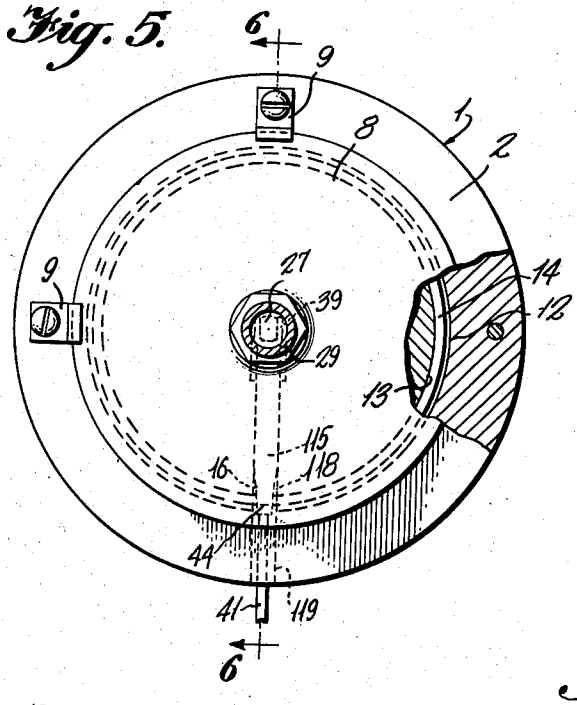


Fig. 6.

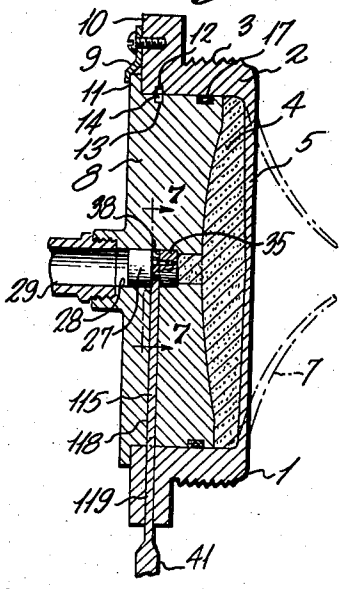


Fig. 7.

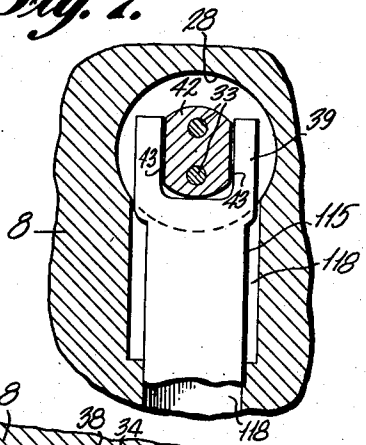


Fig. 8.

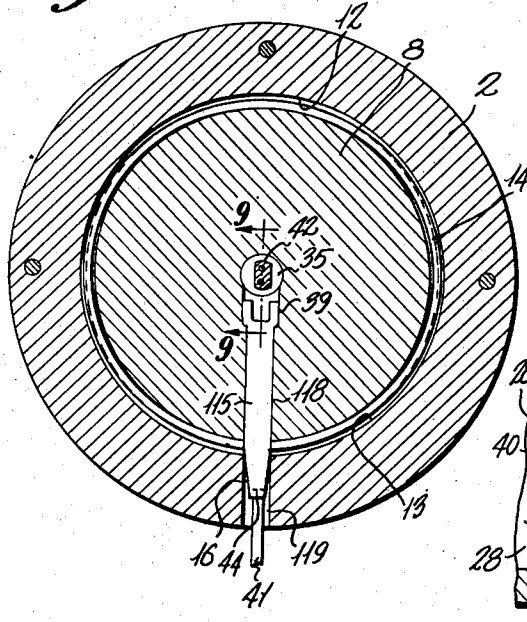
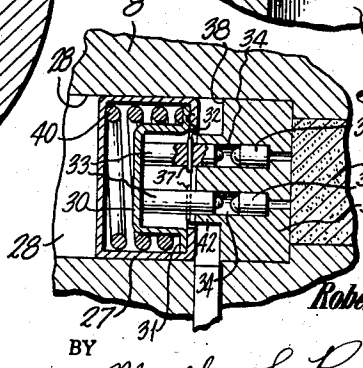


Fig. 9.



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2,828,691

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Application June 18, 1956, Serial No. 591,933

10 Claims. (Cl. 102—70)

This invention relates to new and improved igniters for use in initiating the burning of a combustible charge such as the solid or liquid propellant of a rocket, torpedo, jet assist take-off unit, catapult, gas generator unit and the like. More specifically it relates to igniters equipped with novel safety features to prevent premature or accidental ignition of the propellent charge.

The igniter charge in the igniter unit is subject to accidental combustion due to such factors as inadvertent or stray electrical discharge, mechanical shock or self-ignition. When the igniter is in position in the device which it is to actuate, accidental ignition of the igniter charge initiates burning of the propellant in the rocket or the like with frequently disastrous results.

The object of this invention is to provide igniters which, in the event of accidental ignition of the igniter charge, possess safety means permitting discharge of the burning igniter charge particles and high temperature gases in a direction away from the chamber containing the propellent charge so that they do not contact and thereby prematurely ignite the propellant.

Another object is to provide impact-actuated igniters which are equipped with safeguards against premature impact ignition of the igniter charge.

Other objects and advantages of my invention will become obvious from the following description and drawings.

In the drawings:

Figure 1 is a plan view of the igniter, parts being broken away.

Figure 2 is a longitudinal section taken along lines 2—2 of Figure 1.

Figure 3 is a transverse sectional view showing the parts in armed position.

Figure 4 is a fragmentary longitudinal section showing the parts in armed position.

Figure 5 is a modified form of igniter, parts being broken away.

Figure 6 is a longitudinal section taken along lines 6—6 of Figure 5.

Figure 7 is a fragmentary cross-sectional view taken along lines 7—7 of Figure 6.

Figure 8 is a transverse sectional view showing the parts in armed position.

Figure 9 is a fragmentary sectional view taken along lines 9—9 of Figure 8.

Broadly speaking, my invention comprises one or more safety features which maintain the igniter in "unarmed" or "safe" position until the igniter is ready for firing, at which point the igniter is "armed" in such manner that the firing mechanism is no longer interrupted or ignition of the propellant prevented.

One of the safety features of my invention comprises a safety "blow-off" means whereby accidental ignition of the igniter charge due, for example, to such factors as mechanical shock, self-ignition or premature triggering of the electrical or impact ignition-actuating mechanism,

results in expulsion of the burning particles and high temperature combustion gases in a direction away from the propellent charge so that the latter is not ignited. This mechanical "blow-off" feature comprises an outer wall or closure plate on the igniter which, in safety position, is disengageably secured so that it can be ejected by the pressure of the burning igniter charge, thereby providing a safe vent for the combustion products. In the armed position, this closure plate is locked to the igniter receptacle by a locking mechanism provided by a slidable means, which for convenience will be referred to as the arming rod, and the combustion products of the igniter charge are forced to vent into the propellent chamber.

As an additional safety feature in the case of impact-actuated igniters, the arming rod, when in safety position, namely when not locking the closure plate to the igniter receptacle, is interposed between the impact means and igniter means, such as a primer or percussion cap which initiates combustion of the igniter charge, in such manner that the firing pin cannot strike the igniter means, and thereby prevents ignition even though accidental actuation of the impact mechanism may occur.

The accompanying drawings illustrate various embodiments of my invention.

Referring first to the group of Figures 1 to 4, the igniter body 1 comprises a receptacle or cup 2 adapted to be inserted into and fastened to the chamber wall of the rocket or other device containing the propellent charge to be ignited. The fastening means can be peripheral, external threads 3 on the igniter cup, as shown, which cooperate with threads in the igniter-receiving mouth of the combustion chamber or it can be any other desired and suitable joining means. The igniter cup contains a suitable igniter or explosive charge, such as black powder 4.

The bottom or base 5 of the igniter cup comprises, at least in part, a non-combustible element which ruptures under pressure. The desired rupturability can be attained in any desired manner as, for example, by forming the bottom of or incorporating into it, a sheet of metal or plastic sufficiently thin and frangible to cause the sheet to break when a determined level of igniter charge combustion gas pressure is reached. Another method of ensuring rupturability is by making the bottom of varying thickness as shown and providing lines of weakness as, for example, in the form of radiating lines 6 along which the base opens out under pressure. Figure 2 shows schematically in dotted lines the effect of rupture of a base weakened in such manner as to burst open into pie-shaped segments 7. The number and arrangement of the lines of weakness can be varied as desired in order to control the direction of discharge of ignition products from the igniter into combustion chambers of different designs.

The mouth of the igniter cup is sealed by insertion of a closure plate 8 which is secured to the cup by disengageable means such as the several attachment clips 9. The clips are fixed to flange 10 which extends laterally from the rim of the cup and engage flange 11 of the closure plate. The attachment clips should be strong enough to hold the closure plate to the igniter cup against ordinary handling forces but sufficiently weak to give and allow the closure plate to be expelled under explosive force from the igniter charge when the plate is not in fixed engagement as will subsequently be described. The rupturable base of the igniter cup should be engineered to certainly withstand higher pressures than the attachment clips so that the latter can yield before the cup bottom can rupture.

The igniter cup is provided with an annular groove 12 which is contiguously aligned with a similarly shaped groove 13 in the closure plate. The split or C-shaped retaining or locking ring 14, in the normal or safe position, is inherently contracted so as to be within the closure

plate groove 13 as shown in Figures 1 and 2. When in this position, the locking ring does not engage the igniter cup and, therefore, does not interfere with movement of the plate relative to the igniter cup. Should the igniter charge accidentally explode, the pressure of the combustion gases overcomes the resistance of the disengageable holding means or attachment clips and ejects the closure plate rearwardly. The hot combustion products of the burning igniter charge vent rearwardly away from the propellent charge, leaving the bottom 5 intact and thus prevent discharge of the burning igniter charge into the combustion chamber and firing of the rocket or other device.

To fixedly engage the closure plate with the igniter cup, the locking ring is expanded into the annular igniter cup groove so that it overlaps grooves 12 and 13 by means of a slidable member or arming rod 15 provided with cammed surface 16, which engage the free ends of the locking ring as shown in Figure 3. The closure plate is thus locked into place and in this armed position, firing of the igniter will cause rupture of the base and release of the burning igniter charge into the combustion chamber resulting in initiation of combustion in the rocket or other device being actuated. To prevent combustion gas leakage, a seal can be provided between the closure plate and igniter cup, such as the O-ring seal 17 shown in Figure 2.

The arming rod is disposed within radial slot 18 of complementary cross sectional shape, formed in the closure plate, and in registering slot 19 formed in the flanged rim of the igniter cup. The arming rod thus acts as an additional member holding the closure plate to the igniter cup. To provide for expulsion of the closure plate in the event of accidental ignition while in the safety position, the arming rod can be made of narrow cross-section in the dimensions perpendicular to the closure plate as shown and provided with a line of weakness 44 coincident with the plane of the interface of the closure plate and igniter cup so that it will yield and break outward under pressure.

The drawings illustrate two modifications of impact-actuated igniters. Figures 1–4 show an igniter in which the impact means is mechanically actuated, as by a trigger and hammer mechanism. Figures 5–9 show an igniter in which the impact means is fluid pressure actuated as, for example, by a liquid or compressed air. In both cases, I have provided a safety feature which comprises interposing the arming rod between the impact means and the primer or squib so that the firing pin cannot strike, and thereby explode the primer cap and fire the igniter. When the arming rod is shifted into armed position, namely when it expands the retaining ring into locking engagement between the closure plate and igniter cup, it is simultaneously removed from its impact-interrupting position and the igniter is in readiness for firing.

Referring again to Figures 1–4, ignition of the black powder charge is initiated by impact detonation of primer or percussion cap 20. The primer, which comprises a highly sensitive detonating compound such as fulminate, can be associated with a booster charge such as tetryl. Firing is accomplished by forcible impact of the firing pin 21 on the primer. Striking of the primer cap by the firing pin is accomplished by impact means 22, which in this case is a mechanically driven bolt.

In safety position, as shown in Figure 2, the arming rod 15 is interposed between the impact means or bolt and the firing pin and primer cap so that the applied force cannot be transmitted to the primer.

To bring the igniter into firing readiness, the slidable arming rod is shifted so that an aperture 23 in the arming rod is brought into alignment with the bolt and firing pin and the striking force of the impact means is transmitted therethrough. To transmit the impact force, a loosely fitting plug 24 can be inserted into the arming rod aperture, forming in effect another member in the line of force transmission. In armed position, this plug abuts plate 25 attached to the firing pin. Compression spring 26 maintains the firing pin in spaced position from the primer cap prior to firing.

When the igniter is fired, the bolt, which can be mechanically actuated by any suitable means, strikes the plug, which in turn transmits the impact force to the plate attached to the base of the firing pin. The spring is compressed and the firing pin strikes the primer cap which detonates and sets off the ignition sequence.

When the arming rod is in the position shown in Figure 4, in which it permits transmittal of impact force from the impact means through the firing pin to the primer, its lower portion is in the position, shown in Figure 3, in which the cammed faces 16 have expanded the locking ring into locked position with respect to the closure plate and flanged rim of the igniter cup, preventing expulsion of the closure plate and compelling the rupture of the igniter cup bottom and resultant release of the burning igniter charge into the combustion chamber, thus initiating combustion of the propellent in the in the combustion chamber in which the igniter is seated.

In the modification shown in Figures 5–9, the impact means is piston 27 positioned within an axial bore 28 in the closure plate. The piston is actuated by a fluid medium under pressure. A portion of hose or pipe 29 providing the compression fluid, such as compressed air, is shown in Figure 6. Disposed within the hollow piston 27, is a cup-shaped element 30 having an outwardly turned rim or annular flange 31. The cup flange abuts against inwardly turned flange 32 of the piston. Firing pins 33 are adjacent to the bottom of the cup 30 and extend into bores 34 in immovably seated block 35. The firing pins are maintained in fixed, pre-firing position spaced from the primer or percussion caps 36, which are seated within the block bores, by shear nibs 37 attached to the firing pins. The face of the block adjacent the piston is recessed at its periphery thereby providing an annular rabbet 38 between the block and piston as shown in Figures 6 and 9. The boss 42 which is the central part of the block 35 defined by the rabbet 38 is non-circular, being flattened on opposite sides as indicated by reference character 43 in Figure 7 in planes parallel to the sides of the arming rod 115. The latter is formed at its inner end with a yoke 39 which slidably embraces the flattened sides of the boss 42.

In the safety position, as shown in Figures 5, 6 and 7, the yoke end 39 of arming rod 115 extends into rabbet 38. The arming rod is thus interposed between the piston and the block containing the primer caps, preventing the piston from descending any substantial distance into the rabbet. Pressure exerted on the piston cannot be transmitted to the firing pins which are thereby maintained out of impact contact with the primer caps.

To place the igniter in firing readiness, the arming rod is slidably disengaged from its position between the piston and block as shown in Figures 8 and 9. The piston is thus free to move down into rabbet 38 when fluid pressure is applied. As the piston is pushed under pressure into rabbet 38, spring 40 is compressed against flange 31 of the cup-shaped element 30 thereby exerting force on the cup flange. This, in turn, exerts a force on the firing pins and shear nibs 37 but movement of the firing pins is prevented by bearing of the shear nibs on block 35. When the force on the shear nibs becomes sufficient to cause their physical failure, the shear nibs rupture, freeing the firing pins which, driven by the spring force, strike and detonate the primer caps, thereby initiating ignition. Since shifting of the arming rod out of the safety position shown in Figure 9 simultaneously expands the locking ring, locking the closure plate to the igniter cup, the explosion pressure within the igniter receptacle causes

rupture of the base and release of the burning igniter charge into the combustion chamber resulting in initiation of combustion of the propellant.

The movement of the arming rod from safe to armed position can be achieved by any suitable means such as by a handle 41, which can be manually operated, or by means not shown, for example, lanyard, lever, gear, screw and crank, hydraulic piston and the like.

It will be understood that although the illustrative examples described above and in the drawings show both safety features of my invention in combination, this does not necessarily delineate the scope of the invention. My novel closure plate "blow-off" device can be employed alone with igniters actuated in any desired manner, including igniters fired by electrical squib as well as those actuated by impact. In such case the arming rod retains solely the function of operating the locking ring.

I claim:

1. An igniter comprising a cup containing an igniter charge adapted to be inserted into the opening in the wall of a chamber containing a combustible charge, said cup having its mouth facing outwardly with respect to said chamber and having an inner wall rupturable under pressure exerted by combustion products of the igniter charge, a plate adapted to be inserted into the mouth of the cup forming a closure therefor, means for disengageably securing the plate to the cup, said securing means being yieldable to pressure exerted by combustion products of the igniter charge whereby the closure plate can be ejected outwardly, said securing means being yieldable to release said ejectable closure plate at pressures lower than that required to burst said rupturable wall, said cup and said closure plate being provided with oppositely positioned contiguous annular grooves, a split locking ring normally contained within the groove of the closure plate, and slidable means for expanding said locking ring into overlapping relationship between said contiguous grooves whereby said closure plate and said cup become fixedly engaged.

2. The igniter of claim 1 in which the slidable means has a portion provided with cam faces positioned to expand the locking ring.

3. An igniter comprising a cup containing an igniter charge adapted to be inserted into the opening in the wall of a chamber containing a combustible charge, said cup having its mouth facing outwardly with respect to said chamber and having an inner wall rupturable under pressure exerted by combustion products of the igniter charge, a plate adapted to be inserted into the mouth of the cup forming a closure therefor, means for disengageably securing the plate to the cup, said securing means being yieldable to pressure exerted by combustion products of the igniter charge whereby the closure plate can be ejected outwardly, said securing means being yieldable to release said ejectable closure plate at pressures lower than that required to burst said rupturable wall, said cup and said closure plate being provided with oppositely positioned contiguous annular grooves, a split locking ring normally contained within the groove of the closure plate, slidable means for expanding said locking ring into overlapping relationship between said contiguous grooves whereby said closure plate and said cup become fixedly engaged, igniter means for igniting said igniter charge and impact means for actuating said igniter means, said slidable means being interposed between said impact means and said igniter means in such manner that transmission of impact force to the igniter means is prevented when the slidable means is out of expansion engagement with the locking ring, whereby accidental impact actuation of the igniter means is prevented.

4. The igniter of claim 3 in which the slidable means has a portion provided with cam faces positioned to expand the locking ring.

5. An igniter comprising a cup containing an igniter charge adapted to be inserted into the opening in the wall

of a chamber containing a combustible charge, said cup having its mouth facing outwardly with respect to said chamber and having an inner wall rupturable under pressure exerted by combustion products of the igniter charge, a plate adapted to be inserted into the mouth of the cup forming a closure therefor, means for disengageably securing the plate to the cup, said securing means being yieldable to pressure exerted by combustion products of the igniter charge whereby the closure plate can be ejected outwardly, said securing means being yieldable to release said ejectable closure plate at pressures lower than that required to burst said rupturable wall, said cup and said closure plate being provided with oppositely positioned contiguous annular grooves, a split locking ring normally contained within the groove of the closure plate, said closure plate having a bore therethrough communicating with the interior of said igniter and having a radial guideway intersecting said bore, and in sequence a firing pin spring biased out of contact with said primer and means within said bore for transmitting impact force to said firing pin, a slidable member operating in said guideway having an aperture therethrough adjacent its inner end, a plug loosely held in said aperture adapted to be moved by said slidable member into force transmitting alignment with said impact force transmitting means and said firing pin, said slidable member having a portion provided with cam faces positioned to expand said locking ring when said plug is moved into force transmitting alignment, and to permit said ring to contract when said slidable means moves out of force transmitting alignment.

6. An igniter comprising a cup for an ignition charge adapted to be inserted into the opening in the wall of a chamber containing a combustible charge, said cup having its mouth facing outwardly with respect to said chamber and having a wall common to said chamber rupturable under pressure exerted by combustion products of the ignition charge, a closure plate insertible fittably into the mouth of said cup, means for disengageably securing the closure plate to the cup, yieldable to said pressure to release said closure plate whereby it can be ejected by said pressure, the pressure at which said disengaging means yields being lower than that required to burst said rupturable wall, said cup and closure plate having registering peripheral grooves, a split locking ring normally wholly contained within the groove of said closure plate, the latter having a bore therethrough communicating with the interior of said cup, a firing unit within said bore comprising a primer block having an annular rabbet about its outer end defining a boss of less diameter than said bore, a counter bore through said block opening in the outer end of said boss, a primer within said counter-bore adjacent its inner end, a spring cage slidably seated within said bore comprising an outer shell with an in-turned flange at its inner end, and an inner shell with an out-turned flange at its inner end freely seating against said in-turned flange, said inner shell being dished to telescope over said boss, a firing pin adjacent to the dished end of said inner shell and extending within said outer bore into operative proximity to said primer, a spring retained between said shells, reacting against the end of the outer shell and the flange of the inner shell, fluid pressure means communicating with said bore at its outer end, for moving said outer shell to compress said spring, a shear-nib attached to said firing pin for immobilizing said inner shell and firing pin until said spring has acquired a potential force determined by said shear nib, to cause said firing pin to deliver an impact blow to said primer upon failure of said shear nib, said closure plate having a guideway communicating with said bore in the zone of said rabbet perpendicular to said bore and opening laterally to the outside of said closure plate, an arming rod slidable in said guideway having furcations at its inner end adapted to embrace said boss and obstructing said rabbet to the exclusion of said inner shell, when at its inner limit

position, preventing force transmission to said shear nib, said arming rod being provided with a cam engageable with the ends of said locking ring to hold it spread in locking relation to both grooves when said arming rod is in its outer limit position.

7. An igniter adapted to be inserted in the opening in the wall of a combustion chamber containing a combustible charge, said igniter comprising a unitary receptacle the wall structure of which is constructed to enclose an igniter charge, said wall structure including two walls constructed to release responsive to pressure of the igniter charge combustion products, one of said walls releasing at lower pressure than the other, the wall that releases at higher pressure being between the igniter charge and said combustion chamber when said igniter is in inserted position, locking means, operative at will, for locking against release that wall which responds to lower pressure and igniter means for igniting said igniter charge.

8. An igniter adapted to be inserted in the opening in the wall of a combustion chamber containing a combustible charge, said igniter comprising a unitary receptacle the wall structure of which is constructed to enclose an igniter charge, said wall structure including a rupturable wall and an ejectable wall, both subject to igniter charge combustion product pressure, said rupturable wall being conditioned to burst at a higher pressure than that required to release said ejectable wall, the rupturable wall being between the igniter charge and said combustion chamber when said igniter is in inserted position, means for securing said ejectable wall to said receptacle, said securing means being yieldable at pressure lower than that required to burst said rupturable wall, and locking means, operative at will, for locking said ejectable wall against release.

9. An igniter adapted to be inserted into the opening in the wall of a combustion chamber containing a combustible charge, said igniter comprising a receptacle for an igniter charge, said receptacle having two walls constructed to release under pressure from the igniter charge combustion products, one of said walls releasing at lower pressure than the other, the wall that releases at higher pressure being adjacent the combustible charge when said igniter is positioned in said combustion chamber, locking means, operative at will, for locking against release that wall which responds to lower pressure, igniter means for igniting said igniter charge, and impact means for actuating said igniter means, said locking means being interposed between said impact means and said igniter means in such manner that transmission of impact force to the igniter means is prevented when said locking means is out of locking engagement with the wall which responds to lower pressure, whereby accidental impact actuation of the igniter means is prevented.

10. An igniter adapted to be inserted into the opening in the wall of a combustion chamber containing a combustible charge, said igniter comprising a receptacle for an igniter charge and having a rupturable wall and an ejectable wall, both subject to igniter charge combustion product pressure within the receptacle, the rupturable wall being adjacent the combustible charge when said igniter is positioned in said combustion chamber, means for securing said ejectable wall to said receptacle, said securing means being yieldable to release said ejectable wall at pressures lower than that required to burst said rupturable wall, means for locking said ejectable wall against release at pressures higher than that required to burst said rupturable wall, igniter means for igniting said igniter charge, and impact means for actuating said igniter means, said locking means being interposed between said impact means and said igniter means in such manner that transmission of impact force to the igniter means is prevented when said locking means is out of locking engagement with said ejectable wall, whereby accidental impact actuation of the igniter means is prevented.

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