March 19, 1946. F. R. AMTHOR 2,396,978

SHELL

Filed April 28, 1941

Fig. 1.

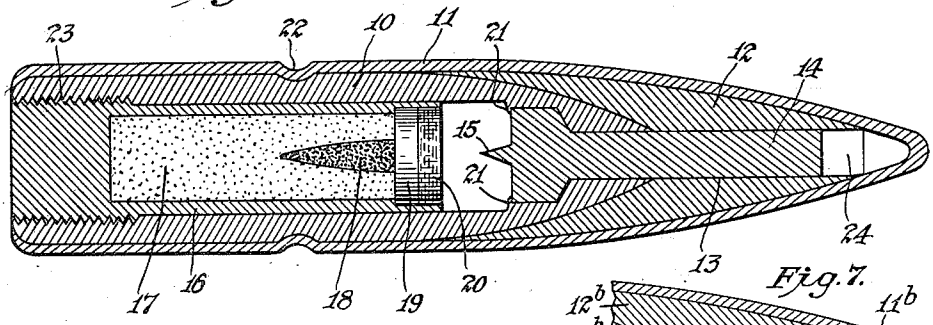


Fig. 7.

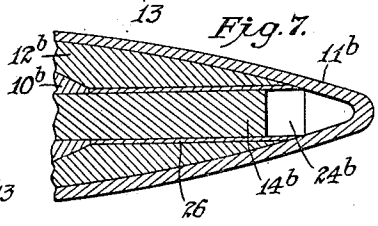


Fig. 2.

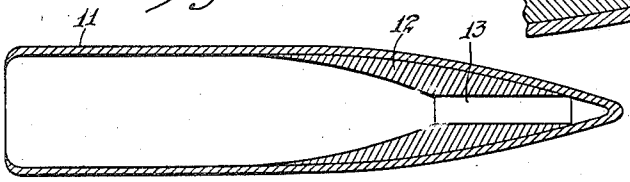


Fig. 6.

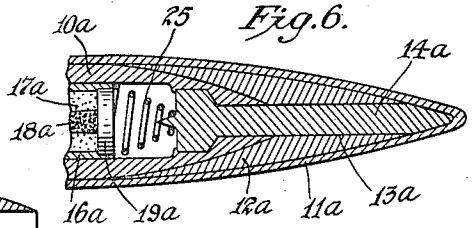


Fig. 3.

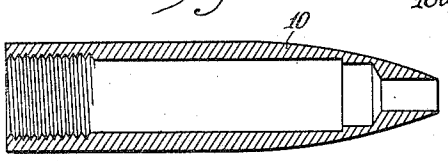


Fig. 4.

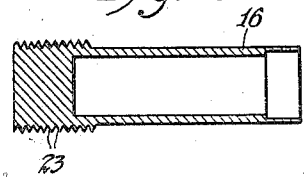
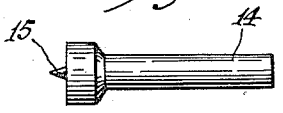


Fig. 5.



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UNITED STATES PATENT OFFICE

2,396,978

SHELL

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Application April 28, 1941, Serial No. 390,681

7 Claims. (Cl. 102—56)

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

This invention relates to explosive shells and more especially those suitable for small calibre weapons such as machine guns, and has for its object to provide a simple shell adapted to function on impact, yet safe to handle, manufacture and fire in a gun of small calibre. Another object is to enhance the safety character of such a shell, a further object is to provide a shell that is inexpensive to manufacture, free of springs, centrifugal releases, timing mechanism, and is provided only with an impact responsive fuse.

Although there is a need for a small calibre shell for use against aircraft, there has nevertheless been no satisfactory practicable device of this character. It is not feasible to reduce the size of the shell such as is used for larger sizes of fixed and separate loading ammunition, in order to obtain a shell suitable for machine guns. The fuses for such larger size shells are quite complicated and it would be unduly expensive and unnecessarily hazardous to make such a complicated construction for a small calibre weapon, because some of the parts might get out of order and not function as intended. No small calibre shell can conveniently have satisfactory timing mechanism in order to cause explosion at a predetermined place in the trajectory of the shell. A number of suggestions have been made for small calibre shells which are responsive to impact, but heretofore no satisfactory suggestion has been devised which is at the same time safe to manufacture and handle as well as safe to fire in a gun.

According to this invention a shell is provided with a firing pin held in its safe position during set back by the provision of at least two factors, either of which alone should suffice without the other. One is the provision of a firing pin which is about .0007 inch larger than the recess in which it slides. Another is the crimping of a part of the steel core over an inner end face of the firing pin to positively lock it in its safe position. Substantial clearance between the primer and the firing pin in its safe position is another feature of safety, since the pin is moved through this distance under a substantial friction brake, due to the pin having a drive fit in its recess.

Referring to the drawing,

Fig. 1 is a longitudinal section through one embodiment of this invention.

Fig. 2 shows the outer casing of gilding metal having soft metal point filler.

Fig. 3 shows the steel core for a shell shown in Fig. 1.

Fig. 4 shows the removable casing for the explosive charge, booster and primer.

Fig. 5 illustrates the firing pin.

Fig. 6 is a longitudinal section showing a modified construction, and Fig. 7 is another modification.

The shell exemplified in Fig. 1 includes the usual steel core 10 provided with a jacket of gilding metal 11, soft enough to receive the impression of the lands and grooves in the rifling. The forward part is usually provided with soft metal such as a lead and antimony composition 12. A firing pin 14 is on impact intended to be slidable in a recess 13 in the steel core and soft metal, such firing pin being provided with the usual conical point 15 for cooperation with a primer. Within the steel core 10 is a removable container 16, also preferably of steel for the explosive charge 17. Where needed a booster charge 18 is provided between the charge 17 and a primer 19. To cause delay in the action of the firing pin a thin pad of balsa wood 20 may be provided. The pad 20 is not at all necessary and when used is usually of less thickness than is illustrated in Fig. 1. This pad must, of course, be of less thickness than the length of the conical point 15 on the firing pin.

To provide a positive locking means for the firing pin which is adapted to allow the pin to function on impact yet hold it in a safe position at other times, a crimping tool is adapted to cause portions of the steel core to be bent or crimped over the inner end face of the firing pin, the crimped portions being designated in Fig. 1 by the numeral 21. It will be understood the crimped portions are localizebd rather than of continuous angular extent. A convenient crimping tool having short cutting edges may provide two, four, or any number of crimped over portions. The threads 23 on the rear of the container 16 are preferably coated with Petman's cement to provide a tight seal against any gases from the propelling charge damaging the material for the explosive charge or pre-igniting it. In the embodiment illustrated in Fig. 1 substantial clearance space 24 is provided in the nose so that both the gilding and filler metals must be mashed in to a substantial extent before the firing pin is moved.

One important feature of this invention is the provision of what is designated as a "drive fit," such fit being applied between the pin and the

walls of its recess. This drive fit is usually defined as resulting from having the firing pin of larger diameter than its recess by an amount not substantially more than .00075 inch. In hand made .50 caliber samples used and tested it was found that when the firing pin had a diameter larger by .0003 to .0007 inch, satisfactory results were obtained, that is, when the diameter of the pin was larger than the diameter of its recess by this amount. The result gave a tight friction fit or the effect of a braking action on the firing pin. This fit was so tight that the pin could not be moved except by successive blows of a hammer. In the specimen of a fifty caliber shell the recess for the pin was formed by drilling it to a smaller than its finished size and then reaming the hole to an eighth-inch size, when the firing pin before insertion had a diameter as given by a micrometer of .1257 inch.

The external jacket of gilding metal and the soft metal filler may be separately formed from the rest of the structure, as shown in Fig. 2. The firing pin is then inserted and may be driven home by an appropriate impact receiving tool which is adapted to fit around the conical point 15. In assembly a jig or other tool may be used for making sure the firing pin has been fully seated in its safe position. After that the edge portions of the shoulder around the firing pin may be crimped over as shown at 21. Of course the steel core 10 will have to be inserted in the jacket before the firing pin is put in position. The precise fit necessary is obtained principally between the steel of the core 10 and the steel of the firing pin, though, of course, the same diameter of recess within the soft metal is desirable in order that the soft metal may likewise produce as much of a braking action as is possible upon the firing pin. The explosive charge and its primer are filled in the container 16 when this container is out of the projectile illustrated. After being filled this container with its primer and balsa wood pad if used, is inserted into the steel bore 10, the steel threads have been coated with Petman's cement as previously described. The usual crimped groove or cannelure 22 is placed to insure the gilding metal jacket being locked to the core.

Having the firing pin make a less tight fit in its recess should permit the shell to be more sensitive on impact. When the firing pin is of a size for the drive fit described above it is believed the safety factor due to this drive fit or friction braking effect on the pin is superior due to the crimping alone although the crimping of the core shoulder over an end face of the firing pin is believed a satisfactory safety feature which should of itself be capable of holding the firing pin in its intended position during set back, that is, during the time the explosive charge in the gun is accelerating the projectile. Instead of having the rather large clearance space 24 in front of the firing pin, this clearance space may be entirely removed by having the firing pin extend forwardly to and substantially contiguous the gilding metal jacket. The substantial clearance space shown in Fig. 1 as being provided between the rear of the firing pin and the primer is a feature of safety, especially when it is considered that during the time the firing pin travels this distance it is subjected to the heavy friction braking effect described above as being due to the drive fit.

Safety in manufacture of this projectile is attained by the filling of the container outside of the core and its subsequent insertion. The firing pin may be readily tested as described above in order to make sure that it is properly seated in its safe position remote from the primer. The crimped over portions may be increased in number to still more strongly hold the firing pin positively locked in its safe position. Safety in handling this projectile is obtained by the combined crimping and friction braking effects on the firing pin, as well as by the clearance space 24 which would enable the projectile to be safely dropped on the floor on its nose without setting off the primer and explosive charge. Safety in the gun during set back is attained by the crimping and braking features described above in connection with the firing pin. The wall and the base of the explosive container 16 should be about the thickness indicated, that is, about ⅜ of an inch for a ½ inch projectile. The friction braking action and the crimping each assists in maintaining the firing pin in its safe position at all times within the gun. By removing the balsa wood pad 20 and doing away with the nose clearance space 24, the projectile may be made to explode more promptly on impact. Of course, if desired, the size of the firing pin may be less than the amount indicated above so that the bursting charge may be ignited more readily on impact and without any unnecessary delay. One advantage of this invention is the absence of any timing device or centrifugal arming or safety mechanism. When TNT is used a booster charge 18 is usually considered necessary, but when an explosive charge such as tetryl is used no booster charge is necessary. The type of steel core and the type of steel in the container 16 may, to some extent, determine the destructive action of the burst. The core 10 may be of any type steel desired such as machinery steel, or some of the various tungsten carbide alloys which have been suggested for armor piercing projectiles. Due to the absence of any timing mechanism it is possible that this shell may not be desirable on any projectile having a diameter of larger than 37 millimeters.

The embodiment illustrated in Fig. 6 has the firing pin 14*a* extend forward into cooperation with the gilding metal jacket, there being no clearance space 24 such as is present in Fig. 1. In place of the balsa wood pad 20, the embodiment of Fig. 6 contemplates the provision of a conical spring 25 between the removable container 16*a* and the firing pin for the purpose of assisting the firing pin in maintaining its safe position. This spring 25 is shown as being both conical and helical in shape in order that the convolutions when the spring is compressed tend to occupy a position in a plane normal to the longitudinal axis of the projectile and these convolutions when fully compressed are of less extent longitudinally of the shell than the length of the firing point 15 on the firing pin. This spring 25 may be used in the projectile of Fig. 1 in place of the pad 20, or if desired this spring 25 may take the place of either the crimping effect or the friction braking effect, but preferably this spring 25 should not take the place of both such features.

In Fig. 7 is shown the tube 26 around the firing pin to provide additional friction or a tighter fit than is possible with the lead and antimony mixture. This tube extends from the core to the jacket and is preferably of brass though it may be of other materials and made to fit as tightly as is desired to increase the safety of the shell. In assembly, measuring the depth of movement of

the pin on application of a force of known or fixed magnitude, will indicate whether the fit is suitable for the safety desired in any of the embodiments illustrated.

I claim:

1. In a shell having a body portion, an explosive charge, a primer, a firing pin in a recess in the fore part of said body portion, the improvement which comprises a ledge around an inner end portion of said firing pin, and inner end face of said pin being slightly forward of said ledge in its safe position, and at least a portion of said ledge having been crimped over said pin to lock the same in position.

2. A small caliber shell having a gilding metal jacket, a steel core, soft metal in the nose of the shell between the jacket and core, an explosive charge in the core, a primer for the charge, a firing pin slidable in a recess in the nose of the shell but enclosed by said jacket, the improvement for enhancing safety in handling said shell which comprises the separation of said firing pin and jacket by an amount sufficient to allow substantial flattening of the jacket and soft metal therein under impact before said pin begins to move toward said primer.

3. A small caliber shell having a core, a jacket for said core, gilding metal in the nose between said core and jacket, a bursting charge within said core, a primer in front of said charge, a firing pin enclosed by said jacket and slidable in a recess in the core and soft metal, the improvement which comprises said firing pin being provided with a drive fit in at least a portion of its recess whereby the sliding of the pin is substantially retarded, said pin also being provided with clearance spaces at each end of the pin within said jacket.

4. In a shell having a body portion, an explosive charge, a primer, a firing pin in a recess in the fore part of said body portion, the improvement which comprises a ledge around the inner end of said recess, an inner end face of said pin being slightly forward of said ledge in its safe position, and portions of said ledge having been crimped over said pin to lock the same in position in combination with said pin having a drive fit in said recess and being larger than said recess by an amount not over .00075 inch and at least .0003 inch.

5. In a small caliber, impact responsive shell having a steel core, a jacket of gilding metal, a soft metal filler in the nose between the jacket and core, an explosive charge and primer insertable as a unit in said core, a firing pin slidable in a recess in the forward portion of the shell, the improvement which includes the following safety features, a drive fit between said pin and its recess, portions of the core being crimped over the pin to hold it in its safe position, and the nose of the shell in advance of the foreward end of said pin having a clearance space requiring substantial deformation of the jacket and filler before the pin is moved.

6. In a small caliber, impact responsive shell having a steel core, a jacket of gilding metal, a soft metal filler in the nose between the jacket and core, an explosive charge and primer insertable as a unit in said core, a firing pin slidable in a recess in the forward portion of the shell, the improvement which includes the following safety features, a drive fit between said pin and its recess, portions of the core being crimped over the pin to hold it in its safe position, and the nose of the shell in advance of the foreward end of said pin having a clearance space requiring substantial deformation of the jacket and filler before the pin is moved, the core between said primer and pin in its safe position having substantial clearance distance through which pin can move only under force sufficient to overcome its drive fit, and a fibrous frangible pad contiguous said primer.

7. A small caliber shell having a jacket, a core, a filler of soft metal between the core and jacket in the nose of the shell, an explosive charge in the core, a primer for said charge, a firing pin between the primer and forward end of the shell but enclosed by said jacket, and the improvement which includes a tube around said pin between the core and jacket harder than the soft metal filler and of a size to exert substantial friction on said pin during set back, said pin having a drive fit in said tube.

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