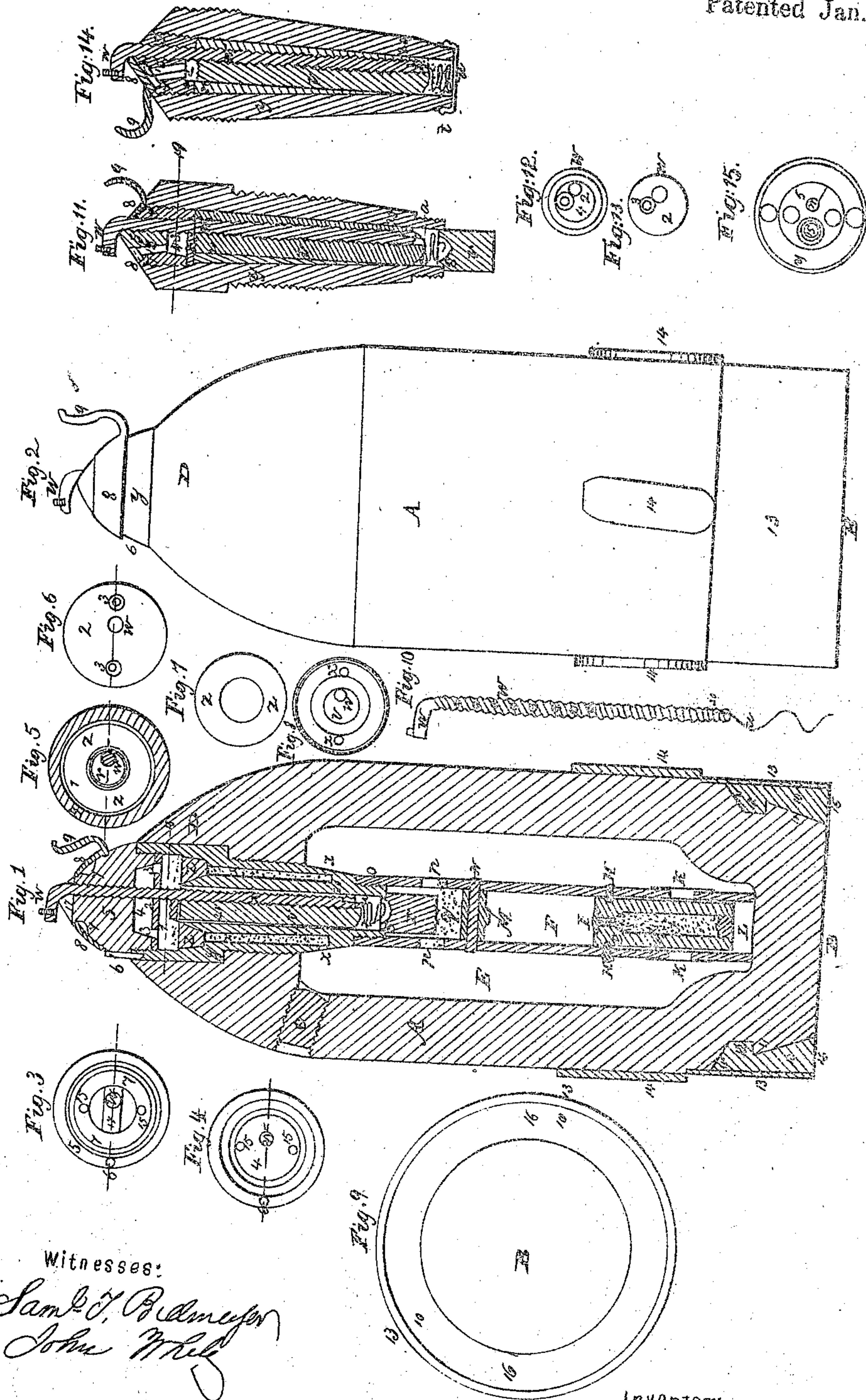


W. W. HUBBELL.

Shell-Fuse.

No. 34,059.

Patented Jan. 7, 1862



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IMPROVEMENT IN EXPLOSIVE SHELLS FOR ORDNANCE.

Specification forming part of Letters Patent No. 34,059, dated January 7, 1862.

To all whom it may concern:

Be it known that I, WILLIAM WHEELER HUBBELL, of the city of Philadelphia, State of Pennsylvania, have invented a new and useful Improvement in Projectiles for Ordnance; and I hereby declare the following to be a full, clear, and exact description thereof.

The nature of my invention consists, first, in constructing an expanding fire-chamber around the mouth of the burning column of the fuse, with a flat base and direct or quick acting vent, to expand and hold the fire to explode the shell, notwithstanding the entrance of water; second, in the construction and manner of application of an improved device, to explode the projectile on percussion, after firing it from a gun, as well as on time; third, in the construction and manner of application of an improved device to explode the projectile on concussion after firing it from the gun; fourth, in the construction and manner of application of an improved device to explode the projectile on impact after firing it from the gun; fifth, in the construction and manner of application of an improved device to explode the projectile at any instant of time and any place or position after firing it from the gun; sixth, in the construction and manner of applying these improved devices together in one projectile, so as to develop their respective properties, as exigencies may require in an action, in the same projectile.

For information I will explain that the explosion by or on "percussion" is caused by the use of detonating powder or other detonating substance, to originate the fire without ignition by the fire generated in the gun. The explosion on "concussion" is where the fire generated in the gun by the cartridge ignites a composition in a fuse carried by the projectile, which composition burns in the flight, and the shock of concussion, by a device, admits the fire thus generated to the explosive contents of the projectile. The explosion on "impact" is where the projectile also takes its fire from the gun and burns in the flight, and by devices applies the fire to the explosive contents through the agency of its being bedded or closed, or becoming a mine in any material without regard to shock or concussion, or the *vis inertiae* of any body in the projectile. The explosion at "any" desired "instant of time" is where the projectile contains

a device capable of regulation to cause the fire of its fuse to come in contact with its explosive contents at the expiration of any desired fixed time after the flight has commenced, and then explode, either in the air or among troops or cavalry, or in any material it may have entered, and be at the time.

For a detailed statement of the manner of constructing and applying my invention, I will refer to the accompanying drawings by letters and figures.

In these drawings, Figure 1 represents a longitudinal section through the center of the projectile, with the device for causing the rifle motion and the devices for exploding it on percussion, on concussion, on impact, and at any desired instant of time all combined. Fig. 2 represents a side perspective view of the projectile. Fig. 3 represents a top view of the capping of the fuse with its lead cover 8 removed and the timing-rod W removed. Fig. 4 represents a perspective view of the bottom of the capping 5 and its fire-chamber 4. Fig. 5 represents a view of the lower part of the chamber 1 on the line 18, Fig. 1. Fig. 6 represents a ground view of the water-plate 2 of the fire-chamber 4. Fig. 7 is a top view of the concussion device or lead stopper Z. Fig. 8 is a ground view of the annular recess, in which the concussion device is located to cover its firing-vents *x x*. Fig. 9 is a rear view of the projectile. Fig. 10 is a perspective view of the timing-rod W removed. Fig. 11 represents a longitudinal section of the fuse without the concussion device and without the percussion device. Fig. 12 is a section on the line 19 of Fig. 11, showing the fire-chamber 4 and the vent 3 of its water table or plate 2. Fig. 13 is a ground-plan of the water-table. Fig. 14 is a longitudinal section of the fuse without either the water-table or the concussion device, or the percussion device or the safety attachment *r*; but it shows the timing principle in the simplest form of fuse adapted for field-service. Fig. 16 is a top view of the fuse, Fig. 14, with its lead cover and timing-rod removed.

The body A of the projectile is hollow, and the space E contains gunpowder to explode it. When the percussion-exploder is employed, the hollow is filled through the filling-screw C. When this percussion device is omitted, the hollow may be filled through the fuse-hole in

the front D. The body A of the projectile is cylindrical from the rear or base B to the curve of the front D, which is formed on a curve with a radius equal to or about the same as the diameter of the cylindrical body. The total length of the projectile should be equal to, or about equal to two and a half times its diameter. This long cylindrical body gives a good bearing to prevent shake in the gun. The cylindrical part should be turned off true, and about three-hundredths of an inch windage allowed. The front D is re-enforced, as shown in Fig. 1, so as to support the fuse and to compensate for the increased weight given to the rear B by the lead and copper or malleable band employed to obtain the rifle motion in the grooves of the rifle-gun, and to close the windage, so that the center of gravity shall be at about the center or middle of the length of the projectile. In the solid shot using this band of lead and copper on its base, this location of the center of gravity is attained by casting a cylindrical hole in the base, extending forward to the middle of the projectile.

The expanding band is similar to that described in my patent of January 24, 1860, 13 being the copper facing, 10 the lead filling, 12 the groove, 11 and 11' the beveled facing, and 14 are lugs for large sizes of shells, for improvements in forming and fastening which I intend to apply for separate Letters Patent.

The percussion device for exploding the projectile consists of a cylinder, F, of brass or iron screwed or secured in front at O onto the inner end of the fuse-stock, and the lower or rear end of the cylinder bears on the bottom of the projectile, and is covered with paper between them, the bottom of the projectile being faced by the same tool, which forms the shoulder at y, so as to make a uniform bearing. In the cylinder is a striker, G, of brass, or lead and antimony, or type-metal, carrying fulminate i in its front, and with a magazine, j, secured by a cork, the striker, for safety, being held by two small lead screws, H H, opposite the holes K K, and with a space, L, for the striker to recede in, cutting off the soft or lead screws by its inertia when the projectile starts in the gun, in the manner described in my patent of 24th January, 1860. The improvement in this percussion device at present consists in securing a head, M, in the cylinder by means of a pin, N, through it and the cylinder, or by means of screw-threads inside of the cylinder, or their equivalent, below the inner end of the fuse-column, and in securing the percussion-cylinder to the inner end of the fuse-stock, as described; or the head M may be formed of the inner end of the fuse-stock, if the safety-stopper r be omitted, thereby combining the percussion device with the fuse, so that both shall be capable of operating as required in the same projectile; also, in forming a chamber, q, between the head M and the fuse-stock, with holes p p for the safety-stopper r to act in and for the fire to pass from the fuse to the explosive

contents of the projectile in the space E, notwithstanding the use of the percussion device attached to it. When the projectile strikes to penetrate an object and materially retard its velocity, the *vis inertiae* of the striker, then lying in the rear of its cylinder, causes it (the striker) to fly forward and explode its fulminate against the nipple or head M, and the explosion of the magazine j drives its fire back through the holes K K, through the paper which covers them, into the powder of the projectile at E, causing its explosion by the time it has penetrated.

The concussion device consists in forming in the metal or brass of the fuse-stock, around the mouth of the burning column v, a beveled-faced annular groove, in which is set, with heavy or one thousand pounds pressure, a ring, Z Z, of lead, covering over two holes, x x, which extend from the base of this groove to the interior of the projectile x' x', and filled with gunpowder secured in them by a little wax at x' x'. This lead ring Z Z, when in its seat, excludes the fire of the fuse from the holes x', and when the lead ring, by its *vis inertiae*, flies forward on the concussion or penetration of the projectile, it admits the fire to the holes x to explode the projectile. In front of the lead ring is formed a chamber, 1, which receives the fire from the smaller mouth of the fuse-column v and expands it as it burns, and this chamber is large enough to receive the lead ring as it flies forward to uncover the holes x when the projectile is penetrating. The fire expands in the chamber 1 horizontally as it issues from the smaller aperture of the column v', and passing horizontally or laterally finds its way out of the vents or holes 3 3, which are opposite the base of the chamber 1, so that any water in the flight or on ricochet that may enter shall not pass into the burning column; also, the mouth of the aperture or column v is slightly raised above the base of the chamber, to prevent water from entering the aperture. So, also, the mouths of the vents 3 3 are slightly raised above the base of the water table or plate 2, to prevent water from entering these holes, and prevent the extinguishment of the fuse-column, or make it hold its fire. When the projectile penetrates into any material, its velocity is retarded, and the momentum of the lead ring or valve causes it to fly forward out of its seat against the holes 3 3, thus uncovering the holes x x and directing the fire to them, which, by their priming of powder, lead the fire directly into and cause the explosion of the powder of the projectile in the hollow E, on concussion.

The impact device consists in forming the fuse with a cylindrical hollow, y, and burning column v open on the inner end at t, of the same diameter with the fire-chamber 4 in a water-capping between the outer vent or vents, 15, and a water table or base, 2, with a vent or vents, 3, through it, so that the fuse shall carry the fire and not be extinguished by the impact or material nor by water; but the im-

pact stopping the outer vent, 15, the accumulation of gas in the cylinder of the stock from the burning composition shall produce an internal pressure to force the remaining composition back through the inner cylindrical end of the stock into the explosive powder while on fire, and thus explode the projectile on impact; also, to protect the burning composition from dampness and for safety; and so as to also apply the timing principle, presently described, I screw a lead stopper, *r*, a short distance into this inner end of the stock at *s*. The screw-thread is formed on it by setting it into the threads of a screw-cut die by a pointed punch forming the bowl in the end of this safety-stopper at *s*, and a little dissolved gum-shellac is placed around it at *s* to secure it in place water-proof and tight; also, on the front of the fuse-capping 5, I form an annular priming-chamber, 7 7, and cover it with a leaden ring or cover, 8, with a handle, 9, by which it is pulled off when the projectile is placed in the muzzle of the gun, to expose the priming of this annular chamber to the fire of the gun for ignition. From the priming-chamber 7 one or more vents, 15, lead into the fire-chamber 4. The fire-chamber 4 is formed by an opening turned, bored, or cast in the bottom of the capping and set over a water table or plate, 2, with one or more vents 3 through it, communicating with the burning column. The vent 3 is swelled above the surface of the plate, so that any water on the plate shall not run into the vent, but will be dissipated and dispelled out of the outer vents, 15. To prime the capping and chambers, a strand of quick-match is coiled around in the priming-chamber 7, and down one of the vents 15, into the fire-chamber 4, where a little mealed composition is placed, and the strand coiled and cut off, and another strand of quick-match extends from the chamber, through the vent 3, into the chamber 1, and coiled loose, and a little mealed composition placed in that chamber; also, a piece of cotton-match is pressed on the top of the composition column. When the charge of the gun is fired and the projectile starts in the gun, the lead stopper *r* strips its screw-threads and opens the inner end of the stock for the admission of the fire through it. The inner end may also be closed with muslin coated with shellac, as in Fig. 14. In this a little powder is first put in the space *t* to ignite, and blow the cover and fire in finally. The firing of the gun ignites the priming and the composition column of the fuse.

To explode the projectile at any instant of time, I have invented a device of great importance. It is very desirable, in an action, to be able to explode the projectiles at any time and place among infantry or cavalry, or in any object, all in the same shell and without opening the fuse or removing it, and by a quick and positive or certain manipulation. To accomplish this result, I drive the composition column *v* to burn for a long range or period, as desired, and with a steel rod or

spindle set and held by a die in the bottom, on one side of the column, where the timing-rod *W* is located, or in the center of the column. The steel rod has one thickness of thin paper around it, forming a paper face to the opening it will leave when drawn out. The composition may also be driven in a paper case or lining, 21, held in a steel die, or held by the stock itself, the driving-tool being steel, and grooved or bored to fit to the steel rod and notched like a wafer seal on its end. The composition may consist of seventy-six parts of niter, six parts of charcoal, and sixteen parts of sulphur well powdered and mixed together and driven with about two thousand two hundred pounds pressure on the drift to each .4 of an inch of the column. When the composition is driven, the steel rod is drawn out, leaving the hole with the paper face down the side of the column at *W*, or in its center. Below the column I leave a space or chamber, *t*. I construct a timing-rod, *W*, of brass, with a quick or double, treble, or four-threaded screw cut on it, which rod passes through the water-plate 2 and screws through the capping 5, which holds or sustains it. It also easily screws down into the opening at *W*, formed by the steel rod and stops it up as far as it extends, so as to exclude the fire. In the lower end of the timing-rod is a slit, 20, holding a strand of quick-match *u*, which lies in the space *t*. On the upper end of the timing-rod is a crook or handle or a button to turn it. When the timing-rod is entirely down, the fuse must burn its whole length before its time expires, and to shorten the time to any desired instant the rod is turned quickly and screwed out or upward, which opens the hole and raises the quick-match in the hole, so that when the column burns to such fixed point the fire passes down the hole and quick-match into the powder, which explodes the projectile. The sides of the timing-rod are provided with notches filed across them, opposite each other. (shown on one side in Fig. 10,) and the rod *W* is broken off at the top of the capping 5 at one of these notches nearest to it, when it has been screwed out to shorten the time. Each notch and each thread of the screw, or each turn of the rod, determines a certain shortening of the time to any desired point or distance, easily determined in firing, according to the size of the thread, length, and composition of fuse, and the weight of projectile, elevation, and charge used. In Fig. 1, the timing-rod comes out in the screw-notch 17; and I have contemplated, in some projectiles for field-service, to make the rod for timing on the same principle, of soft copper and smooth, (not screw-cut,) and to slide or draw up to shorten the time, and secure it by bending it over in front in this screw-notch 17, and clip the outer end off, thus holding and protecting it at its set-point until the projectile explodes. By drawing or screwing this timing-rod up the time of the fuse is shortened to any instant to cause explosion on time from the extreme

range—say four or five miles range—down to close to the gun, without opening the fuse or shell, and while the fuse is in the projectile. The gradation of the time and distance will result from the proportions, quality, and length of the composition-column, which is capable of infinite variation, and of the charge in the cartridge; and is always ascertained or tested with every mixing or supply by firing a few of the fuses or projectiles of the size desired to be used, as is usual in practice in timing fuses and proving powder. To temper the composition of the fuse a little quicker add a little charcoal; to temper it slower add a little niter. The proportions of the composition before stated will burn about an inch in six seconds. The following proportions will burn about an inch in three seconds: niter, seventy-six ounces; sulphur, sixteen ounces; charcoal, eight ounces. The following proportions will burn about one inch in eight seconds: niter, seventy-seven ounces; sulphur, sixteen ounces; charcoal, five ounces. The following proportions will burn about one inch in seven seconds: niter, seventy-eight ounces; sulphur, sixteen ounces; charcoal, six ounces.

These devices to explode projectiles on impact, and at any instant of time, may be applied to spherical projectiles as well as to elongated or rifle projectiles, constructed without the percussion or the concussion devices attached to them, as shown in the Figs. 11, 12, and 13, and Figs. 14 and 15; and for very large spherical shells all the devices may be applied—that is, the percussion, the concussion, the impact, and the timing devices, as shown in section in Fig. 1, and in Figs. 2, 3, 4, 5, 6, 7, 8, and 10; and in loading the spherical shell, the fuse or exploder described should always be placed in the same position in the gun as in the rifle projectile—that is, foremost, and coincident or parallel, as to its axis, with the axis or line of fire of the gun. A small pin, 6, holds the capping, so as to unscrew or take out the fuse without straining the timing-rod.

Type-metal, or a combination of lead and antimony, may be used to make the fuse-stock *y*, when the thickness of the shell in front is sufficient to support the metal, either by a coned face or a screw-thread throughout its length, or particularly at or near its inner end, so that the stock shall not be strained or part by the inertia of such weak metal. The drawings, Figs. 1, 11, and 14, show the fuse-stock constructed or formed so as to be supported in this manner and admit of the use of type-metal, it being much cheaper to make it of such metal than of gun-metal or brass. The water-capping and water table or plate are best made of brass. The stock may also be brass.

Having now fully described my invention, and the manner of making and using it, what I claim is—

1. The vent 15 opposite and nearly or quite at right angles to the base of the chamber 4,

to receive and discharge the fire as quick as possible, and deliver the water direct on the base of the chamber to diffuse it in the best manner, as described.

2. Expanding the fire in an enlarged chamber around the mouth of the burning column, so as to secure a large body of fire to insure the explosion of the shell, as described.

3. Combining the percussion-exploder with the burning fuse by securing the cylinder *F* to the inner end of the fuse-stock, and providing it with a head for the striker inside of the cylinder, so as to unite the percussion and the fuse principles for explosion, as described.

4. The lead stopper *v*, inserted in and secured to the inner end of the fuse-stock, by screw-threads or similar means, as and for the purpose described, and also forming the chamber or space *t*, between this stopper and the burning column, as described.

5. The chamber *q* and its opening *p*, between the head *M* and the fuse column, as described.

6. The lead or metallic stopper *Z Z*, in the metal base or groove, covering the holes *x*, and releasing on concussion to explode the projectile, as described.

7. The fire-chambered water-capping, combined with the cylindrical fuse opening or stock carrying the burning column, with cylinder-opening at the inner end, to hold the fire and explode the shell on impact, as described.

8. The adjustable metallic timing-rod *W*, in the burning column or near its side, to adjust the fuse to explode the projectile at any instant of time, as described, also the strand of quick-match *u*, in its lower end, to raise and lead the fire down on time, as described.

9. The fire-chamber 4, in the capping between the water table or plate 2 and the capping-vent formed by combining them, to prevent extinguishment of the fuse, as described, also the raised vent 3 of the water-table into the chamber, as described, to increase its capacity to exclude water, also the chamber 1, between the vent 3 and the orifice of the column *c*, as described.

10. Forming an enlarged or priming chamber, 7, around or by the side of the timing-rod, to insure an ignition of the fuse by presenting a large priming-surface for the smaller vent, and allow the timing-rod to extend through the capping and be adjusted without interfering with the priming, as described.

11. The file-cuts or fracturing-points on the side of the timing-rod, so as to break it off without the use of an instrument, in adjusting the time in action, as described, also the quick or double three or four threaded screw on the timing-rod, to adjust it quickly as described.

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Witnesses.

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