Dec. 17, 1963 E. M. HARVEY ETAL 3,114,290

BREECH SEALING MEANS FOR AUTOMATIC FIREARMS ADAPTED TO FIRE CASELESS AMMUNITION

Filed Oct. 12, 1962 3 Sheets-Sheet 1

Fig. 1

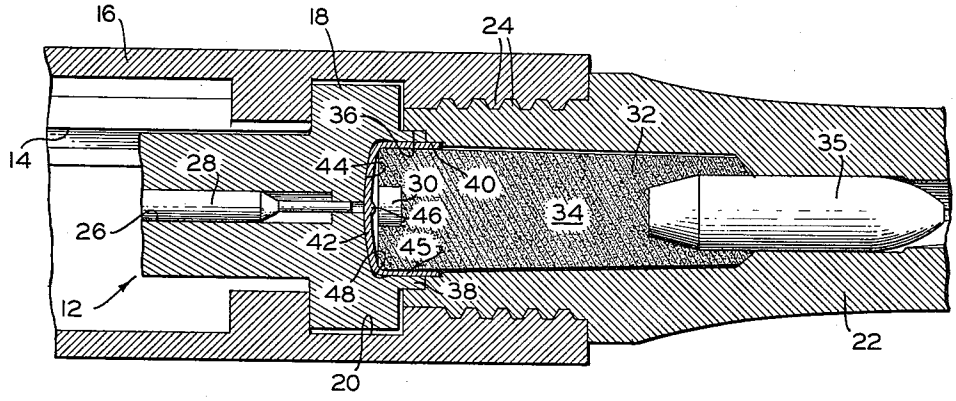


Fig. 2

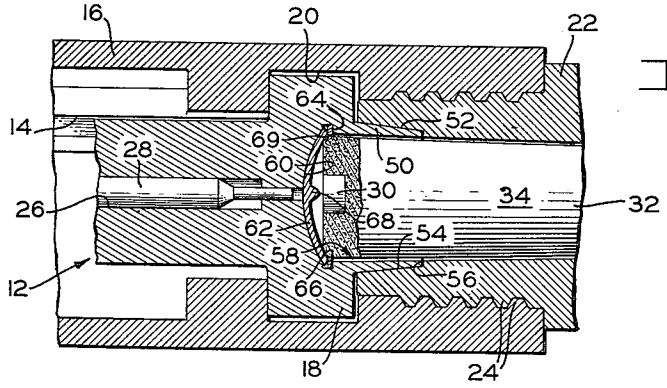
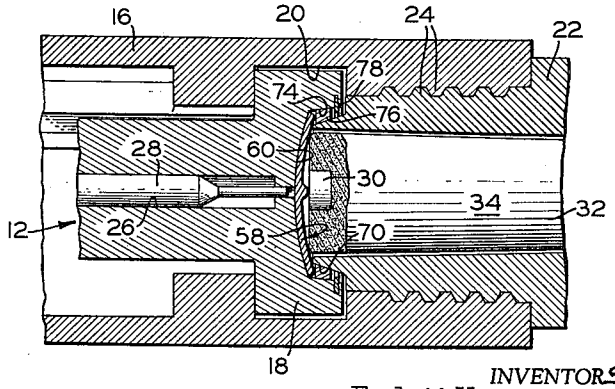


Fig. 3



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Fig. 4

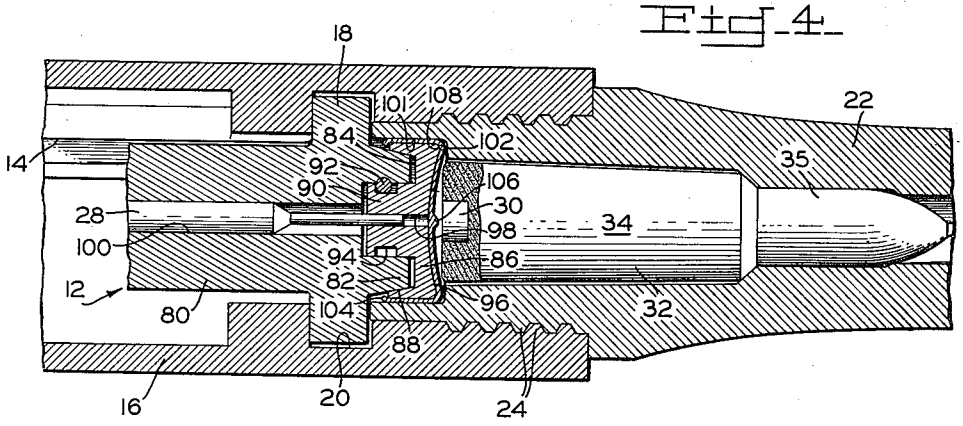


Fig. 5

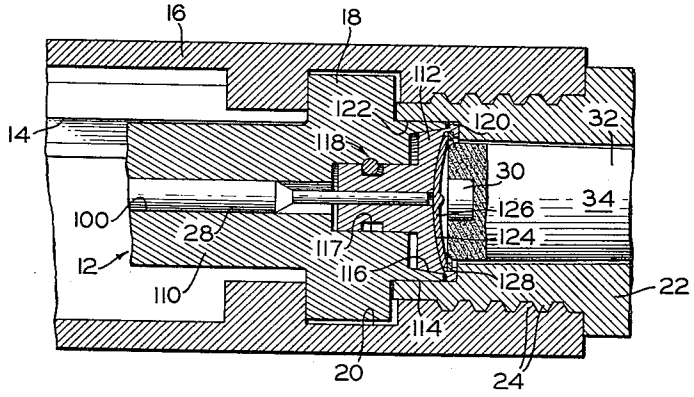
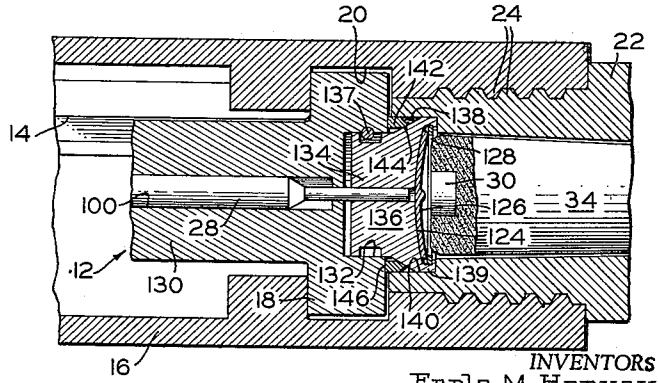


Fig. 6



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BREECH SEALING MEANS FOR AUTOMATIC FIREARMS ADAPTED TO FIRE CASELESS AMMUNITION

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Fig. 7

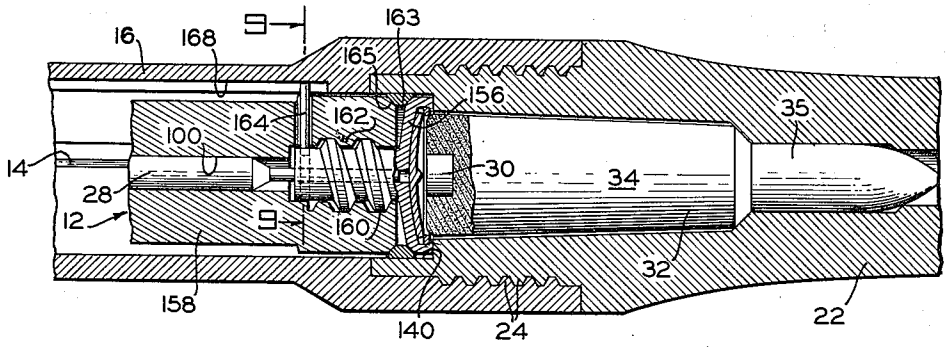
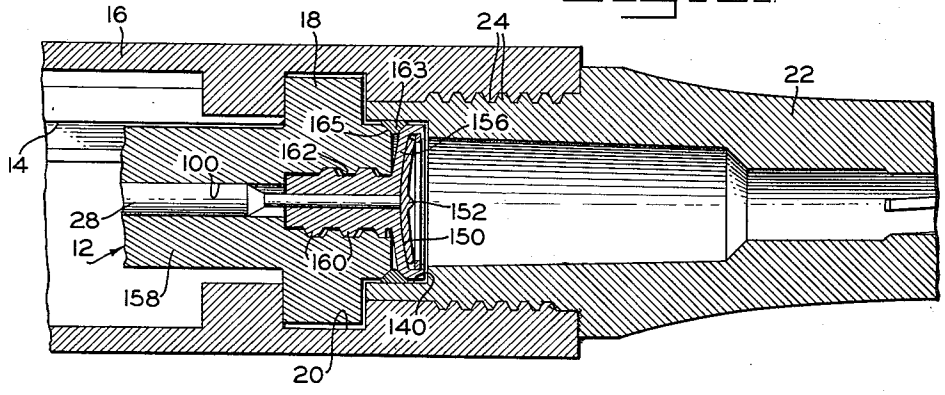


Fig. 8



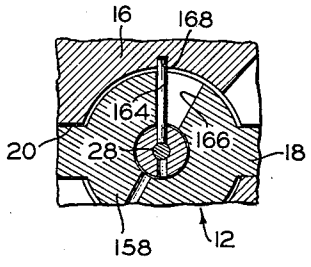


Fig. 9

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BREECH SEALING MEANS FOR AUTOMATIC FIREARMS ADAPTED TO FIRE CASELESS AMMUNITION

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16 Claims. (Cl. 89—26)
(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 bolt-operated automatic firearms adapted to fire caseless cartridges and is more particularly directed to means for obturating the interface of the barrel and bolt against the passage of the combustion gases produced by the firing of the cartridge.

In conventional ammunition of the type utilized in automatic firearms having a reciprocating bolt and a percussion type firing pin carried in the bolt, the propellant charge is contained in a resilient metal case shaped to fit the length and contour of the firing chamber in the barrel. When the cartridge is fired, the case is expanded into obturating or gas sealing contact with the walls of the firing chamber until the pressure therein is drastically reduced subsequent to the exit of the projectile from the barrel. Thereupon, the resulting contraction of the fired cartridge case permits the withdrawal thereof from the firing chamber by suitable extractor mechanism secured to the forward end of the recoiling bolt.

While this type of ammunition satisfies current military requirements, firearm designers have long recognized that, if the metallic case could be eliminated as a component of a complete cartridge, the resulting substantial reduction in weight thereof could provide an appreciable increase in the cyclic rate of the firearm. Moreover, the utilization of caseless cartridges would also permit the elimination of the extractor and ejector structures normally required to dispose of spent cartridge cases thereby enhancing the rate of fire through the consequent decrease in the weight of the recoiling bolt. Another advantage inherent in the use of caseless cartridges is the elimination of any need for utilizing critical space in tanks and aircraft for the storage of spent cartridge cases. Furthermore, the ability to provide a complete round of ammunition without the necessity for the conventional brass case would obviously reduce the supply requirements for this expensive and increasingly critical material.

The possibility of obtaining the foregoing advantages in percussion fired military firearms has recently led to the development of a cartridge which meets the ballistic requirements of conventional ammunition even though the propellant charge and the primer are incorporated into a self-contained unit which is completely consumed during firing. However, while the feasibility of such combustible ammunition has been clearly demonstrated by the firing of single cartridges, the prior art has not as yet been able to utilize this improvement in semiautomatic or fully automatic firearms due to the problems involved in successfully obturating the breech against the escape of the combustion gases generated by the firing of the cartridges.

Accordingly, it is an object of this invention to provide positive obturation of the breech in an automatic firearm of the type wherein percussion firing is utilized to discharge caseless ammunition.

It is a further object of the present invention to provide a flexible member for a firearm of the aforesaid type which can be secured to the front end of a reciprocal bolt to positively obturate the firing pin hole therein.

Still another object of this invention is to provide a flexible member of the aforesaid type which will also transfer the impact of a forwardly moving firing pin to the primer in the rear end of a caseless cartridge for ignition thereof.

Another object of this invention is to provide a two-part bolt wherein relative movement between the parts during the locking and firing cycle of the firearm is utilized to compress a resilient ring therebetween to obturate the interface between the barrel and the bolt.

A specific object of this invention is to provide an improved breech structure for a firearm adapted for the firing of caseless cartridges wherein the inteface between the rear end of the barrel and the front end of a two-part bolt is completely obturated by the combination of resilient means between the two parts of the bolt and a flexible member retained in the front part of the bolt to seal the firing pin hole therein.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

FIG. 1 is a sectional plan view of the breech end of a bolt-operated firearm showing a single obturating member for completely sealing the breech end of a firing chamber against the escape of the combustion gases generated by the discharge of a caseless cartridge;

FIG. 2 is a similar sectional view showing another form of obturating member specifically designed to seal the firing pin hole in a firearm bolt while the interface between the bolt and barrel is being sealed against the passage of combustion gases by an extension on the face of the bolt;

FIG. 3 is a view corresponding to FIG. 2 but showing a firearm structure in which obturation at the interface between the bolt and the barrel is effected by a flexible ring disposed between angular surfaces on the breech end of the barrel and on the front end of the bolt while obturation of the firing pin hole is simultaneously effected by a flexible diaphragm mounted in the face of the bolt;

FIG. 4 is a section of the breech end of an automatic firearm showing another form of a single obturating member specifically designed for retention by the bolt head portion of a two-part bolt;

FIG. 5 is a view similar to FIG. 4 but showing a separate obturating member in the breech designed to supplement the obturation achieved through mating angular surfaces on a bolt body and a bolt head;

FIG. 6 is a view similar to that of FIG. 5 but showing a structure wherein the obturation between the bolt body and bolt head is achieved by a separate sealing ring therebetween;

FIG. 7 is a sectional elevational view showing an alternate two-part bolt structure wherein the obturation of a resilient ring in simultaneous engagement with the breech end of the barrel and the adjacent surfaces on both parts of the bolt is controlled by the threaded engagement between the bolt parts which are shown in the positions assumed immediately prior to the firing of the caseless cartridge;

FIG. 8 is a sectional plan view showing the relative positions of the bolt body and bolt head in FIG. 7 subsequent to the firing of the caseless cartridge; and

FIG. 9 is a fragmentary sectional view taken along line 9—9 in FIG. 7 to show the structure which prevents rotation of the bolt head during the locking and unlocking rotation of the bolt body.

In accordance with the teachings of the present invention, it has been found that the gases generated by the firing of a combustible caseless cartridge may be effec-

tively sealed or obturated, as referred to hereinafter, against entry into the interface between the bolt and the breech end of the barrel by a cup of resilient metal surrounding the rear end of the cartridge and extending forwardly beyond such interface in intimate contact with the walls of the firing chamber in the barrel or with the walls of a counterbore in the barrel disposed rearwardly of the firing chamber. The base of the cup is flexibly formed and is interiorly provided with an integral protuberance adapted to ignite the primer in the rear end of the cartridge when forced forwardly under the impact of a slidable firing pin in the bolt. The cup is retained in a recess in the face of the bolt for movement therewith during recoil and counter-recoil. In the event the junction between the bolt and the breech end of the barrel is effectively obturated by angular mating surfaces therebetween, the obturation of the firing pin hole in the bolt may be accomplished by a flexible diaphragm retained in a suitable recess in the front end thereof. The obturation of this flexible diaphragm may also be supplemented by the utilization of a two-part bolt having a wedging or threaded engagement between the two parts.

As shown in the drawings, the obturation structures of the present invention are particularly adapted, but not necessarily limited, to those automatic or semiautomatic firearms in which a bolt 12 is reciprocably mounted in suitable longitudinal ways 14 in a receiver 16 and is provided with oppositely disposed locking lugs 18 at the forward end thereof for engagement with correspondingly formed locking recesses 20 in receiver 16 disposed rearwardly of the breech end of a barrel 22 threadably mounted in the forward end of receiver 16 as shown at 24. Bolt 12 includes a central hole 26 therethrough for the slidable passage of a firing pin 28 arranged to ignite a combustible primer 30 in the rear end of a suitable granular propellant charge 32 molded into a self-contained cartridge 34 having a configuration similar to that of the brass case normally utilized in conventional ammunition. The forward end of propellant charge 32 is molded about the base of a conventional bullet 35.

As illustrated in FIG. 1, the breech end of barrel 22 is counterbored at 36 to slidably receive a corresponding cylindrical extension 38 on the face of bolt 12. Counterbore 36 is forwardly extended in barrel 22, as indicated at 40, but at a reduced diameter and to a lesser extent to receive the forward end of an obturating cup 42 preferably fabricated of a resilient metal, such as brass, and seated against an arcuate end wall 44 of a recess 45 centrally formed into the face of bolt 12. Cup 42 is formed with an arcuate base of slightly lesser curvature than that of end wall 44 and is tightly fitted into recess 45 to ensure retention thereof during the recoil and counterrecoil movements of bolt 12. The base of cup 42 is centrally provided with a protuberance 46 which serves as a striker for igniting primer 30 upon impact therewith and is normally spaced out of contact therewith to permit the usual feeding and chambering movements of cartridge 34. During the chambering of cartridge 34, the entry of bolt extension 38 into barrel counterbore 36 serves to properly align the walls of cup 42 for a smooth entry into barrel counterbore 40 despite the tolerances which customarily exist between bolt 12 and receiver 16. When bolt extension 38 contacts the shoulder formed by barrel counterbore 36, the forward edge of cup 42 will be spaced from the bottom of the forwardly disposed counterbore 40 to avoid interference with the locking of bolt 12 in battery position.

When firing pin 28 is driven forwardly by suitable means, such as a hammer (not shown), the flexible nature of the base of obturating cup 42 permits striker 46 thereon to be forced forwardly into primer 30 for detonation of the propellant charge 32 in the same manner as conventional cartridges with separate metallic cases. In order to permit this forward flexure of the base of obturating cup 42, bolt 12 is relieved by an annular shallow

groove 48 at the base of recess 45. As the pressure in the firing chamber increases, the side walls of cup 42 are forced into tight contact with the mating wall surfaces in barrel counterbore 40 and in bolt recess 45. At the same time, the base of cup 42 is forced into tight contact with arcuate end wall 44 in bolt recess 45 to complete the obturation of the interface between the locked bolt 12 and the breech of barrel 22. As the pressure in the firing chamber is reduced, the resulting contraction of obturating cup 42 out of engagement with the interior of barrel 22 frees bolt 12 for subsequent recoil movement. Retention of cup 42 in bolt recess 45 is effected by the press-fitted engagement therebetween as well as by the slight interference afforded by the metal which has been extruded into shallow groove 48.

In FIG. 2 there is shown a firearm breech structure in which bolt 12 is provided with a forwardly extending hollow cylindrical portion 50. The exterior surface of portion 50 is forwardly sloped, as indicated at 52 to mate with a correspondingly sloped surface 54 within a counterbore 56 in the breech end of barrel 22. The hollow interior of bolt extension 50 is continued rearwardly into the face of bolt 12 to form a recess 58 for accommodating the primer end of propellant charge 32. As indicated at 60, the end wall of recess 58 is dished to receive a flexible arcuately formed diaphragm 62 held in place by an annular retaining washer 64 inserted into a corresponding groove 66 in the walls of bolt recess 58 immediately forward of the arcuate end wall 60 thereof. Although diaphragm 62 may be formed of any flexible material, it has been found that brass will produce the best results. The front face of diaphragm 62 is formed with a central protuberance 68 for igniting primer 30 when forced forwardly into contact therewith by slidable firing pin 28. The normal curvature of diaphragm 62 keeps protuberance 68 out of contact with primer 30 during the forward chambering movement of cartridge 34. If a closer fit is desired between the rear end of cartridge 34 and flexible diaphragm 62, the base of the cartridge may be beveled as shown at 69.

Thus, when caseless cartridge 34 is fired, the side walls of hollow bolt extension 50 are forced into obturating contact with the oppositely sloped wall surface 54 of counterbore 56 in barrel 22. At the same time, diaphragm 62 is forced rearwardly into full mating contact with arcuate end wall 60 of bolt recess 58 to prevent any passage of the combustion gases into firing pin hole 26. It is, therefore, readily apparent that the combination of bolt extension 50 and flexible diaphragm 62 effectively seals the interface of barrel 22 and bolt 12 against the escape of combustion gases without undesirable interference in the normal locking and recoiling functions of bolt 12.

In FIG. 3, there is shown a breech structure containing a flexible diaphragm 62 similar in configuration and function to the one illustrated in FIG. 2. However, in this structure, it is no longer necessary for a portion of bolt 12 to project into the critical firing chamber area in barrel 22. Instead, the exterior of barrel 22 is rearwardly beveled, as shown at 70, and the interior of cylindrical recess 58 in the face of bolt 12 is forwardly sloped as indicated at 74, but not to the same degree as bevel 70 on barrel 22. However, the diameter of bolt recess 58 is sufficiently enlarged over that of the beveled rear end of barrel 22 to accommodate a resilient obturating ring 76 therebetween, of brass or other suitable material, which is secured therein by a retaining washer 78 equivalent to washer 64 in FIG. 2. The inner and outer peripheries of ring 76 are planar in configuration and are parallel to one another. Such construction facilitates the contact between ring 76 and the respective angular surfaces on bolt 12 and barrel 22 and also provides a mechanical advantage therebetween which ensures the required compressive force on ring 76.

During the forward movement of bolt 12 into battery

position, the planar surfaces of ring 76 are physically compressed by the converging angular surfaces on bolt 12 and barrel 22. Upon the firing of caseless cartridge 34, ring 76 is further compressed by the combustion gases directed against the rear face thereof and, consequently, provides the necessary obturation of the interface between bolt 12 and barrel 22. At the same time, the obturation of firing pin hole 26 is obtained by the flexure of diaphragm 62 into contact with end wall 60 of bolt recess 58.

While single bolts can generally be adequately obturated by the structures described above, it has been found that the necessary tolerances inherent in the manufacture of bolt 12 and receiver 16 frequently render it impossible to obtain the required tight contact at the interface between bolt 12 and barrel 22. However, the adverse effect of these tolerances can be virtually eliminated by the utilization of a two-part bolt wherein the head portion thereof is suitably secured to the body to permit relative limited longitudinal movement of the latter when the head portion is halted in battery position.

One such bolt assembly is illustrated in FIG. 4 wherein the body 80 thereof is formed with a hollow cylindrical extension 82 projecting forwardly of locking lugs 18 thereon to slidably engage in a corresponding annular recess 84 formed into the rear end of a cylindrical bolt head 86. The exterior periphery of extension 82 is forwardly sloped, as indicated at 88, to mate with the oppositely sloped outer wall surface in annular recess 84. At the same time, the cylindrical core 90 formed by annular recess 84 projects into the interior of hollow extension 82. The slidable engagement between bolt head 86 and bolt body 80 is limited in the longitudinal direction by a key 92, or other suitable retaining member, projecting from the interior wall surface of hollow extension 82 and engageable in a circumferential groove 94 of greater width formed in core 90. The front face of bolt head 86 is dished, as shown at 96, and is centrally pierced by a firing pin hole 98 in axial alignment with a larger diameter firing pin hole 100 in bolt body 80.

The breech end of barrel 22 is counterbored, as shown at 101, to a slightly larger diameter than the exterior diameter of bolt head 86 to accommodate a flexible cup 102 therebetween. The base of cup 102 is arcuately contoured to fit against the dished face of bolt head 86 while the walls of cup 102 extend rearwardly in intimate contact with the exterior periphery of bolt head 86. In order to ensure retention of cup 102 on bolt head 86 during recoil movement of bolt body 80, the rear edge of cup 102 is formed with diametrically opposed tabs 104 which are inwardly turned to engage with the rear edge of bolt head 86.

As bolt body 80 is rotated into locked battery position, bolt head 86 advances cup 102 into contact with the forward end wall of barrel counterbore 101. Thereupon, the final movement of bolt body 80 into locked battery position advances the forwardly sloped periphery of hollow extension 82 into wedging contact with the corresponding wall surface in bolt head annular recess 84. This wedging engagement between bolt body 80 and stationary bolt head 86 serves to compensate for any variation in the tolerances therebetween and between bolt body 80 and receiver 16. Thereupon, the forward movement imparted by firing pin 28 to the base of flexible cup 102 advances a central protuberance 106 thereon into firing contact with primer 30 in caseless cartridge 34. In order to provide for this flexure of the base of cup 102, the junction of the forward end wall and side walls in barrel counterbore 101 is suitably grooved as best shown at 108.

In FIG. 5 there is shown an alternate version of a two-part bolt consisting of a bolt body 110 and a bolt head 112. The front end of bolt body 110 is formed with a forwardly projecting hollow extension 114 having a forwardly and outwardly sloped interior 116 communicating with a rearwardly extending central bore 117. The rear end of bolt head 112 is cylindrically formed to slidably fit into bolt body bore 117 while the front end of bolt head 112 is suitably enlarged and sloped to fit into hollow extension 114. Bolt head 112 is retained for limited longitudinal movement therein by key and groove means 118 similar to the structure illustrated in FIG. 4. The forward end of bolt head 112 is formed with an outwardly turned flange 120 extending in front of bolt body extension 114 into slidable contact with the side walls of a counterbore 122 in the breech end of barrel 22. If considered desirable, the exterior periphery of bolt body extension 114 and the side walls of barrel counterbore 122 may be forwardly tapered to a slight extent to provide for an unobstructed entry of bolt head 112 into counterbore 122. The front face of bolt head 112 is formed with a dished recess, as shown at 124, to form a seat for a flexible arcuate diaphragm 126 which is retained in place by an annular washer 128 in substantially the same manner as that described in connection with the structure of FIG. 2.

As bolt body 110 is rotated into locked battery position, the forward movement thereof relative to the stationary bolt head 112 will press bolt head flange 120 tightly against the breech face of barrel 22 and at the same time will provide a wedging action which forces the exterior periphery of bolt body extension 114 into tight engagement with the side walls of barrel counterbore 122. Thus, when caseless cartridge 34 is fired in the manner previously described, the pressure of the expanding combustion gases forces diaphragm 126 back into obturating engagement with the face of bolt head 112. At the same time, the slight setback of bolt head 112, as the locking tolerances are taken up, forces the exterior periphery of bolt body extension 114 into even tighter obturating engagement in barrel counterbore 122.

Another means for obturating the firing chamber in which a caseless cartridge 34 is arranged to be fired by a longitudinally slidable firing pin 28 carried in a two-part bolt assembly is shown in FIG. 6. In this structure the front end of a bolt body 130 is provided with a central cylindrical recess 132 adapted to slidably receive a corresponding cylindrical portion 134 extending from the rear end of a bolt head 136. Suitable key means 137 is provided to limit the longitudinal movement of bolt head 136 relative to bolt body 130. Bolt head 136 is angularly enlarged, as shown at 138, to form a cylindrical front end 139 adapted to fit within a corresponding counterbore 140 in the breech end of barrel 22. In this position, the space between the wall of barrel counterbore 140 and the angular exterior of bolt head 136 is occupied by an obturating ring 142 having a bevel 144 on the front face thereof corresponding to the angular periphery of bolt head 136. The rear face of ring 142 is squared off, as illustrated at 146, to fit against locking lugs 18 on bolt body 130. The front face of bolt head 136 is arcuately recessed, as indicated at 124, in the same manner as that illustrated in FIG. 5 and is similarly provided with diaphragm 126.

As bolt body 130 is rotated into locked battery position, the forward travel of bolt head 136 is terminated upon contact with the forward end of barrel counterbore 140. However, the slidable connection between bolt head 136 and bolt body 130 permits the latter to continue to advance and rotate until contact is made with the breech face of barrel 22. During this locking movement of bolt body 130, ring 142 is compressed against the angular surface 138 on bolt head 136 to expand into obturating contact with the walls of counterbore 140 in barrel 22. When cartridge 34 is discharged by firing pin 28, the pressure of the combustion gases tends to force bolt head 136 rearwardly thereby increasing the obturation function of ring 142. At the same time, flexible diaphragm 126 is forced into tight engagement with the face of bolt head recess 124 to seal the firing pin hole therein.

The foregoing obturation function of ring 142 may be

even further enhanced if the engagement between a bolt head 156 and a bolt body 158 is provided by mating Acme-type threads as shown at 160 and 162, respectively, in FIGS. 7 and 8. Bolt head 156 is threaded into bolt body 158 until both members contact the opposite faces of a sealing ring 163 generally similar to ring 142 but also beveled at the rear farce thereof as indicated at 165. In this position, the engagement between threads 160 and 162 will provide a rearward clearance therebetween as best shown in FIG. 7.

Thus, when the forward travel of bolt head 156 is halted by contact with the front end wall of counterbore 140 in barrel 22, the continuing locking rotation of bolt body 158 results in a camming action between threads 160 and 162 which draws bolt head 156 rearwardly relative to bolt body 158. In order to prevent bolt head 156 from rotating during the locking rotation of bolt body 158, the former is provided with a vertical pin 164 adjacent the rear end thereof which extends through a radial slot 166 in bolt body 158 to project into a longitudinal groove 168 along the interior wall surface of receiver 16. During this slight rearward movement of bolt head 156, ring 163 is correspondingly compresed into obturating engagement with the interior wall surface of barrel counterbore 140. Upon the firing of cartridge 34, the expanding gas pressure forces bolt head 156 rearwardly to the position shown in FIG. 8 to the extent permitted by the existing clearance between threads 160 and 162. As a result, ring 163 is additionally compressed into even tighter contact with barrel counterbore 140 at the very instant when maximum obturation of the interface between bolt 12 and barrel 22 is required. When the gas pressure is reduced to the point at which bolt body 158 begins to unlock, the rotative movement thereof, during such unlocking, forces bolt head 156 forwardly to the extent permitted by the existing clearance between threads 160 and 162 thereby reducing the pressure on ring 163 to permit subsequent unobstructed recoil of the entire bolt assembly.

Thus, there is here provided an effective means for obturating the interface between a barrel and bolt upon the firing of a caseless combustible cartridge. Such obturation may be accomplished by a single cup-shaped member retained by the face of the bolt and interposed between the mating surfaces of the barrel and bolt in battery position. In the event greater obturation is required, this may be accomplished by the utilization of a two-part bolt consisting of a body and a separate head with mating wedge surfaces therebetween to permit the head to set back upon the firing of the caseless cartridge and obturate the interface between the bolt and the barrel. In the instances in which the bolt consists of two parts, the obturation of the firing pin hole in the bolt head is effected by a separate flexible member retained in the front face thereof. In some cases, the obturation between the bolt and the barrel may be supplemented by a separate ring interposed between the two parts of the bolt and in simultaneous contact with the barrel. These novel obturating devices do not interfere with the required percussion discharge of the combustible primer in the rear end of the caseless cartridges.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claims are intended to include such variations.

We claim:

1. In a firearm, a fixed barrel having a firing chamber therein adapted to seat a caseless cartridge with a combustible primer in the rear end thereof, a reciprocal bolt having a recess in the front face thereof for receiving the rear end of the cartridge and having a firing pin hole therethrough in communication with said recess, a flexible diaphragm having an integral striker projecting forwardly therefrom, means for retaining said diaphragm within said recess with said striker normally out of contact with the primer in the cartridge, resilient means encircling the rear end of the cartridge in contact with the interface between said bolt and said barrel, and a firing pin slidably disposed in said bolt for flexing said diaphragm to advance said striker into firing contact with the primer in the cartridge whereby said diaphragm and said resilient means respectively obturate said firing pin hole and said interface between said bolt and said barrel in response to the pressure generated by the combustion gases evolved upon the firing of the cartridge.

2. The combination defined in claim 1 wherein said flexible diaphragm and said resilient means are combined to form a unitary cup.

3. The combination defined in claim 1 wherein said flexible diaphragm is peripherally retained in said recess in the front face of said bolt, and said resilient means comprises a hollow extension projecting from the front end of said bolt and having a forwardly sloped external surface adapted to be forced into obturating contact with a correspondingly sloped surface within said barrel in response to the pressure of the combustion gases.

4. The combination defined in claim 1 wherein said flexible diaphragm is peripherally retained in said recess in the front face of said bolt, and said resilient means comprises a ring disposed between forwardly converging angular surfaces on said bolt and said barrel.

5. In a firearm having a receiver, a barrel fixedly mounted in the receiver and having a firing chamber adapted to seat a caseless cartridge including a combustible primer in the rear end thereof, a bolt slidably disposed in the receiver for reciprocal movement to and from locked battery position, said bolt having a firing pin hole therethrough communicating with an enlarged forwardly opening recess adapted to receive the rear end of the cartridge, a flexible diaphragm peripherally secured in said bolt recess to block said firing pin hole, resilient means projecting from the front face of said bolt into blocking contact with the interface between said barrel and said bolt in the locked battery position thereof, a striker integrally formed on the front face of said diaphragm, and a firing pin slidably disposed in said bolt for flexing said diaphragm to advance said striker into firing contact with the primer in the caseless cartridges whereby the pressure of the combustion gases generated during the firing forces said diaphragm into mating contact with the end wall of said forwardly opening bolt recess to obturate said firing pin hole and simultaneously forces said resilient means against the interior surface of said barrel to obturate the interface between said bolt and said barrel.

6. The combination defined in claim 5 wherein the front face of said bolt is formed with a forwardly extending circular flange surrounding said enlarged recess therein, and the breech face of said barrel is counterbored rearwardly of said firing chamber therein to receive said flange during the forward movement of said bolt into locked battery position for guiding said resilient means into said firing chamber to surround the rear end of the caseless cartridge.

7. The combination defined in claim 5 wherein said flexible diaphragm forms the base of a forwardly opening integral cup, said resilient means forms the sidewalls of said cup, and wherein said enlarged recess in said bolt includes means for retaining said cup against displacement therefrom.

8. The combination defined in claim 5 wherein the forward end of said bolt includes a bolt head and means for slidably limiting longitudinal movement thereof relative to said bolt, said barrel includes a counterbore rearwardly of said firing chamber therein, said flexible diaphragm forms the base of a rearwardly opening integral cup, and said resilient means surrounds said bolt head to form the sidewalls of said cup.

9. The combination defined in claim 5 wherein said resilient means comprises a hollow extension on the front

end of said bolt having a forwardly and outwardly sloped interior surface, a correspondingly sloped bolt head slidably retained in the front end of said bolt for limited longitudinal movement therein whereby the setback movement of said bolt head in response to the pressure of the combustion gases forces the walls of said hollow bolt extension into obturating contact with the interior surface of said barrel.

10. The combination defined in claim 5 wherein the forward end of said bolt is formed with a counterbore, and said bolt includes a bolt head slidably retained in said counterbore for limited longitudinal movement, said bolt head having a forwardly sloped section terminating in an enlarged front end equivalent in diameter to the front end of said bolt, said barrel having a counterbored breech rearwardly of said firing chamber for slidably receiving said enlarged front end of said bolt head, and wherein said resilient means comprises a ring disposed between the front face of said bolt and the sloping surface on said bolt head whereby said ring is adapted to be compressed into obturating contact with the interior surface of said counterbored breech end of said barrel in response to the setback of said bolt head under the pressure generated by the combustion gases.

11. The combination defined in claim 5 wherein the front end of said bolt is counterbored to form an internally threaded opening communicating with said firing pin hole therein, the breech end of said barrel is counterbored rearwardly of said firing chamber therein, said bolt includes a bolt head of equivalent diameter having an exteriorly threaded extension of lesser diameter projecting rearwardly therefrom into mating engagement with the threaded interior of said opening in said bolt, means for preventing rotation of said bolt head during the locking rotation of said bolt, and said resilient means comprises a ring disposed between said bolt and said bolt head and adapted to be compressed into obturating engagement with the interior wall surface of said barrel breech counterbore during the locking of said bolt in battery position, said ring being thereby positioned for further compression during the setback imparted to said bolt head upon the firing of the caseless cartridge as the tolerances between the threads on said bolt and said bolt head are taken up.

12. In a firearm having a fixed barrel terminating in a counterbore at the breech end thereof, a firing chamber in the barrel disposed forwardly of the counterbore and adapted to seat a caseless cartridge having a combustible primer in the rear end thereof, and a bolt disposed for reciprocal movement to and from locked battery position, the combination of, a hollow extension projecting forwardly from the front face of the bolt and having a convergingly sloped exterior, a bolt head having a rearwardly facing annular groove with an angular wedge surface therein adapted for mating engagement with the sloped exterior of said hollow bolt extension, key means in said bolt extension engageable with said bolt head for limiting longitudinal movement thereof relative to the bolt, said bolt head having a dished recess in the front end thereof and a longitudinal firing pin hole in communication with said recess, a rearwardly opening cup of resilient metal fitted over said bolt head for entry into the counterbore at the breech end of the barrel during movement of the bolt into locked battery position, tab means at the rear edge of said cup engageable with the rear end of said bolt head for retention thereof, said cup having an arcuate flexible base and a striker integrally formed on said base to protrude forwardly therefrom, and a firing pin slidably disposed in the bolt and engageable with the rear face of said base to force said striker forwardly into firing engagement with the primer in the caseless cartridge whereby the wedging engagement between said hollow bolt extension and said bolt head during the setback imparted to the latter in response to the pressure of the gases generated by the firing of the cartridge forces said cup into obturating engagement with the interior of the barrel counterbore.

13. In a firearm having a fixed barrel terminating in a counterbore at the breech end thereof, a firing chamber in the barrel disposed forwardly of the counterbore and adapted to seat a caseless cartridge having a combustible primer in the rear end thereof, and a bolt disposed for reciprocal movement to and from locked battery position, the combination of a hollow extension projecting forwardly from the front end of the bolt and having a divergingly sloped interior, a bolt head having an enlarged front end with a sloped exterior surface adapted for wedging engagement in said hollow bolt extension, key means in said bolt extension engageable with said bolt head for limiting longitudinal movement thereof relative to the bolt, said bolt head having a dished front face in communication with a firing pin hole therethrough, a flexible arcuate diaphragm having an integral striker protruding from the front face thereof, washer means for retaining said diaphragm in said dished recess of said bolt head, and a firing pin slidably disposed in the bolt and engageable with the rear face of said diaphragm to force said striker forwardly into firing engagement with the primer in the caseless cartridge whereby the wedging engagement of said bolt head in said hollow extension during the setback imparted to the former in response to the pressure of the gases generated by the firing of the cartridge forces the exterior surface of said hollow bolt extension into obturating engagement with the interior surface of the counterbore in the breech end of the barrel while said diaphragm is being forced against the front face of said bolt head to obturate the firing pin hole therein.

14. In a firearm having a fixed barrel terminating in a counterbore at the breech end thereof, a firing chamber in the barrel disposed forwardly of the counterbore and adapted to seat a caseless cartridge having a combustible primer in the rear end thereof, and a bolt disposed for reciprocal movement to and from locked battery position, the combination of, a bolt head having a cylindrical rear end and an enlarged front end joined by divergingly sloped intermediate section, the bolt having a forwardly opening counterbore in the front end thereof for slidably receiving said cylindrical rear end of said bolt head, key means in said bolt counterbore engageable with said cylindrical rear end of said bolt head for limiting longitudinal movement thereof relative to the bolt, said bolt head having a dished recess in the front end thereof and a firing pin hole therethrough, a flexible arcuate diaphragm having an integral striker protruding from the front face thereof, washer means for retaining said flexible diaphragm in said bolt head recess, a resilient ring having a beveled front face corresponding to the angularity of said sloped exterior of said intermediate section of said bolt head, said ring being seated for simultaneous contact with the front face of the bolt, the interior wall surface of the counterbore in the breech end of the barrel, and said sloped surface on said bolt head, and a firing pin slidably disposed in the bolt and engageable with the rear face of said flexible diaphragm to force said striker forwardly into firing engagement with the primer in the caseless cartridge whereby the setback imparted to said bolt head in response to the pressure of the gases generated by the firing of the cartridge wedges said resilient ring into obturating contact with the interior surface of the counterbore in the breech end of the barrel while said diaphragm is being forced against the front face of said bolt head to obturate said firing pin hole therein.

15. In a firearm having a receiver, a barrel fixedly secured in the receiver and terminating in a counterbore at the breech end thereof, a firing chamber in the barrel disposed forwardly of the counterbore and adapted to seat a caseless cartridge having a combustible primer in the rear end thereof, and a bolt disposed for reciprocal movement to and from locked battery position, the combina-

tion of, a bolt head having an enlarged front end equivalent in diameter to the front end of the bolt and a rearwardly projecting body of lesser diameter formed with a plurality of Acme-type threads about the exterior thereof, said bolt head having a firing pin hole therethrough communicating with a forwardly opening recess in said enlarged front end, a flexible diaphragm having an integral striker protruding from the front face thereof, washer means for retaining said diaphragm within said recess in said bolt head, the bolt having an interiorly threaded opening in the front end thereof for mating engagement with said threaded exterior on said bolt head body, means for preventing rotation of said bolt head relative to the bolt during the rotation of the latter into locked battery position, a ring of resilient material having a beveled front and rear face and disposed between the front face of the bolt and the rear face of said enlarged front end of said bolt head in mating engagement with corresponding bevels thereon whereby the rotation of the bolt into locked battery position threadably retracts said bolt head to precompress said resilient ring into engagement with the interior surface of the counterbore in the breech end of the barrel, and a firing pin slidably disposed in the bolt and engageable with the rear face of said flexible diaphragm to force said striker forwardly into firing engagement with the primer in the caseless cartridge whereby the tolerances in the threaded engagement between the bolt and said bolt head permit the latter to move rearwardly in response to the gases generated by the firing and wedge said precompressed ring into full obturating engagement in the barrel counterbore while said diaphragm is being forced against the face of said forwardly opening recess in said bolt head to obturate said firing pin hole therein, said threaded engagement between the bolt and said bolt head also serving to advance the latter during the unlocking rotation of the bolt to the extent of the existing tolerances to thereby relax the wedging force on said resilient ring and free said bolt head for movement out of battery position.

16. The combination defined in claim 15 wherein said means for preventing rotation of said bolt head relative to the bolt comprises a vertical pin fixedly secured in the top of said bolt head rearwardly of said threaded exterior thereof the bolt having a radially extending slot therethrough for passage of said pin, and the receiver having a longitudinal slot in the interior thereof for passage of the upper end of said pin during the reciprocal movement of the bolt.

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