No. 763,302. PATENTED JUNE 21, 1904.

H. S. MAXIM.

# FUSE FOR ARMOR PIERCING PROJECTILES.

APPLICATION FILED DEC. 17, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 2

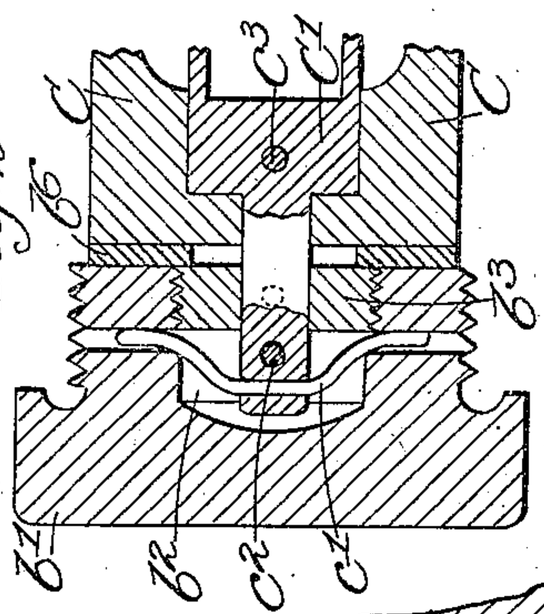


Fig. 3

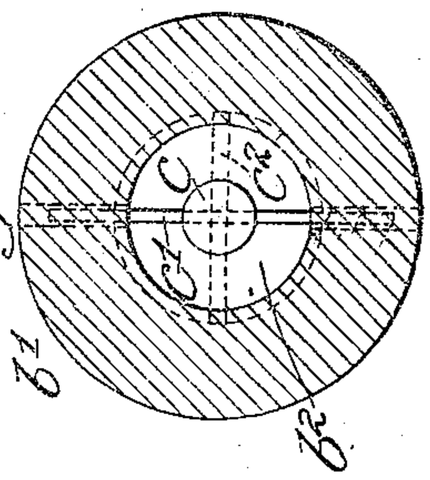
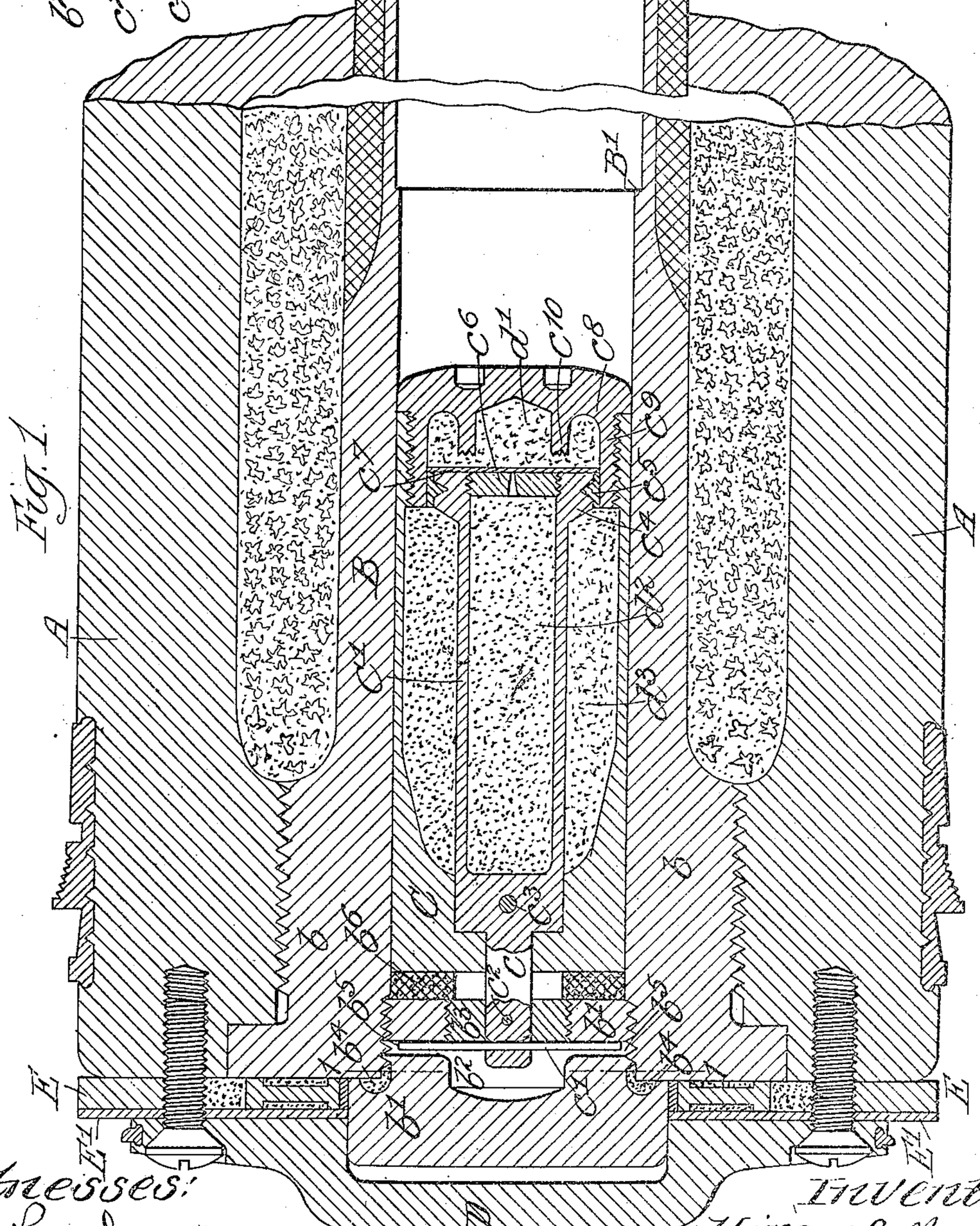


Fig. 1.



Witnesses:
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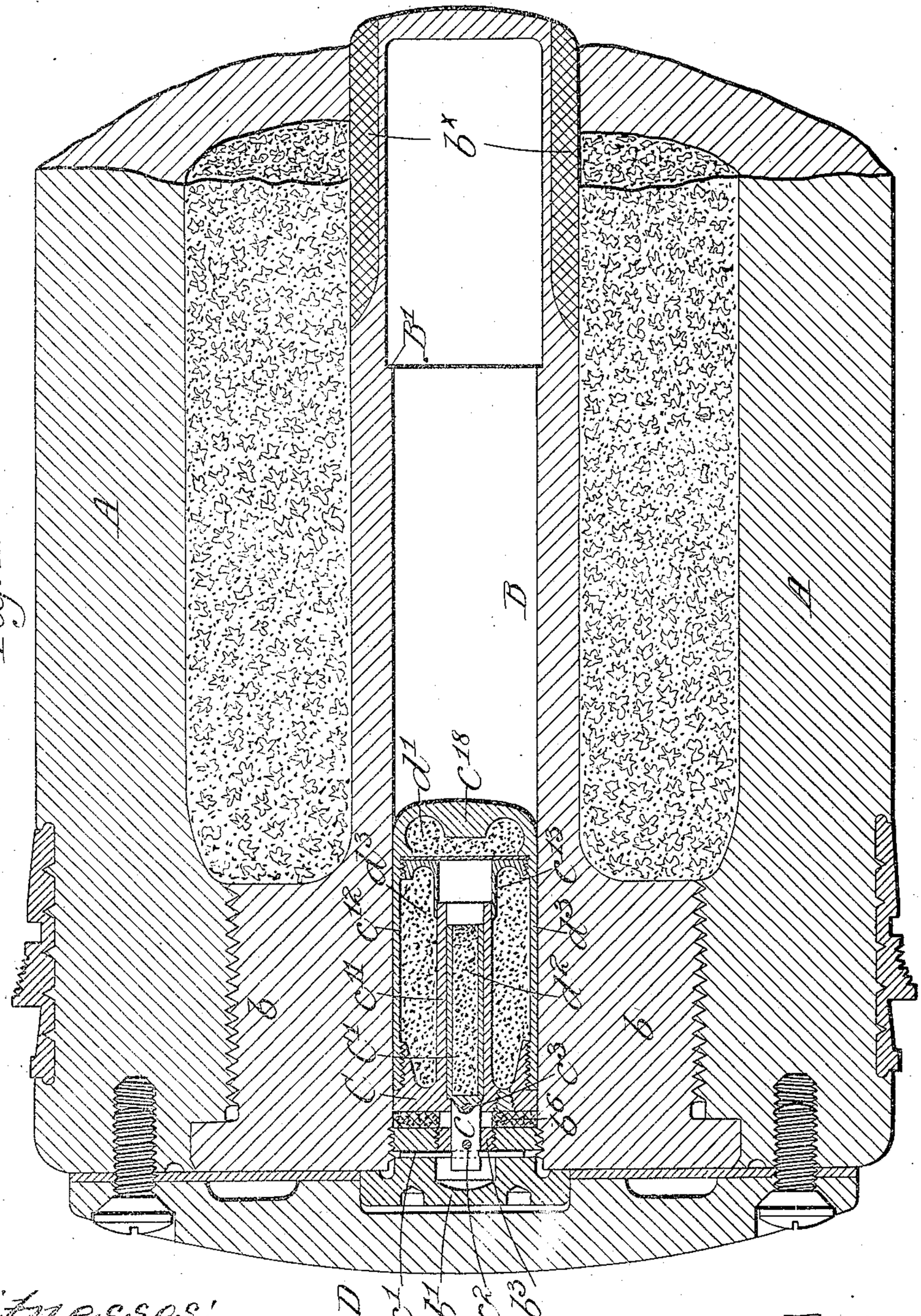
Fig. 4.

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# UNITED STATES PATENT OFFICE.

HIRAM STEVENS MAXIM, OF LONDON, ENGLAND.

## FUSE FOR ARMOR-PIERCING PROJECTILES.

SPECIFICATION forming part of Letters Patent No. 763,302, dated June 21, 1904.

Application filed December 17, 1901. Serial No. 86,328. (No model.)

*To all whom it may concern:*

Be it known that I, HIRAM STEVENS MAXIM, Chevalier of the Legion of Honor, civil and mechanical engineer, a subject of the King of Great Britain, residing at 18 Queens Gate Place, London, England, have invented certain new and useful Improvements Relating to Fuses for Armor-Piercing Projectiles, of which the following is a specification.

This invention has reference to fuses for armor-piercing projectiles.

Armor-piercing projectiles charged with very powerful explosives—such, for instance, as picric acid or mixtures of picric acid with dinitrobenzol, nitrobenzol, dinitronaphthalene, nitromannite, nitroglycerin, trinitrotoluene, trinitrocresol, or the like employed alone or mixed with themselves or other modifying substances—such as mineral oils, castor-oil, and such like—should be provided with fuses which contain no "dangerous" or sensitive substances. It is also necessary that such fuses should have a delayed action, so that they do not explode at the instant of the projectile striking an object. When picric acid is modified sufficiently to enable it to pass in a projectile through an armor-plate without being detonated by the shock of impact, it is necessary to provide a large and violent detonating charge to explode it after it has passed through the said armor-plate. All dangerous explosives, such as fulminate of mercury and chlorate compounds, are highly objectionable in such fuses. Therefore it is necessary for my purpose to construct the fuse on a different principle from any heretofore employed. Moreover, in very large projectiles charged with high explosive it is desirable that the projectile when once loaded should need no further manipulation beyond that necessary for conveying it to and placing it in the gun before it is fired. In ordinary projectiles the charge is placed in the projectile and the projectile is not "fused" until about the time when it is to be used; but there is always more or less danger in handling the fuses. It is better, therefore, that the projectiles be so constructed and loaded that they do not have to be manipulated after once having been prepared and that the detonating charges be of an unquestionably good character in respect of their insensitiveness and keeping qualities.

According to my invention the fuse may be in the form of a cylindrical receptacle having three compartments for containing the detonating charges, which I term "primary," "secondary," and "tertiary" charges. The said fuse is located in a tube or pocket which extends from the base of the projectile into the main charge of explosive, and said fuse is normally held at the rear or base end of said tube or pocket by means of two transverse pins. Within the fuse is a movable piece or striker which is normally held fast in said fuse by a transverse pin. On shock of discharge due to the firing of the gun one of the trasverse pins by which the fuse is held in place in the tube or pocket is sheared and the other pin bent. The bent pin effectually resists any forward movement of the fuse in its tube or pocket during the flight of the projectile; but on impact of the projectile this bent pin is sheared by the momentum of the fuse. The said fuse then advances in its tube or pocket, strikes the inner closed end thereof, and is thus suddenly checked in its movement. The movable piece or striker within the fuse then shears its pin and moves forward independently of the fuse. In so doing the said striker explodes the primary charge of the fuse, and this explosion detonates the secondary charge, which in turn detonates the tertiary charge. The detonation of the tertiary charge causes the main charge in the projectile to be detonated and the projectile to be burst.

In order that my said invention may be clearly understood, I will describe the same more fully with reference to the accompanying drawings, in which—

Figure 1 is a longitudinal section of a portion of an explosive projectile provided with my improved fuse. Fig. 2 is a detail sectional view, and Fig. 3 is a detail cross-section on the line 1 1 of Fig. 1. Fig. 4 is a view similar to Fig. 1, showing a modified form of my fuse.

A is the body of the projectile, B the tube

or pocket extending from the base of the projectile into the said body, and C is the fuse.

The aforesaid tube or pocket B is provided with a screw-threaded flanged portion $b$, by which it is connected to the body of the projectile. It is open at its rear end and closed at its forward end, and it is formed at its inner end with a series of longitudinal grooves for the purpose of weakening the said tube laterally, so that it will readily burst when the fuse is exploded within it. These grooves receive metallic fillets $b^{\times}$, of metal, which are soldered or otherwise secured therein. The aforesaid open end of the tube is provided with a detachable plate or plug $b'$, having a cavity $b^2$, that receives a steel disk $b^3$. The said plug $b'$ is provided with a soft-metal filling or packing-ring $b^4$, which is crushed when the plug is screwed firmly home, thereby making a gas-tight joint at this point. At the base of the projectile is a detachable base-plate D, which is suitably shaped to inclose the aforesaid plug $b'$. This base-plate is flanged and is connected with the projectile by means of screws or otherwise. Interposed between the said flanged plate and the base of the projectile are an obturator-ring E and a thin metallic plate E'. The latter is adapted on the firing of the gun to bend rearwardly over the periphery of the said base-plate D.

C' is the aforesaid movable piece or striker which is contained centrally within the fuse-body. It is furnished with a stem $c$, which extends through the aforesaid steel disk $b^3$, where it is maintained in place by means of the two transverse pins $c'$ $c^2$, which are preferably composed of copper or brass. The former of these pins passes through a hole in the said stem and the ends enter holes or recesses $b^5$ in the plug $b'$. This pin lies behind without passing through the said steel disk $b^3$ and is therefore unsupported at the part which lies between the said holes or recesses $b^5$, so that it will bend in a rearward direction without breaking. The other pin, $c^2$, extends through a hole in the said stem as well as through a corresponding hole formed in the steel disk $b^3$. The said striker C' is hollow and held in place within the fuse-body by means of a transverse pin, of copper or brass, $c^3$, and the forward end of the striker is formed with a head $c^4$, provided at its periphery with a soft-lead ring $c^5$. The forward end of the striker is closed by a perforated plug $c^6$, in front of which is a disk $c^7$ of ballistite or any hard and tough kind of smokeless powder. The forward end of the body portion of the fuse is closed by a screw-cap $c^8$. This cap has a circular or tubular flange $c^9$, within which fits the aforesaid soft-lead ring $c^5$. The said cap $c^8$ also has an inner short tubular flange $c^{10}$, serving as an anvil against which the striker forces the disk of ballistite $c^7$ to fire the fuse, as hereinafter explained. It will be seen that the interior of the fuse constructed as above described has three chambers or compartments $d'$ $d^2$ $d^3$, the chamber $d'$ containing the primary detonating charge, the chamber $d^2$ the secondary detonating charge, and the chamber $d^3$ the tertiary detonating charge. The said primary charge, being comparatively small, may consist of smokeless powder, such as ballistite, the secondary charge $d^2$ may consist either of some nitro or picrate explosive or of common black powder, and the tertiary charge may consist of pure picric acid or of some nitro compound, such as smokeless powder. Between the base of the fuse and the face of the aforesaid plug $b'$ I leave a space for the reception of a ring or washer $b^6$, of felt or other appropriate material of a flexible nature.

When the projectile is fired from the gun, it is of course very violently set forward by the pressure of the powder-gases, the fuse and all its parts being thus set back relatively to the projectile. The fuse thus compresses the washer $b^6$ to about one-sixth of its original thickness. This action shears the pin $c^2$ and bends the other pin, $c'$, into the form of a crank, as represented in Fig. 2, which formation of the pin effectually prevents the fuse from traveling forward in the tube or pocket B during the flight of the projectile from the gun. On impact of the projectile the fuse by its momentum shears the aforesaid pin $c'$ and advances independently of the projectile, whereby the cap $c^8$ at the forward end of the fuse violently strikes the closed end of the tube or pocket B. The force of this blow suddenly checks the motion of the fuse and the internal striker by its momentum shears the pin $c^3$ and advances independently of the fuse, thereby bringing the disk $c^7$ of smokeless powder into violent contact with the anvil $c^{10}$. The said disk of smokeless powder is thus detonated and the primary charge of explosive $d'$ is fired. The explosion of this charge fires the secondary charge $d^2$, which in turn fires the tertiary charge $d^3$. This charge $d^3$ being of suitable magnitude bursts the fuse-body and the surrounding weakened portion of the tube or pocket B, thereby detonating the main charge in the projectile and bursting the latter. The aforesaid peripheral lead ring $c^5$ prevents direct contact of the head $c^4$ of the striker with the interior surface of the flange $c^9$, and being of a comparatively soft nature insures that the said striker will not be unduly retarded in its movement toward the anvil $c^{10}$.

After impact of the projectile the time occupied by the shearing of the two pins $c'$ $c^3$ and by the travel of the fuse to the closed end of the pocket B and the ensuing movement of the striker provides for a delayed action of the fuse, so that the bursting of the projectile does not take place until after it has had time to pierce or pass through the armor-plate of the structure it is fired at.

A fuse constructed as above described need contain no dangerous explosives. The explosive materials in the fuse are recognized as being quite safe, and nothing except their being fired from a gun in a projectile and the projectile subsequently coming into contact with some hard substance can cause their detonation.

It will be seen that there are two provisions for preventing the entrance of the gases of discharge into the projectile at the base, one being the base-plate with its obturator and the other the packing-ring $b^4$; also that there are no less than three safeguards against the movement of the striker C′ relatively to the body C of the fuse—viz., the pins $c'$ $c^2$ $c^3$—all of which must be sheared before the fuse can detonate.

The interior of the aforesaid tube or pocket B is formed with a shoulder B′, with which the rear end of the fuse-body engages when expanded by the force of the explosion of the contained detonating charges, so that said tube or pocket will be effectually blocked toward the rear by the said fuse-body when the explosion of the fuse takes place.

In the modified construction of the fuse represented in Fig. 4, wherein like letters of reference indicate similar parts to those described with reference to Figs. 1 to 3, the fuse-body is provided with a central tubular portion $c^{11}$, within which the hollow striker C′ is contained. The cap $c^8$ is in this case provided with elongated walls $c^{12}$ and receives a tubular piece $c^{13}$ near its forward end, said tubular piece being of sufficient length to embrace the forward end of the aforesaid tubular part $c^{11}$. These two tubular portions $c^{11}$ $c^{13}$ form a circular partition dividing the interior of the fuse into two concentric compartments, which respectively receive the secondary and tertiary explosive charges $d^2$ $d^3$. The primary charge $d'$ is contained in the cap $c^8$. In other respects the said fuse is similar to that already described and operates in an analogous manner. It does not, therefore, need further description.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In an explosive projectile, the combination of a movable fuse, of means for locking the fuse to the projectile, which means is sheared and the fuse liberated on impact of the projectile thus permitting it to advance independently, of means for stopping the advance of said fuse, of a movable piece within said fuse, of means for locking the movable piece to the fuse, which means is sheared by the inertia of the movable piece when the fuse is stopped thus permitting said movable piece to advance independently, and of means whereby the independent advance of said movable piece detonates the fuse, for the purpose specified.

2. In an explosive projectile, the combination of a movable fuse, of a pocket for said fuse extending into the main explosive charge of the projectile, of a base-plate covering the open end of said pocket, of two transverse pins affixing the said fuse to the rear end of the said pocket, one of said pins becoming sheared and the other bent on the shock due to the discharge of the gun, said bent pin becoming subsequently sheared on impact of the projectile and permitting the fuse to advance toward the closed end of said pocket, of a longitudinally-movable piece in said fuse, of a transverse pin affixing said movable piece to the fuse-body and becoming sheared by the shock due to the fuse striking the closed end of said pocket, and of means whereby the said longitudinally-movable piece when released detonates the fuse, for the purpose specified.

3. In an explosive projectile, the combination of a movable fuse, of a metallic pocket for said fuse extending into the main explosive charge of the projectile, of a detachable base-plate covering the open end of said pocket, of a screw-plug fitting into the open end of said pocket, of a steel disk fitting said plug, of a cylindrical striker within said fuse, of two transverse pins extending through a rearward extension on said striker, one of said pins entering the steel disk and the other lying at the rear thereof and engaging with the plug, of a transverse pin extending through said striker and entering the body of the fuse and of means whereby said pins are successively sheared substantially as and for the purpose specified.

4. In an explosive projectile, the combination with the movable fuse and its retaining-pins, of a metallic pocket extending into the main explosive charge of the projectile and of metal fillets let into longitudinal grooves in the outer circumference of its inner end for weakening said pocket with regard to internal pressures without weakening it with regard to external pressures for the purpose specified.

5. In an explosive projectile, the combination with a movable fuse, of a pocket for said fuse extending into the main explosive charge of the projectile, a detachable recessed plug closing the open end of said pocket, a metallic disk carried by said plug and closing the forward end of the recess therein, a disk of compressible material located between the rear end of the fuse and the front of the plug, a pin extending through said metallic disk and through an extension on the fuse, and a pin extending through said fuse extension and through the recess in the plug, substantially as and for the purpose specified.

6. In an explosive projectile, the combination with the movable fuse, its retaining-pins and its metallic pocket, of a hollow cylindrical striker within the fuse-body, a cap fitting around the head of said striker, an anvil in said cap, a disk of smokeless explosive material located between said striker and said

anvil and a transverse pin locking said striker to said body until said pin is sheared by the momentum of the striker after the fuse-cap strikes the closed inner end of the pocket, substantially as and for the purpose specified.

7. A delayed-action fuse for an explosive projectile, consisting in the combination with the fuse-body, of a hollow cylindrical striker surrounded by the tertiary explosive charge and inclosing the secondary explosive charge, of a cap fitting around the head of the said striker and inclosing the primary explosive charge, of a soft-metal ring interposed between the surface of said head and said cap and separating said primary and secondary charges, of an anvil in said cap and of smokeless explosive material located between said striker and said anvil, substantially as and for the purpose specified.

8. In an explosive projectile, the combination with a movable fuse and its metallic pocket, of a hollow cylindrical striker within the fuse-body, of a cap fitting around the head of said striker, of a primary detonating charge within said cap, of a secondary detonating charge of stronger explosive qualities than the primary charge and located within said hollow striker, of a tertiary detonating charge of stronger explosive qualities than the secondary charge and surrounding said striker, of an anvil in said cap, of a disk of smokeless explosive material located between said striker and said anvil, of a transverse pin affixing said striker to said body, said pin being sheared by the shock due to the striking of the cap of the fuse-body with the closed end of said pocket and of two other transverse pins affixing said fuse to the projectile, said pins being respectively sheared by the shock of discharge and the shock of impact of the projectile, substantially as and for the purpose specified.

9. A delayed-action fuse for an explosive projectile, consisting in the combination of a hollow central cylindrical striker, of a detonating charge surrounding said striker, of another detonating charge located within said hollow striker, of a perforated plug closing the open end of said hollow striker, of a cylindrical head on said striker, of a cap fitting around said head, and containing another detonating charge, of a soft metallic ring located between the periphery of said head and said cap, of an anvil in said cap, of a disk of explosive material located between said head and said anvil, of an extension on said striker extending through the base of the fuse-body, of a transverse pin affixing said striker to said body, and of two other transverse pins extending through the portion of the said extension beyond the base of the fuse-body and engaging with the projectile substantially as and for the purpose specified.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 6th day of December, 1901.

HIRAM STEVENS MAXIM.

Witnesses:
T. SELBY WARDE,
WALTER J. SKERTEN.