D. J. CARTWRIGHT.

SAFETY PERCUSSION FUSE FOR PROJECTILES.

APPLICATION FILED DEC. 10, 1903.

935,188.

Patented Sept. 28, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

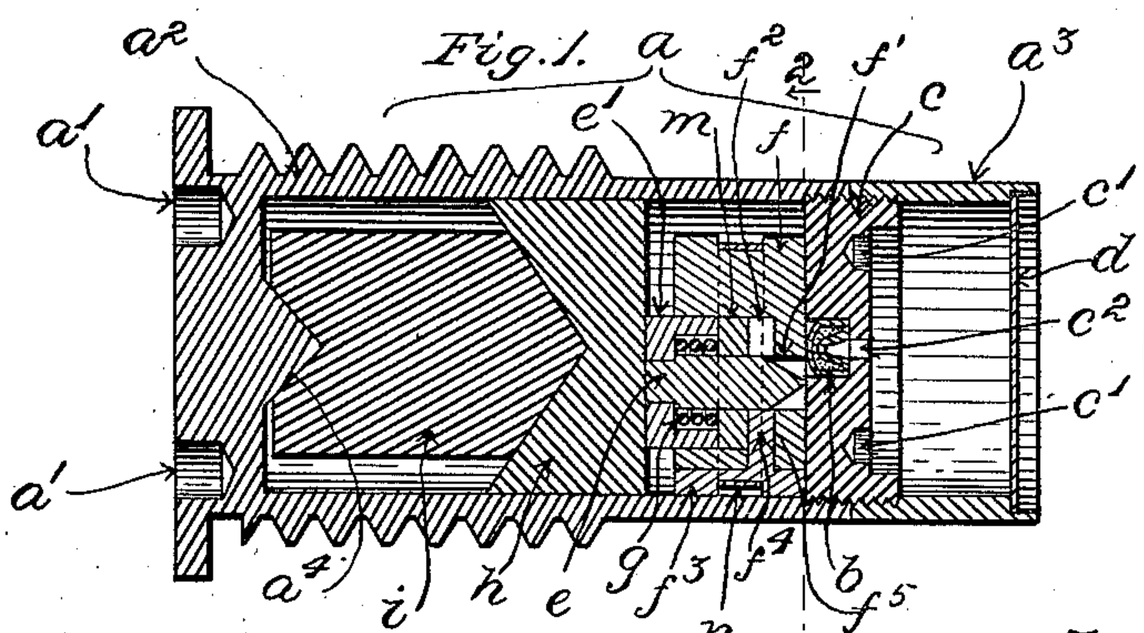


Fig. 2.

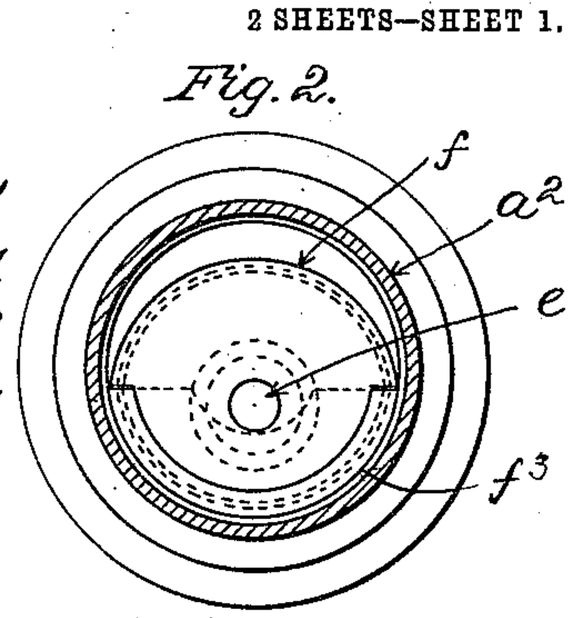


Fig. 3.

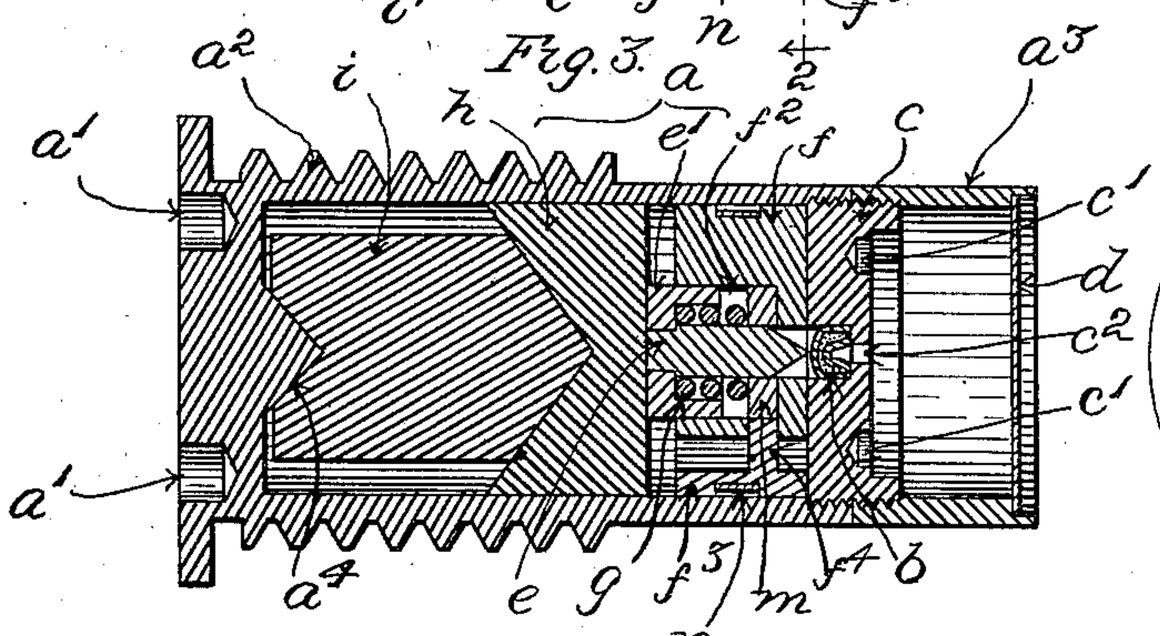
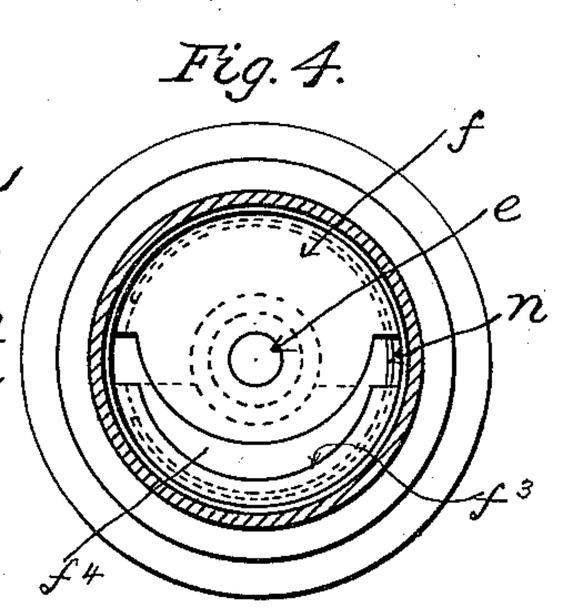


Fig. 4.



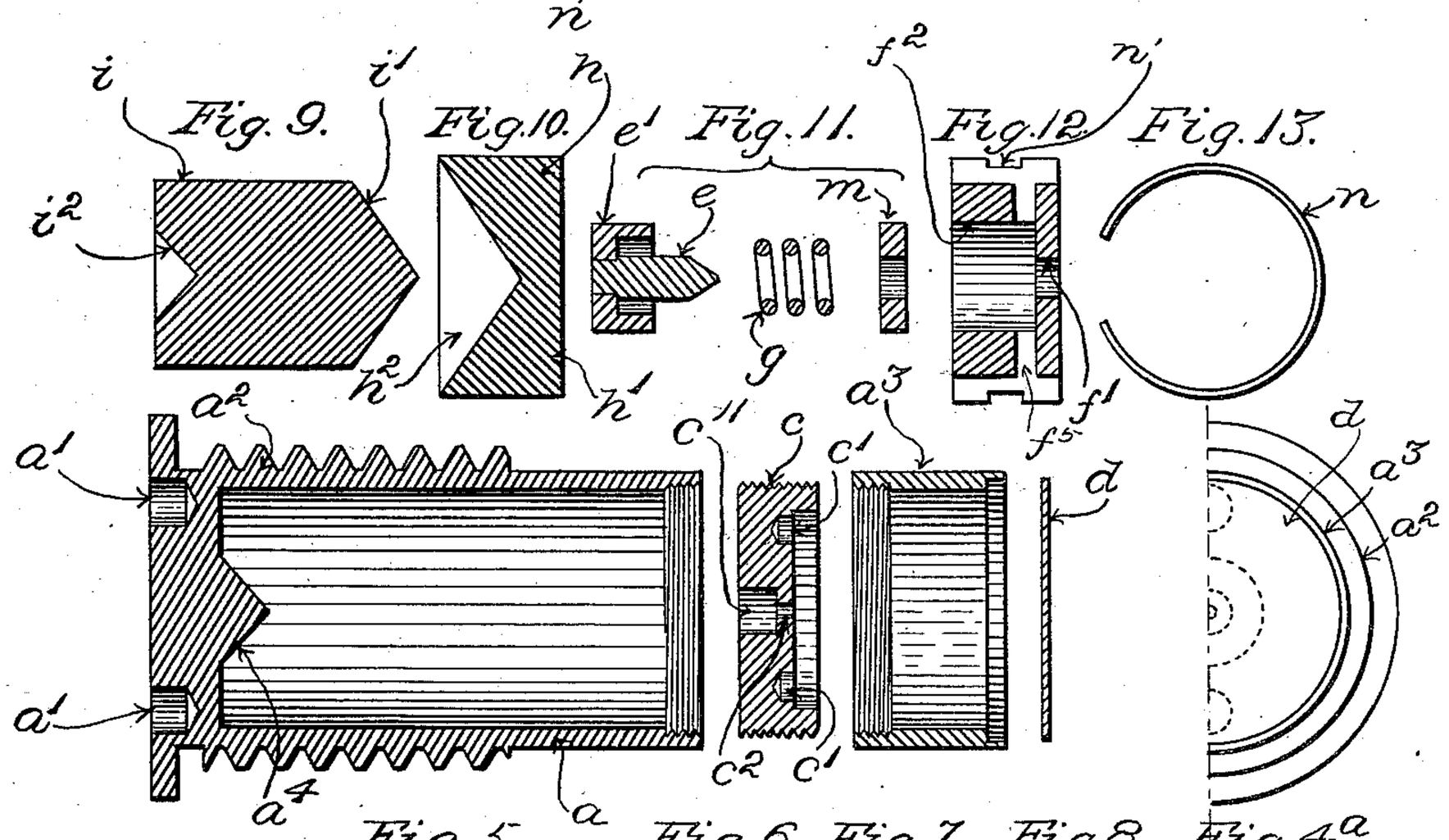


Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 4ª

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2 SHEETS—SHEET 2.

Fig. 16.

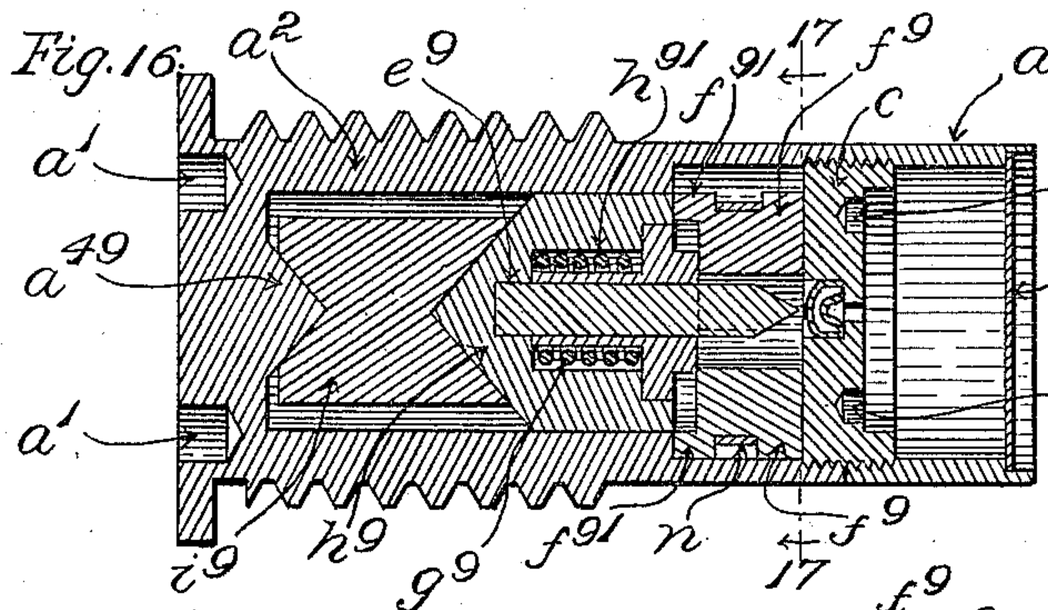


Fig. 17

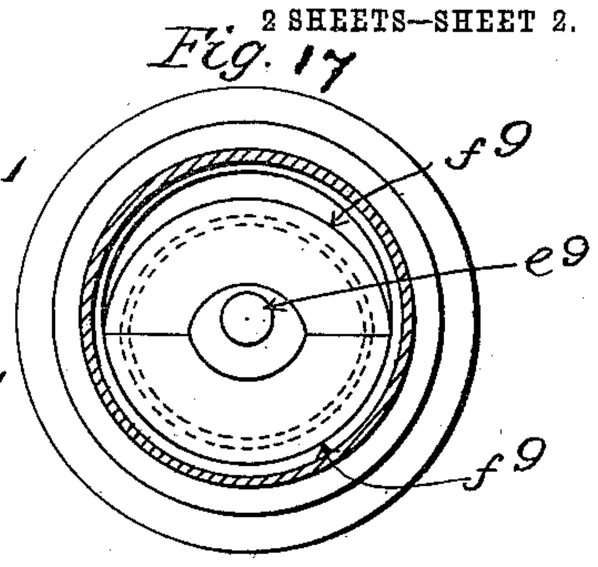


Fig. 18.

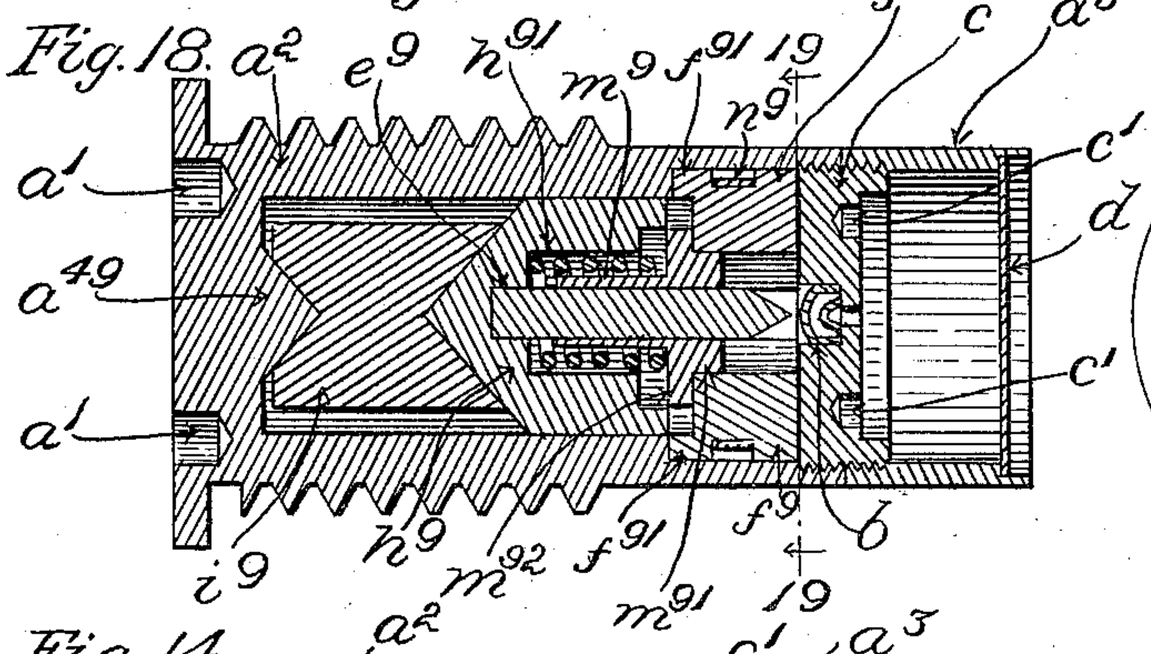


Fig. 19.

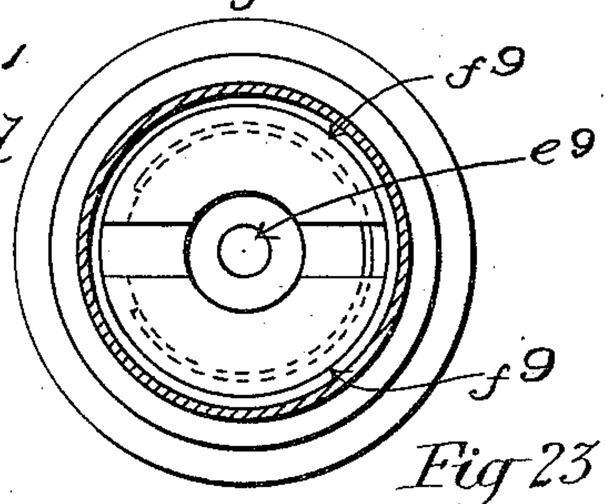


Fig 23

Fig. 14.

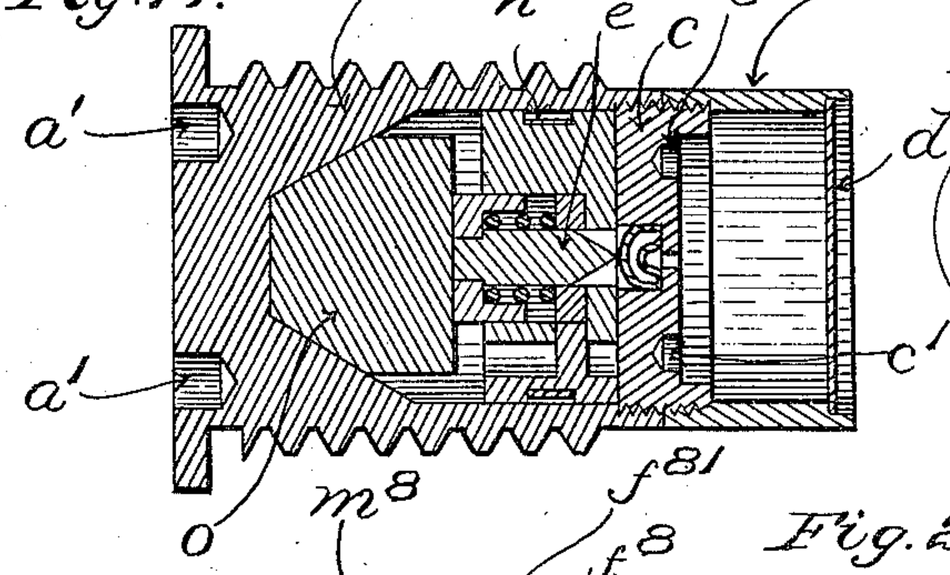


Fig. 15.

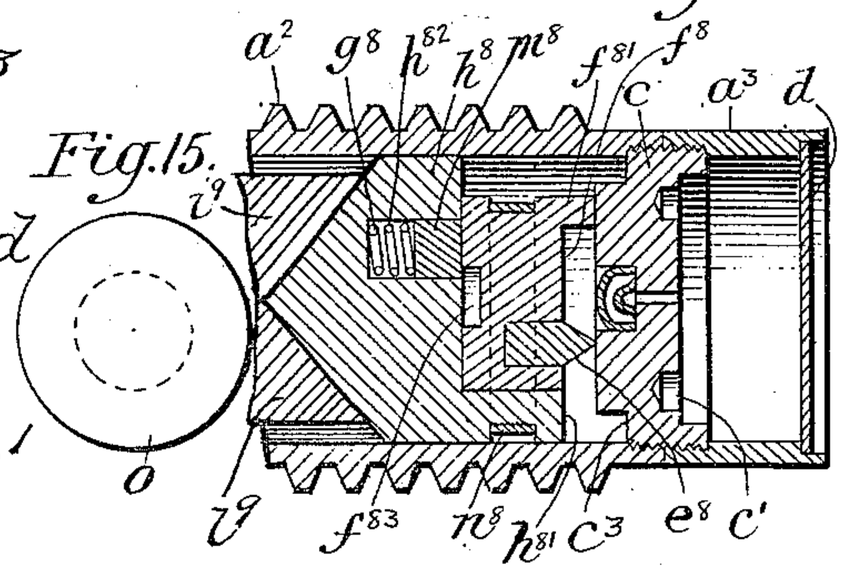


Fig. 20.

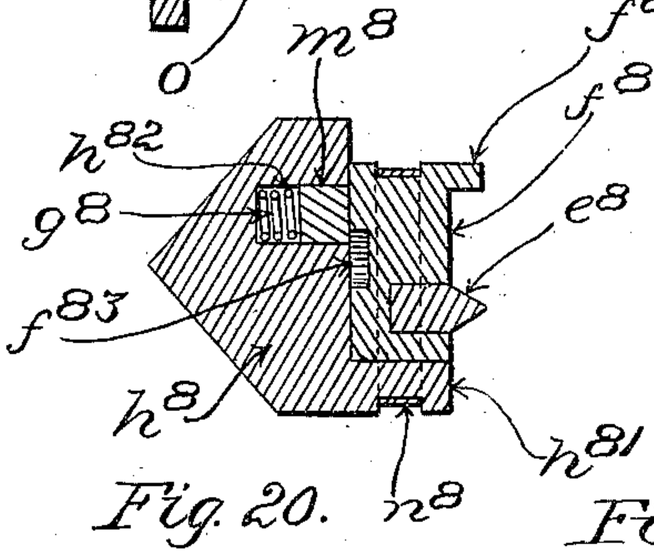


Fig. 21.

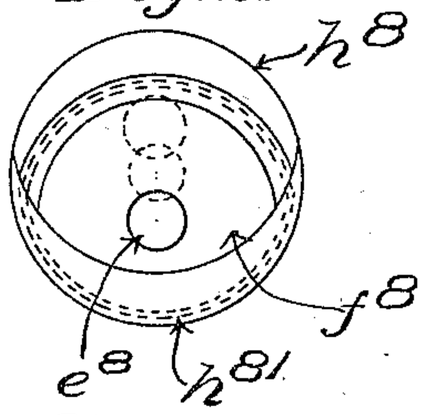


Fig. 22.

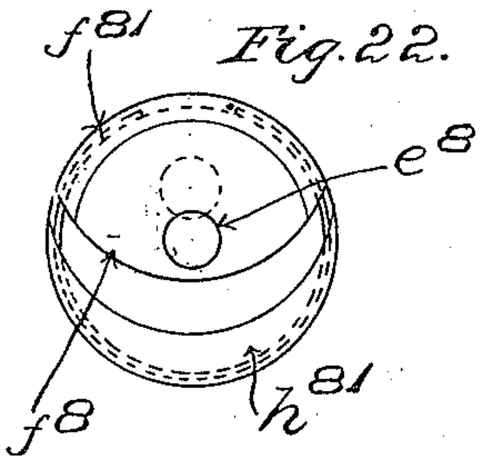
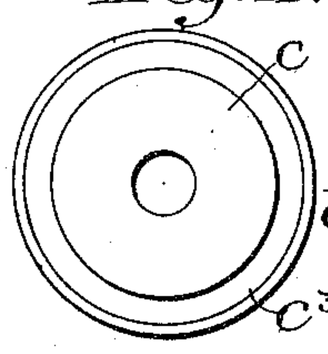


Fig. 24.



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UNITED STATES PATENT OFFICE.

DAVID J. CARTWRIGHT, OF DORCHESTER, MASSACHUSETTS.

SAFETY PERCUSSION-FUSE FOR PROJECTILES.

935,188. Specification of Letters Patent. Patented Sept. 28, 1909.

Application filed December 10, 1903. Serial No. 184,583.

To all whom it may concern:

Be it known that I, DAVID J. CARTWRIGHT, a citizen of the United States, residing at Dorchester, Boston, in the county of Suffolk, State of Massachusetts, have invented a certain new and useful Improvement in Safety Percussion-Fuses for Projectiles, of which the following is a specification, reference being had therein to the accompanying drawings.

The general object of the invention is to produce a safety percussion fuse of improved construction, self-acting and sensitive, absolutely effective when it is to operate to ignite the bursting charge of an explosive projectile, and yet perfectly secure against accidental or premature discharge during transportation or handling.

One feature of improvement consists in a firing-pin or point which is independent of the momentum-piece or device, known as a hammer or plunger, or other actuating means.

Another feature of improvement is an improved safety-device or guard operating effectively to maintain the fuse normally in an "unarmed" state, so that it cannot accidentally become discharged in consequence of jars or shocks, or other like causes, and acting automatically during the flight of the projectile to which the fuse is applied to "arm" the said fuse.

Another feature of improvement consists in rendering the firing-pin or point and the support for the percussion-cap or primer relatively movable in transverse direction, and in providing means adapted to support one of the said parts normally out of line with the other, and for causing the same to be moved into line with the latter in position to enable the detonation of the percussion-cap or primer to be effected.

These and other features of improvement will be fully explained with reference to the accompanying drawings, in which latter,—

Figure 1 shows in longitudinal section a safety percussion device containing the invention in one form of embodiment, the firing-pin or point, and the actuating or motor devices therefor, being represented as locked in the "unarmed" condition. Fig. 2 is a view in vertical cross-section on the plane that is indicated by the dotted line 2—2 in Fig. 1, looking in the direction indicated by the arrows at the ends of the said line. Fig. 3 is a view similar to Fig. 1, showing the firing-pin or point unlocked, the fuse being in "armed" condition. Fig. 4 is a view similar to Fig. 2, showing the safety-device in the position in which it is represented in Fig. 3. Fig. 4ª is a semi-end-elevation of the fuse, looking at the forward end thereof. Fig. 5 shows in longitudinal vertical section the mechanism section of the casing detached. Fig. 6 shows in longitudinal vertical section the partition disk *c* detached. Fig. 7 shows in longitudinal vertical section the magazine section of the casing detached. Fig. 8 shows in vertical section the disk which is employed to close the outer or forward end of the magazine section. Fig. 9 shows in longitudinal vertical section the plunger. Fig. 10 shows in longitudinal vertical section the hammer. Fig. 11 shows in longitudinal vertical section the firing-pin or point and the spring and locking-ring which are applied in connection therewith, the parts being separated from one another. Fig. 12 shows in longitudinal transverse section the body of the safety-device or guard. Fig. 13 shows detached and in expanded condition the split or dividing ring which is employed for holding the parts of the safety-device or guard in their contracted condition. Fig. 14 is a view in longitudinal vertical section of a fuse having the firing-pin and safety-device thereof similar to the fuse of Figs. 1 to 13, but having a different form of actuating means for the firing-pin or point. Fig. 15 is a view showing in elevation detached the actuating device or plunger of Fig. 14. Fig. 16 shows in longitudinal vertical section a fuse in which the firing-pin or point is attached to a momentum-device, the said fuse containing also a modified construction of safety-device or guard, and the parts being in unarmed condition. Fig. 17 is a view in vertical transverse section on the line 17—17 of Fig. 16, looking in the direction indicated by the arrows at the ends of the said line. Fig. 18 is a view similar to Fig. 16, but showing the fuse in armed condition. Fig. 19 is a view similar to Fig. 17, with the parts in the position of Fig. 18. Fig. 20 shows in longitudinal vertical section a plunger having connected therewith a centrifugal safety-device carrying the firing-pin or point. Fig. 21 is a view of the construction shown in Fig. 20, looking from the right hand side in the latter figure, the parts being in unarmed condition. Fig. 22 is a view similar

to Fig. 21 showing the parts in armed condition. Fig. 23 is a partial view on the order of Fig. 1, showing the safety-device of Figs. 20 to 22 in position within the casing of a fuse. Fig. 24 shows in rear elevation the partition or primer disk of Fig. 23.

I will describe, first, the embodiment of the invention which is represented in Figs. 1 to 13.

The casing of the fuse, in its entirety, is designated *a* in Figs. 1 to 13. The said casing, which may vary in form and construction in practice to meet different requirements, is shown as cylindrical and screw-threaded exteriorly to adapt the same to be screwed into a projectile. It also is shown formed with recesses *a'*, *a'*, in the exterior of the head-end thereof for the reception of projections upon a suitable tool which may be used for rotating the fuse in order to screw it into or out of its place in the projectile. Other provisions for enabling the fuse to be conveniently connected with a projectile or disconnected therefrom may be adopted, as preferred. The casing is tubular to receive and contain within its interior the percussion-cap or primer *b*, the means for exploding or detonating the latter, and also when desired, a detonating charge of powder to serve in exploding the bursting charge of the projectile with which the fuse is used. The said detonating charge of powder is provided when the fuse is used in connection with a projectile of one of the larger calibers, and is omitted in the case of use in connection with a projectile of minor caliber.

While the casing may consist, essentially, of a shell of fixed length varying in length according as the detonating charge of powder is or is not employed I deem it preferable to form the casing in two different sections, as shown, and to make provision for enabling them conveniently to be secured together, when it is desired to use them in conjunction with each other, and also to be separated whenever required when so used. Thus, in the figures referred to, the casing comprises a main section, a^2, shown separately in Fig. 5, which contains the percussion-cap or primer and the means for exploding or detonating the latter, and which for this reason I term the mechanism section by way of distinction, and a second section a^3, Figs. 1, 3 and 7, which is adapted to receive and contain the detonating charge of powder, and which for convenience I term the magazine section; and the said two sections are joined together in a separable manner by being caused, respectively, to enter into screw-threaded engagement with the disk *c*, Figs. 1, 3 and 6. The said disk *c* is shown in Figs. 1 and 3 as fitting within the proximate ends of the two sections a^2, a^3, and has a screw-threaded periphery which is engaged with internal threads with which the said ends of the sections are formed. The disk *c* is shown formed with recesses *c'*, *c'*, to receive projections on a suitable tool by means of which the operation of screwing the disk into the section a^2 may be facilitated. The separable two-part construction of the casing is of advantage, inasmuch as it provides for the ready disconnection and removal of the magazine section, whereby it is rendered possible to examine the percussion-cap or primer and operative devices or mechanism without danger, and it also is rendered possible without danger to supply the fuse with a fresh charge of powder in good condition in case of deterioration of the powder that is contained in the said magazine section. Powder is liable to deteriorate in time. In the case of the usual forms of fuses it is not safe to remove the powder therefrom, and consequently the fuse as a whole must be thrown away in the event of deterioration of the powder, whereas in the case of the described construction only the section which contains the powder need be replaced by a fresh one. A disk, such as is employed in practice for closing the outer end of the magazine section a^3 is shown at *d*, Figs. 1, 3 and 8.

The disk *c* substantially closes the end of the chamber of the mechanism section, and when the magazine section is applied, as in Figs. 1 and 3, the said disk *c* constitutes a partition between the mechanism chamber and the chamber for the powder. It is formed with a pocket or seat c^{11} at the side thereof which is turned toward the chamber containing the firing-pin or point and its operating devices or mechanism, as shown most clearly in Fig. 6. The percussion-cap or primer *b* is received within the said pocket or seat, and from the latter a hole c^2 extends outward through the disk for the passage of the flame which is produced by the detonation of the said percussion-cap or primer.

A firing-pin or point is shown at *e*. In percussion fuses in which a movable firing-pin or point is employed it is customary at the present time to attach the firing-pin or point to a heavy movable piece or plunger, or to form the same as a portion of such plunger, the mass of the plunger acting, in consequence of its inertia and of the momentum which it acquires during the flight of the projectile to which the fuse is applied, to cause the firing-pin or point to detonate the cap or primer when the flight of the projectile is suddenly checked. The firing-pin or point *e* is a separate or independent piece or part, as shown by Figs. 1, 3 and 11, and is not attached to a plunger or formed as a portion thereof.

In connection with the firing-pin or point a safety-device or guard is employed, which

is capable of occupying different positions, in one of which the firing-pin or point is prevented from operating to detonate the percussion-cap or primer, the fuse being then in its unarmed condition, while in another of the said positions the firing-pin is rendered capable of acting at the proper time, the fuse being then in its armed condition. In Figs. 1 to 13, the safety-device or guard *f* constitutes a carrier for the firing-pin or point in which the latter is mounted, and by which it is supported adjacent the disk *c*. The said safety-device or guard *f* is formed with a hole through the body thereof, within which hole the firing-pin or point is placed and is intended to have capacity for movement lengthwise. At the side of the safety-device or guard which is next the disk *c*, as at *f'*, the hole corresponds in diameter with the forward portion of the stem of the firing-pin or point, while the remainder of the said hole is enlarged to form a chamber f^2 which receives the enlarged and elongated cylindrical head *e'* of the firing-pin or point. The said cylindrical head makes sliding contact with the wall of the said chamber f^2, and the firing-pin or point is thereby steadied and guided in its movements. A spiral spring *g*, Figs. 1, 3 and 11, acting expansively against one side of the head *e'*, operates with a tendency to move the firing-pin or point endwise in a direction away from the percussion-cap or primer *b*, so as to withdraw within the safety-device or guard *f* the end thereof which is intended to strike against the said percussion-cap or primer, and thereby sheath the said end. This is the normal position of the firing-pin or point. In the said position the enlarged head *e'* of the firing-pin or point projects from the rear side of the safety-device or guard into the mechanism section. Thereby the said head is exposed to the action of the device, hereinafter described, which is intended by its engagement therewith to drive the firing-pin or point endwise to carry its acting end against the percussion-cap or primer *b* for the purpose of detonating the latter.

For the actuation of the firing-pin or point *e* to cause the same to detonate the percussion-cap or primer, two movable parts or members *h* and *i* are employed within the mechanism chamber. The member *h* fits peripherally against the interior surface or wall of the said chamber, and is in sliding contact therewith. It is shown as of cylindrical form and corresponds substantially in diameter with the diameter of the chamber, so that it cannot move transversely therein and can only move longitudinally. Its forward end *h'* is intended to act against the exposed end of the head *e'* of the firing-pin or point *e* for the purpose of communicating a forward movement to the said firing-pin or point. The member *i* occupies a position in the mechanism chamber between the closed rear end of the said chamber and the member *h*. Like the latter it is capable of moving longitudinally of the mechanism chamber at the predetermined time. In addition, it is less in diameter than the said chamber, in order that it may thereby be permitted to move transversely within the chamber. The member *i* is constructed and combined with the member *h* in a manner which causes the member *h* to be moved forward longitudinally within the casing when the member *i* moves either longitudinally or transversely within the mechanism chamber. In Figs. 1, 3, 9 and 10, in order to enable transverse movement of member *i* to be converted into longitudinal movement of member *h*, the forward end of the member *i* is formed with a projecting cone *i'*, and the proximate end of the member *h* is formed with a conical cavity h^2 into which the said projecting cone *i'* of the member *i* enters and which it fits. The rear end of the member *i* is formed with a conical cavity i^2, which receives a centrally-located conical projection a^4 with which the rear end-wall of the mechanism chamber is furnished. The action of the actuating devices or mechanism as thus far referred to is as follows: It being assumed that the fuse is caused to become properly armed during the flight of the projectile to which the fuse is applied, if now the said projectile strikes endwise in its flight, the members *h* and *i* will, by their acquired momentum move forward within the mechanism chamber of the fuse, and through the combined momentum of the two members the member *h*, by acting against the head *e'* of the firing-pin or point *e*, will drive the latter lengthwise toward the percussion-cap or primer. Should the projectile strike sidewise, or with a glancing blow, the shock will cause the member *i* to move transversely within the mechanism chamber. A result of movement of member *i* transversely will be that the pressure of the surface of the cone *i'* against the surface of the conical cavity h^2 in the member *h* will cause the said member *h* to be driven longitudinally within the mechanism chamber so as to operate the firing-pin or point. The engagement of the fixed cone a^4 within the conical cavity i^2 at the rear end of the member *i* will operate with a tendency to restrain somewhat the rear end of the member *i* from transverse movement, so that the member *i* will in a measure swing or turn with reference to the cone a^4 as in effect upon a pivotal connection with the rear end of the casing, thereby increasing the effect of the cone *i'* in pressing forward the member *h* within the mechanism chamber. The rear end of the member *i* will also tend to move transversely, by slipping upon the cone a^4, and when the said

rear end thus shifts transversely the action of the surface of the said cone against the surface of the conical cavity i^2 will operate to cause the member i to move bodily forward in the direction of its length, thereby increasing the extent of the movement which is transmitted to the member h and to the firing-pin or point. For convenience of designation, I term the member h a hammer, and the member i a plunger.

The safety-device or guard f is constructed to hold the firing-pin or point e normally locked in its retracted position against all tendency to be driven forward through the action of the hammer h and plunger i, as in consequence of shocks or movements communicated in handling or transportation, and in firing the gun from which is discharged the projectile to which the fuse is applied. The said safety-device or guard is constructed, also, to be operated by the centrifugal force which is generated by the rotation of the projectile during the flight of the latter, so as to unlock the firing-pin or point and thereby leave the latter free to be actuated by the hammer and plunger. Thus it is furnished with a locking member f^3, which is movable relative to the main portion or body of the guard, the said locking member having an inwardly projecting detent-lip or flange f^4 which works within a slot f^5 that is made through the wall of the body of the guard at one side of the latter, the said slot opening into the chamber f^2, as shown. When the locking member f^3 is closed against the body of the guard, the detent lip or flange f^4 projects within the chamber f^2 into its locking position, as in Fig. 1. The locking member f^3 is held with yielding force in its inner or locking position which is represented in Figs. 1 and 2, through the action of a spring n consisting of a strip of elastic material bent into the shape of a transversely split or divided ring. The said spring clasps the body of the safety-device or guard and its locking member, and is seated in grooves n' in the exterior portions of the said parts. By the tendency of the split or divided ring n to contract, the locking member and body of the safety-device or guard are drawn together, and thereby the locking member is held in the locking position. In the outer position of the said locking member, represented in Figs. 3 and 4, which it is caused to take by the action of centrifugal force, the detent lip or flange f^4 is withdrawn so as to unlock the firing-pin or point and leave it free to be actuated by means of the hammer and plunger.

Under the influence of centrifugal force the safety-device or guard expands against the tension of the split ring n until its opposite portions make contact with the interior surface of the casing. In order that after the safety-device or guard has become expanded in the flight of the projectile so as to unlock the firing-pin or point it may be prevented from closing again into the locking position before the firing-pin or point has been caused to act against the percussion-cap or primer, I provide a latch for holding the safety-device or guard in the expanded or unlocking position thereof. To this end, in connection with the firing-pin or point e and the locking member f^3 of the safety-device or guard there is employed a small ring m, Figs. 1, 3 and 11, the said ring being contained within the chamber f^2 of the guard and being concentric with the firing-pin or point e, which passes through the central opening of the ring and fits such opening. The spring g is compressed between the said ring m and the head e' of the firing-pin or point, the said head being formed with a flange which projects outside the spring g toward the ring m. In the unarmed condition of the fuse which is represented in Fig. 1, in which the locking member f^3 of the safety-device or guard is closed against the body of the safety-device or guard, with its detent lip or flange f^4 projecting into the chamber f^2, the ring m occupies a position between the said detent lip or flange and the flange of the head e' of the firing-pin or point, the spring g being compressed within the space inside the flange of the head. The detent lip or flange f^4 in this position prevents forward movement of the ring m; the latter in turn by its engagement with the flange of the head e' prevents the firing-pin or point from being moved forward. Consequently, the firing-pin or point is held positively in its retracted position, with the acting end of the firing-pin or point sheathed within the safety-device or guard. Outward movement of the locking member f^3 sufficient to withdraw the detent lip or flange f^4 from in front of the ring m will permit the said ring m to be pushed forward by the spring g, as the latter expands, into the position in which it is represented in Fig. 3. This release of the ring m will also release the firing-pin or point from all restraint other than that of the spring g, and renders it capable of being driven forward by the action of the hammer h and plunger i when the projectile strikes in its flight. In the position of the parts which is represented in Fig. 3, the fuse is armed. The members of the safety device or guard having assumed their expanded condition, and the firing-pin or point having been thereby unlocked, the ring m is moved by the spring g as the latter expands, into line with the detent-lip or flange f^4 of the locking member f^3, as shown in Fig. 3. This prevents accidental return of the movable locking-member f^3 to its locking position. It will be perceived that the ring m serves three pur-

poses. It acts as a guide for the firing-pin, or point. In the position of the parts which is represented in Fig. 1 it coöperates with the detent-lip or flange f^4 in locking the firing-pin or point against forward movement. In the position of the parts which is represented in Fig. 3 it engages with the detent-lip or flange f^4 to lock or latch the movable locking member f^3 of the controller or guard in its expanded position, and thereby prevents the firing-pin or point from accidentally becoming locked against movement under the action of the hammer and plunger.

At one side of the center of the firing pin or point the exterior of the body of the safety-device or guard is formed as a segment of a circle which is concentric with the said firing-pin or point. At the opposite side of the center of the firing-pin or point the body of the safety-device or guard is reduced diametrically, and to this reduced portion of the said body the movable locking-member is applied, the exterior of the said locking member having the same curvature as that of the opposite portion of the body. In the expanded condition of the safety device or guard which is represented in Fig. 3 it fills the portion of the mechanism chamber within which it is located, and the firing-pin or point is brought to and held at the center of the said chamber in line with the percussion-cap or primer b. In the contracted condition of the safety-device or guard it does not fill the said chamber, and is capable of movement transversely within the same. In this condition thereof the radial measurements at the side of the same to which the movable locking member is applied are less than those of the chamber, and consequently if this side of the contracted safety-device or guard rests against the inner surface of the wall of the casing the firing-pin or point will occupy an eccentric or off-center position, out of line with the percussion-cap or primer, as shown in Figs. 1 and 2. In this manner the chances of detonation of the percussion-cap or primer in an accidental manner are greatly diminished, since the contracted safety-device or guard is quite likely to assume the off-center position in which it is represented in Figs. 1 and 2.

In the unarmed condition of the fuse which is represented in Figs. 1 and 2, the safety-device or guard occupies a position with the forward side thereof in contact with the disk c, while at the other side of the safety-device or guard the end of the head e' of the firing-pin or point e makes contact with the forward end of the hammer h. Through the engagement of the head e' with the hammer the latter is held firmly in contact at its rear end with the forward end of the plunger i, and the rear end of the plunger i is held firmly against its seat at the rear end of the mechanism chamber. With the parts thus held together, the cones and conical cavities which are located at the opposite ends of the plunger interact to hold the plunger centered with reference to the longitudinal axis of the fuse. In the armed condition of the fuse which is represented in Figs. 3 and 4, the spring g presses the head e' of the firing-pin or point e against the forward end of the hammer h and continues to keep the parts firmly pressed together. Thus, normally, the plunger is held locked positively in its centered position, and at the start of the flight of the projectile to which the fuse is applied it remains thus positively locked until by the expansion of the safety-device or guard the firing-pin or point is unlocked, after which the tension of the spring continues to hold the hammer pressed firmly against the forward end of the plunger, and the rear end of the plunger pressed firmly against the seat therefor which is provided at the closed rear end of the mechanism chamber, until the projectile strikes. Through the uniform distribution of the mass of the plunger with reference to the longitudinal axis of the fuse, which is the axis on which the projectile and fuse rotate during the flight of the projectile, the centrifugal force which is generated by the rotation of the projectile in its flight has no tendency to throw the plunger transversely within the mechanism chamber. Hence, the plunger cannot be operated by centrifugal force in the flight of the projectile to drive the hammer h and firing-pin or point e forward so as to detonate the percussion cap or primer and cause the projectile to explode during flight, as would occur if the plunger were mounted loosely within the case and not held properly in its centered position. It will be clear that the pressure of the head of the firing-pin or point against the forward end of the hammer h, resulting from the action of the spring g, during the flight of the projectile, will operate to prevent creeping forward of the plunger and hammer during such flight, in consequence of retardation in the rate of movement of the projectile.

I contemplate in some cases replacing the hammer h and plunger i which are shown in Figs. 1 to 4, 9, and 10, by a single plunger o which is shown in Figs. 14 and 15, Sheet 2, of the drawings. The front portion of the said plunger is less in diameter than the chamber of the mechanism section a^2 of the casing. The rear portion of the said plunger is conical, usually truncated, as in Fig. 14, and the rear end of the mechanism chamber is correspondingly shaped to form a conical cavity to receive this portion of the plunger. The plunger o is capable of forward movement in the direction of its length when re-

leased to partake of such movement by the unlocking of the firing-pin or point *e*, and it is also intended to have transverse movement within the said chamber. When the projectile to which the fuse is applied strikes endwise the plunger *o* will move longitudinally within the mechanism chamber, and acting as a momentum-device will operate with a tendency to drive the firing-pin or point *e* forward. When the projectile strikes a glancing blow, or sidewise, the tendency of the plunger *o* to move transversely will result in forward or longitudinal movement of the said plunger due to the interaction of the surface of the conical portion of the plunger with the conical portion of the surface of the inner wall of the casing at the rear end of the mechanism chamber.

Figs. 16 to 19 show certain of the improvements embodied in a construction in which the firing-pin or point is attached to a longitudinally movable piece or carrier, the latter being actuated by a plunger which is capable of movement both longitudinally and transversely of the casing, as in the case of the plunger *i* of Figs. 1 to 13. The longitudinally movable piece is designated h^9, it taking the place of the hammer *h* of the construction shown in Figs. 1 to 13. The acting end of the firing-pin or bolt e^9 projects beyond the forward end of the said piece or carrier h^9, the said carrier being of a diameter to fit the interior surface of the wall of the mechanism section a^2, so as to prevent the carrier from transverse movement, while leaving it free to move longitudinally. The plunger i^9 is in general similar to the plunger *i* of Figs. 1 to 13, it having a conical cavity in its rear end which fits a conical projection a^{49} extending forward at the center of the rear end-wall of the casing. The forward end of the plunger i^9, however, is formed with a central conical cavity in place of the conical projection of Figs. 1 to 13, while the rear end of the carrier h^9 has a central conical projection entering and fitting the said conical cavity of the plunger i^9. The safety-device or guard of Figs. 16 to 19 is somewhat different from that of Figs. 1 to 13, it comprising two opposite pieces f^9 which respectively are approximately semicylindrical exteriorly. The plane faces of the meeting sides of the two sections f^9, f^9, fit together, and when thus fitted together the safety-device is smaller in diameter, in nearly all directions, than the portion of the chamber within the magazine section in which the safety-device is placed. In the collapsed or contracted condition of the safety-device or guard, which is shown in Figs. 16 and 17, the said device therefore is movable transversely within the chamber of the casing. The said safety-device or guard occupies a position between the carrier h^9 and the disk *c*. The sections f^9, f^9, thereof are formed with marginal flanges f^{91} f^{91} projecting at the side of the safety-device or guard toward the carrier h^9. In the contracted or collapsed condition of the safety-device or guard, which is the condition thereof which is operative to keep the fuse unarmed, one or both of the flanges f^{91}, f^{91}, project in front of the forward end of the carrier h^9 and engage therewith. As a result of this engagement the safety-device or guard, which is restrained from forward movement by contact with the partition *c*, serves to hold the carrier h^9 in its rearward position. A divided spring *n*, surrounding and embracing the two sections of the safety-device or guard, operates to hold the latter normally in its contracted condition, a hole or opening at the center of the safety-device or guard receiving the forwardly projecting end of the firing-pin or point. When the projectile to which the fuse is applied is fired from a gun the centrifugal force which is generated by the rotation of the projectile in its flight operates to expand the safety-device or guard. As the safety-device or guard expands within the chamber of the mechanism section a^2 of the fuse, the flanges f^{91}, f^{91}, pass outward entirely beyond the forward end of the carrier h^9 as shown in Fig. 18. That portion of the mechanism chamber in which the safety-device or guard is located is sufficiently enlarged radially, as shown in the said figure, to permit of the extent of radial movement of the sections of the safety-device or guard which is necessary in order to enable the flanges f^{91}, f^{91}, to be carried out beyond the carrier h^9 so as to clear and release the latter. In this expanded condition of the safety-device or guard the carrier h^9 is free to move forward within the casing of the fuse.

In Figs. 16 and 18 there is shown a lock for the safety-device or guard acting on the principle of that which is employed in the construction shown in Figs. 1 to 13, and comprising essentially a longitudinally movable member in the shape of a sleeve m^9 fitted upon the exterior of the firing-pin or point e^9. The carrier h^9 is chambered around the firing-pin or point e^9 to receive the locking member m^9 and the expanding spiral spring g^9 which surrounds the latter. The locking member m^9 is formed at its forward end with a cylindrical locking portion m^{91}, adjacent which is a projecting flange or collar m^{92}. The spring g^9 is compressed between the enlarged outer end of the locking member m^9 and the inner end of the chamber h^{91} of the carrier h^9. The said spring acts with a tendency to project the locking member m^9 forward. In the contracted condition of the safety-device or guard the forward end of the locking member makes contact with the rear ends of the sections f^9, f^9, of the safety-device or guard, but when the safety-device or guard

expands the outward movement of the said sections increases the opening at the center of the safety-device or guard sufficiently to receive the cylindrical portion m^{91} of the locking member, and the said locking member therefore is permitted to be moved forward by the action of its spring g^9, the said portion m^{91} entering the said opening at the center of the safety-device or guard. See Fig. 18, in which the fuse is shown in armed condition. The extent of the forward movement of the locking member m^9 is limited by contact of the collar or flange m^{92} with the ends of the sections of the safety-device or guard. The locking member m^9 corresponds in length with the distance between the rear ends of the sections f^9, f^9, and the inner or rear end of the cavity or chamber h^{91} within the carrier h^9. It is, therefore, capable of serving in the contracted condition of the safety-device or guard to lock the carrier h^9 in its rearward position in case the flanges f^{91}, f^{91}, of the sections f^9, f^9, are not called upon to act for this purpose.

Figs. 20 to 23 show a carrier h^8 having in connection therewith a transversely movable safety-device or guard f^8 to which a firing-pin or point e^8 is affixed. The safety-device or guard f^8 fits against the front end of the body of the carrier h^8 between the said body and partition c, the said safety-device or guard having at its front side a flange f^{81} which by contact with the adjacent surface of the partition c in the contracted condition of the safety device that is shown in Fig. 21 acts to hold the carrier h^8 in its rearward position so as to prevent the end of the firing-pin or point from engaging with said partition. From the body of the carrier h^8 projects forwardly a flange h^{81}. A divided or split elastic ring n^8 encircles the said flange, and also the safety-device or guard f^8, and acts to hold the said safety-device or guard pressed radially against the flange h^{81}, as in Figs. 20 and 21. In the position of the safety-device or guard which is shown in Figs. 20 and 21, and which corresponds with the unarmed condition of the fuse, the firing-pin or point e^8 is off-center, and also out of line with the percussion-cap or primer which it is intended to detonate. The mass of the flange f^{81} is sufficiently great to produce a preponderance of weight at the side of the longitudinal axis of the carrier h^8 at which such flange f^{81} is located, so that in the rotation of the projectile to which the fuse is applied the centrifugal action will cause the safety-device or guard to move transversely away from the flange h^{81} until the opposite side of the safety-device or guard makes contact with the inner surface of the casing of the fuse. When such contact occurs, the firing-pin or point e^8 will be centered, as in Fig. 22, and in line with the percussion-cap or primer. A locking device for retaining the safety-device or guard f^8 in centered position is shown in Fig. 20, it comprising a bolt m^8 occupying a chamber h^{82} in the body of the carrier h^8, and backed up by an expanding spiral spring g^8, the said bolt being projected by the action of the spring, as the latter expands, into a hole or cavity f^{83} in the rear end of the safety-device or guard, when such hole or cavity is presented fairly in position opposite the bolt by the outward or radial movement of the safety-device or guard. The side of the partition c which is turned toward the carrier h^8 is rabbeted, as at c^3, Figs. 23 and 24, at the periphery of the partition. In the expanded condition of the safety device which is represented in Fig. 22, the flange f^{81} is presented in line with the annular recess that is produced by the rabbeting, and consequently the carrier h^8 is unlocked and rendered free to advance within the casing so as to carry the firing pin or point against the percussion cap or primer.

I claim as my invention:—

1. In a safety percussion fuse, in combination, a percussion-cap or primer, a firing-pin or point, and a centrifugally-operated support for the said firing-pin or point relative to which the latter is independently movable longitudinally of the fuse, the said support adapted to hold the firing-pin or point normally out of operative alinement with the percussion-cap or primer, and moved under centrifugal action to place the firing-pin or point in operative relations with the percussion-cap or primer.

2. In a safety percussion fuse, in combination, a percussion-cap or primer, a firing-pin or point, a centrifugally-operated support for the said firing-pin or point relative to which the latter is independently movable longitudinally of the fuse, the said support adapted to hold the firing-pin or point normally out of operative alinement with the percussion-cap or primer, and moved under centrifugal action to place the firing-pin or point in operative relations with the percussion-cap or primer, and a hammer independent of the said firing-pin or point to actuate the latter.

3. In a safety percussion fuse, in combination, a percussion-cap or primer, a firing-pin or point, a relatively fixed support for one of the said elements, a momentum device, and a centrifugally-operated support and safety device or guard located between the said momentum device and the said support and moved transversely by centrifugal action in the flight of the projectile to place the fuse in armed condition, the said firing-pin or point being independently movable relative to the said safety device or guard, longitudinally of the fuse.

4. In a percussion-fuse, in combination, a percussion-cap or primer, a firing-pin or point, a centrifugally-operated support for

one of said elements relative to which the latter is longitudinally movable, said support being adapted to hold the said element normally out of operative alinement with the other thereof and moving under centrifugal action to place the firing-pin or point and percussion-cap or primer in operative relations with each other, and a hammer independent of the said firing-pin or point to engage and actuate the said longitudinally movable element.

5. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point and its actuating means, a centrifugally-expansible safety-device or guard normally supporting the said firing-pin or point and relative to which the firing-pin or point is independently movable longitudinally of the fuse, and whereby the fuse is armed during the flight of the projectile, and yielding means to hold the safety device or guard normally in unarming condition.

6. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point and its actuating means, a centrifugally-expansible safety-device or guard supporting the said firing-pin or point and relative to which the firing-pin or point is independently movable longitudinally of the fuse, and yielding means to hold the safety device or guard normally in unarming condition, and means to lock the said safety-device or guard in its expanded condition.

7. A safety percussion fuse comprising, in combination, a percussion-cap or primer, a firing-pin or point, and a safety-device or guard whereby in the unarmed condition of the fuse one of the elements first mentioned is permitted to move transversely of the fuse but is locked against longitudinal movement, and in the armed condition is locked against transverse movement and left free to move longitudinally to detonate the percussion-cap or primer.

8. In a safety percussion fuse, the combination with a casing, a percussion cap or primer, a support for said cap or primer, and a firing-pin or point, of a safety-device supporting a longitudinally-movable firing-pin, and which normally prevents the firing-pin or point from exploding the cap or primer, but permits relative transverse movement between the said cap or primer and firing-pin or point, and in its arming condition alines the said parts and releases the firing-pin or point.

9. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point, one of the said elements being movable with relation to the other thereof to occasion a detonation of the said percussion-cap or primer, a centrifugally-expansible safety-device or guard constituting a carrier for one of the said elements and relative to which the latter is movable longitudinally of the fuse, and means to lock the said safety-device or guard in expanded condition.

10. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point, one of the said elements being movable longitudinally of the fuse with relation to the other thereof, a safety device or guard operated by centrifugal force during the flight of the projectile but normally operating to prevent the said longitudinal movement, a locking collar or ring fitting the said firing-pin or point, and a spring to actuate the said collar or ring to lock the safety device or guard in its arming condition.

11. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point, one of the said elements being movable longitudinally of the fuse with relation to the other thereof, an expansible safety device or guard operating in its normal condition to prevent such movement, a locking collar or ring fitting the said firing-pin or point, and a spring to actuate the said collar or ring to lock the safety device or guard in its expanded condition.

12. In a safety percussion fuse, in combination, a longitudinally-movable firing-pin or point, an expansible safety-device or guard supporting the said firing-pin or point, a locking collar or ring fitting the said firing-pin or point, and a spring to actuate the said collar or ring to lock the safety-device or guard in its expanded condition.

13. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point, actuating means for the said firing-pin or point, a safety-device or guard preventing in the unarmed condition of the fuse the firing-pin or point from being actuated to detonate the percussion-cap or primer, while permitting in such condition transverse movement of the firing-pin or point relative to its actuating means and to the percussion-cap or primer, and expanding under centrifugal action to hold the firing-pin or point from transverse movement while rendering it operative by its actuating means to effect the detonation.

14. In a safety percussion fuse, in combination, the firing-pin or point, means to actuate the said firing-pin or point, and the centrifugally-expansible safety-device or guard supporting the firing-pin or point and having a relatively-movable member provided with a detent.

15. In a safety percussion fuse, in combination, the firing-pin or point, means to actuate the same, the centrifugally-expansible safety-device or guard supporting the

firing-pin or point and having a relatively-movable member provided with a detent, and the spring to hold the firing-pin or point in retracted position.

16. In a safety percussion fuse, in combination, the firing-pin or point, means to actuate the same, the centrifugally-expansible safety-device or guard supporting the firing-pin or point and having a relatively movable member provided with a detent, and the lock whereby the said safety-device or guard is retained in its expanded condition.

17. In a safety percussion fuse, in combination, the hammer, the firing-pin or point, a centrifugally-operated safety-device or guard having a relatively movable member provided with a detent, a locking-ring, and a spring interposed between the said ring and the head of the firing-pin or point.

18. In a safety percussion fuse, in combination, the casing, a hammer fitting the interior of said casing and movable longitudinally within the latter, a plunger arranged between the hammer and one end of the casing, movable transversely within the casing, and operating when thus moved to impel the hammer longitudinally, a centrifugally-expansible safety-device or guard supporting the firing-pin or point and having a relatively-movable member provided with a detent.

19. In a safety percussion fuse, in combination, the casing, a hammer fitting the interior of said casing and movable longitudinally within the latter, a plunger arranged between the hammer and one end of the casing, movable transversely within the casing and having the conical bearings at its opposite ends, the centrifugally-expansible safety-device or guard supporting the firing-pin or point and having a relatively-movable detent-member, and the spring to hold the said firing-pin or point pressed rearwardly.

20. In a safety percussion fuse, in combination, the casing, a hammer fitting the interior of said casing and movable longitudinally within the latter, a plunger arranged between the hammer and one end of the casing, movable transversely within the casing, and having the conical bearings at its opposite ends, the centrifugally-expansible safety-device or guard supporting the firing-pin or point and having a relatively-movable detent-member, the spring to hold the said firing-pin or point pressed rearwardly, and the lock coacting with the firing-pin or point and detent-member.

21. In a safety percussion fuse, in combination, a support for a percussion-cap or primer, a firing-pin or point, a hammer movable longitudinally within said casing, a plunger movable transversely and longitudinally to actuate the said hammer, and a centrifugally-operated safety-device or guard having the said firing-pin or point movably supported thereby and by which the firing-pin or point is brought into operative relations to the percussion-cap or primer during the flight of the projectile.

In testimony whereof I affix my signature in presence of two witnesses.

DAVID J. CARTWRIGHT.

Witnesses:
CHAS. F. RANDALL,
WILLIAM A. COPELAND.