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H. P. MERRIAM.

SHELL FOR HIGH EXPLOSIVES.

No. 431,374. Patented July 1, 1890.

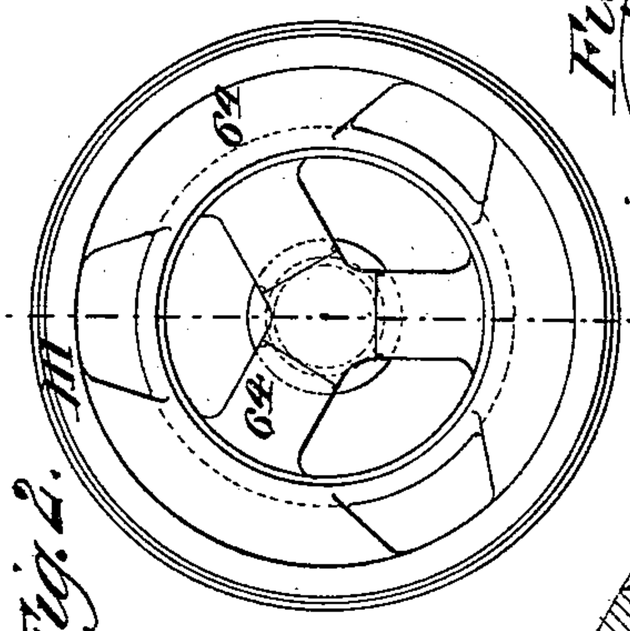

Fig. 2.

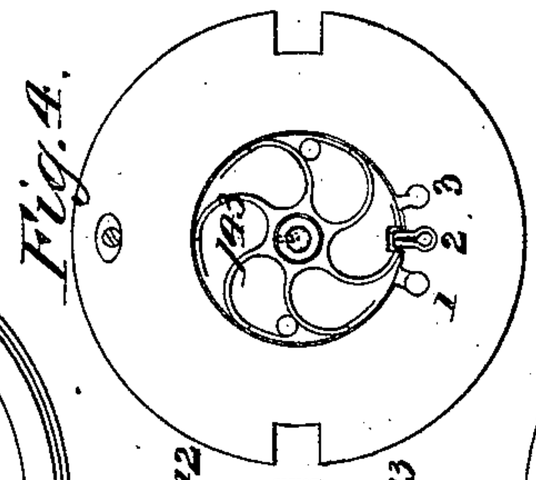

Fig. 4.

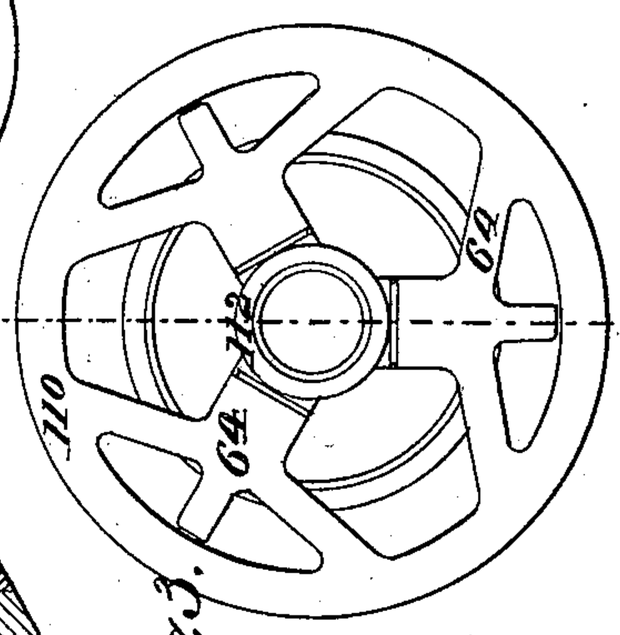

Fig. 3.

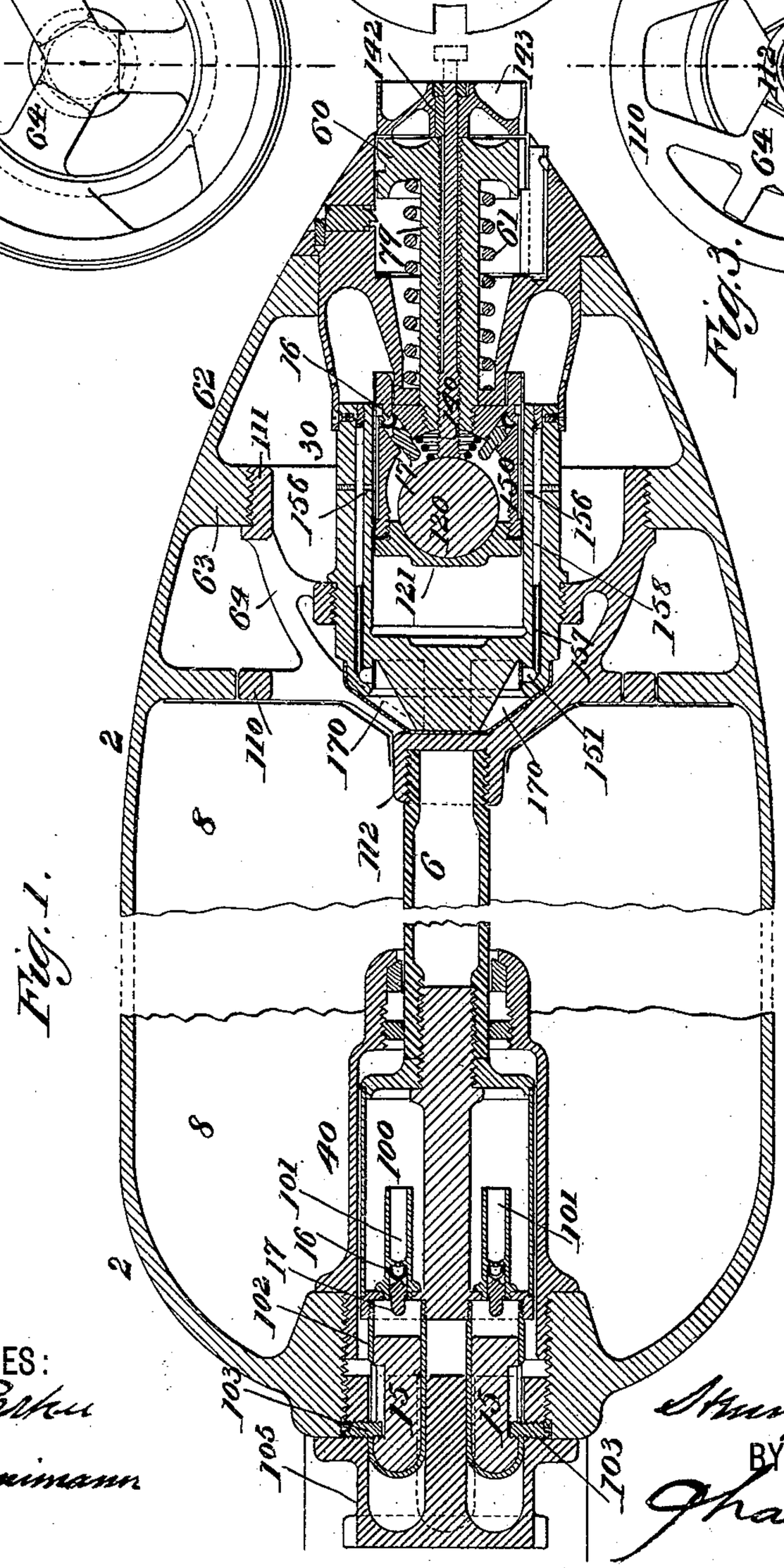

Fig. 1.

Fig. 5.

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Fig. 6.

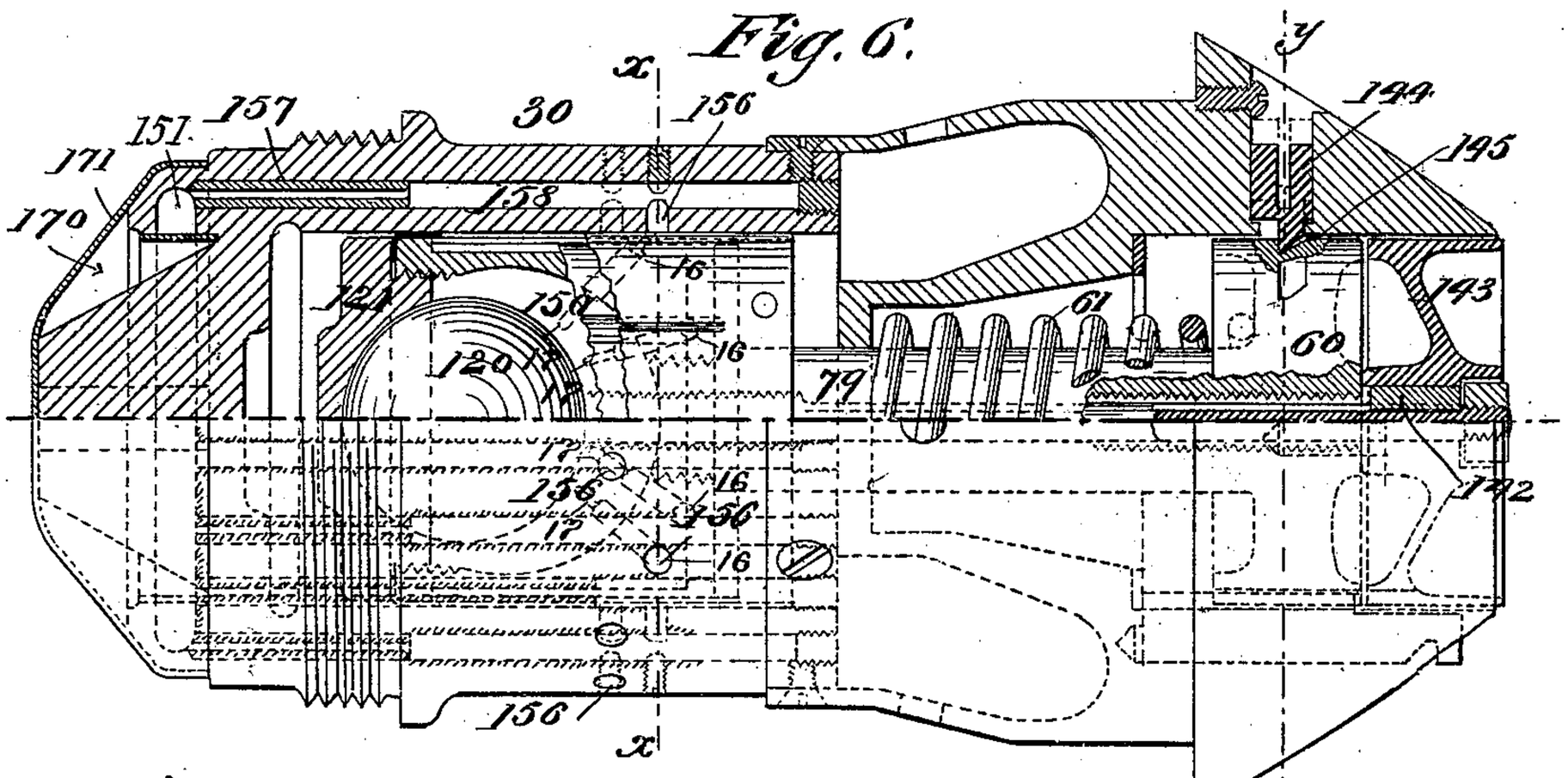

Fig. 11.

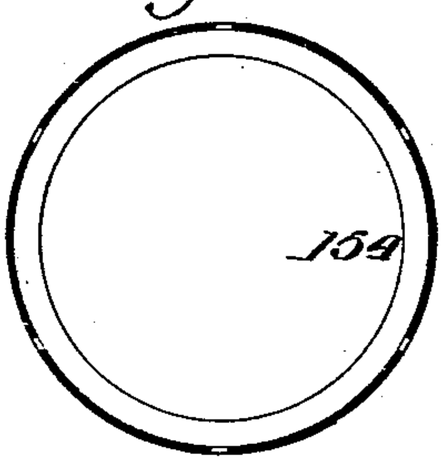

Fig. 10.

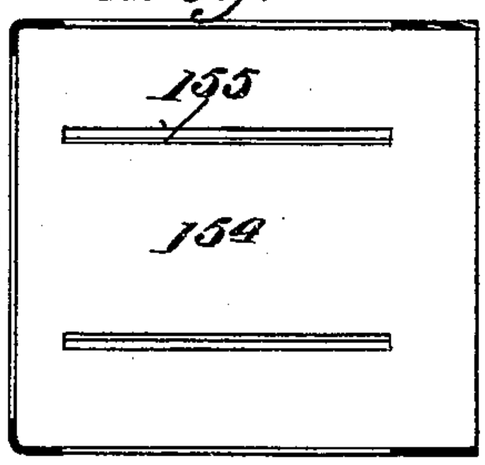

Fig. 9.

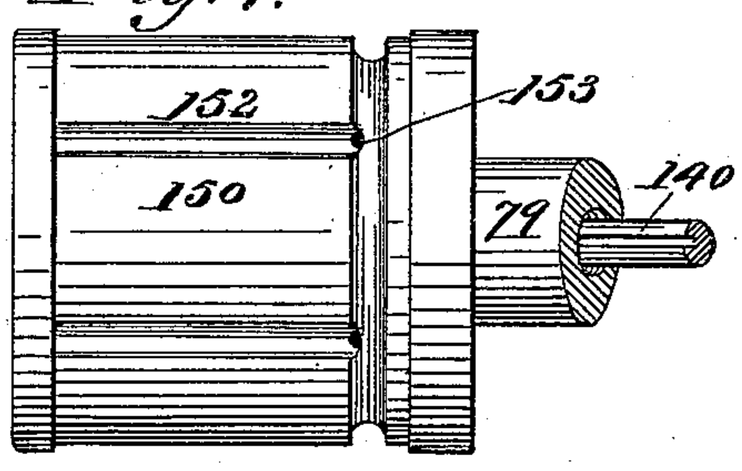

Fig. 7.

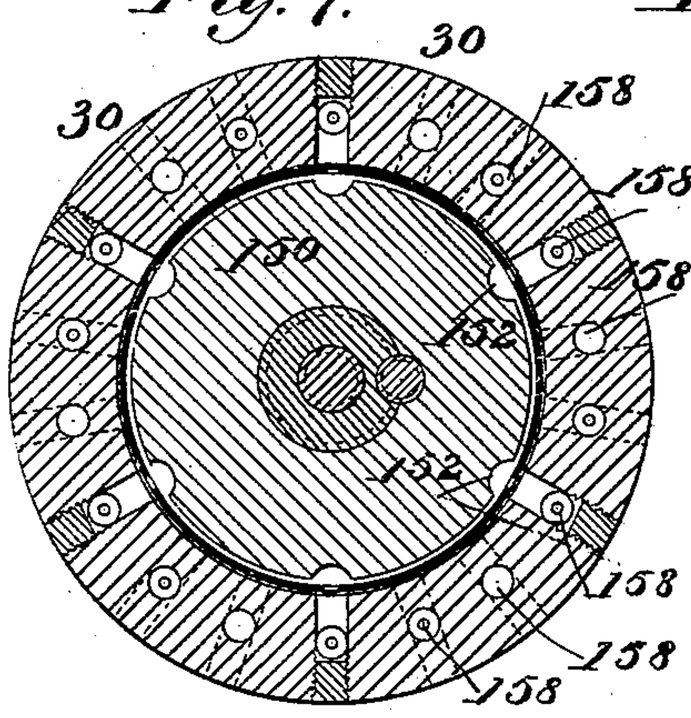

Fig. 8.

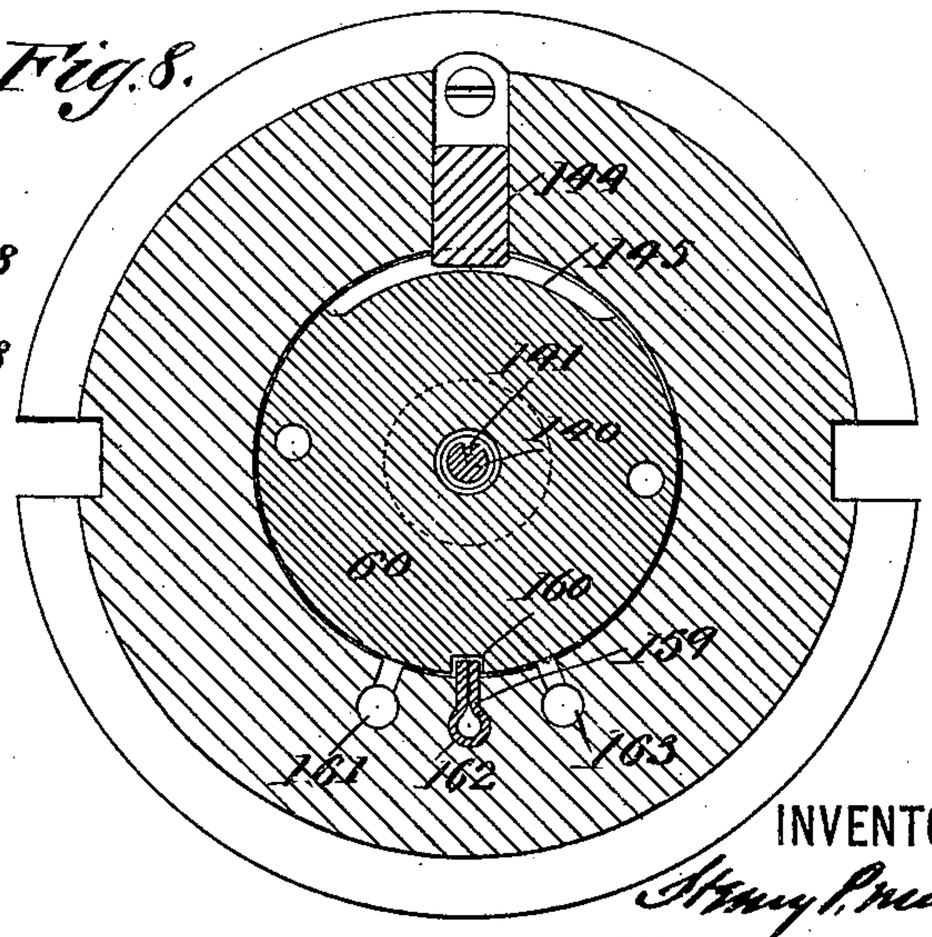

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Fig. 12.

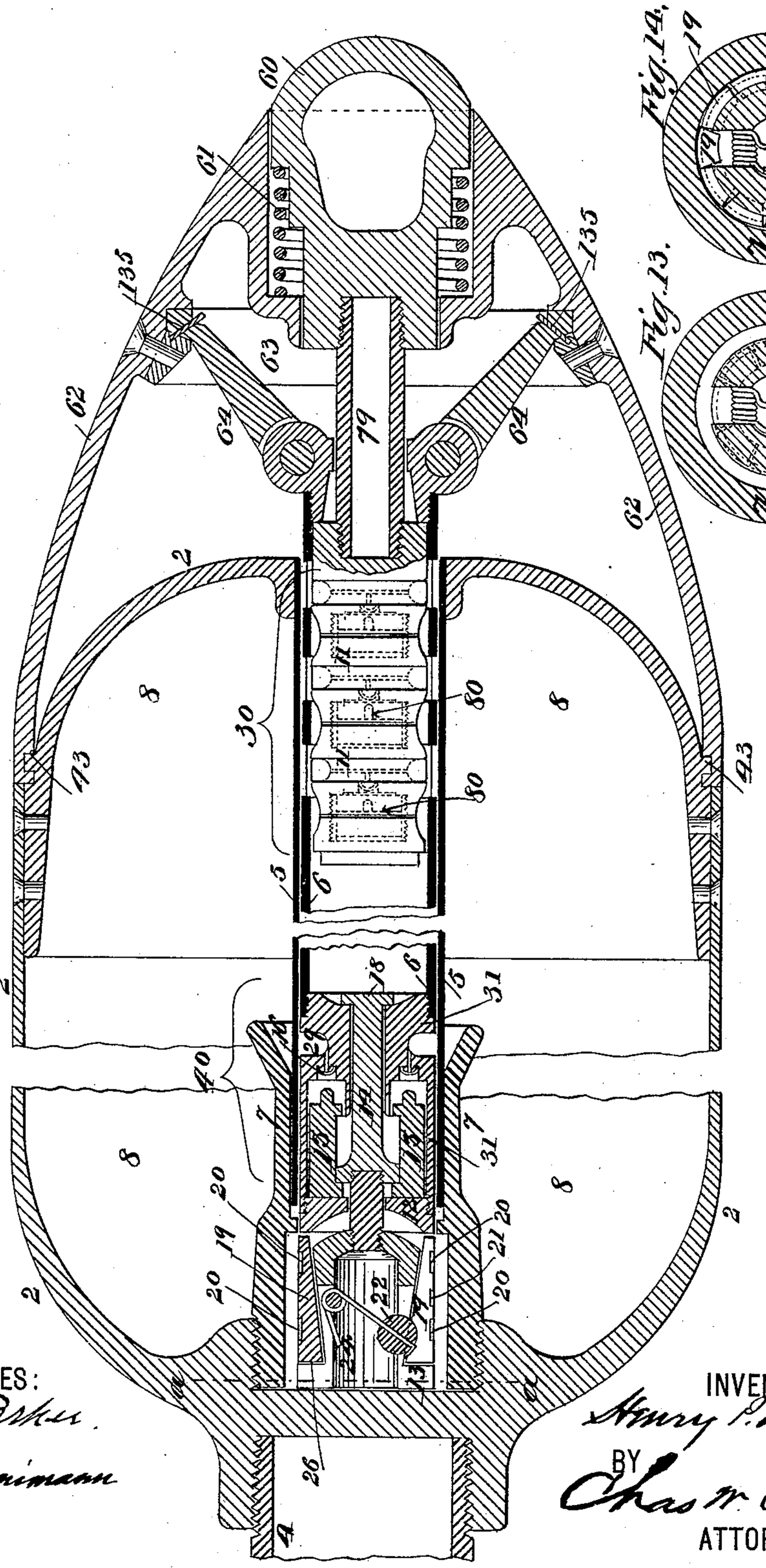


Fig. 14.

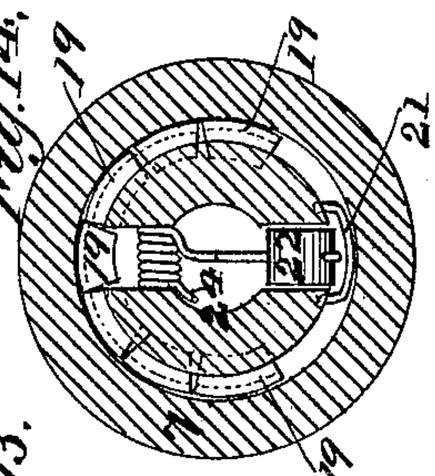
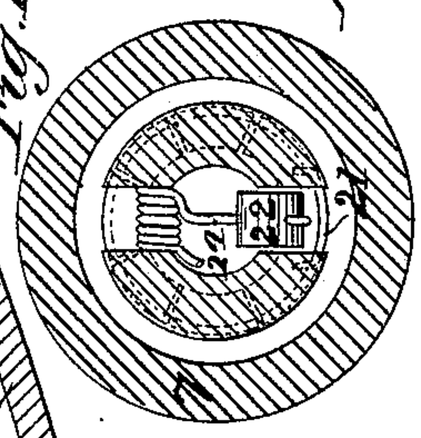


Fig. 13.



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UNITED STATES PATENT OFFICE.

HENRY P. MERRIAM, OF NEW YORK, N. Y.

SHELL FOR HIGH EXPLOSIVES.

SPECIFICATION forming part of Letters Patent No. 431,374, dated July 1, 1890.

Application filed September 23, 1889. Serial No. 324,718. (No model.)

To all whom it may concern:

Be it known that I, HENRY P. MERRIAM, a citizen of the United States, residing at the city, county, and State of New York, have invented certain new and useful Improvements in Shells for High Explosives, of which the following is a specification.

My invention relates to mechanism for detonating a highly-explosive shell-charge with a delay or instant-acting fuse, according to the nature of the concussion of the shell upon a body of water or upon a solid.

My invention consists of a radiating structure or a series of arms connecting obliquely to the axis of the shell between the collapsible head and a detonator-shaft actuated by longitudinal movement, whereby discharge is insured by the concussion of any portion of the head upon a solid target.

My invention also consists of a movable apex provided to the head of the shell, to which apex is connected a detonator having delay action, the apex being depressible by contact with a body of water, thereby detonating the shell-charge after the projectile has passed beneath the surface.

My invention also consists of a spherical detonating-hammer adapted to act in different directions, and also a safety device for holding the same in an inactive position until the proper time.

Other novel details are also included in the invention, which will be subsequently pointed out.

Referring to the drawings, Figure 1 is a sectional elevation of a shell constructed according to my invention; Fig. 2, a detail view of the radiating connecting structure, looking from the front toward the rear; Fig. 3, a similar view of said structure, looking from the rear toward the front; Fig. 4, a front end view of the detonator-releasing device, and Fig. 5 a detail view showing one of the covers or thimbles which hold the hammers of the rear fuse in their proper position. Fig. 6 is an enlarged side elevation, partly in section, of the forward fuse and detonating mechanism; Fig. 7, a cross-section of Fig. 6 on the line *x x;* Fig. 8, a cross-section of Fig. 6 on the line *y y;* Fig. 9, a side elevation in detail of the ball-hammer-containing case; and Figs. 10 and 11, longitudinal, sectional, and cross-sectional views, respectively, the cap or envelope that fits said case. Fig. 12 is a sectional elevation showing a modified construction of the elements of the invention; and Figs. 13 and 14, detail views pertaining to Fig. 12, being taken on the line of section *a a*, showing different positions of the parts.

2 2 represent the body of the shell; 8 8, the chamber containing highly-explosive material, such as dynamite; 62, the collapsible head of the shell; 6, the tube or shaft bearing the instant-action detonators 40, and 64 the radiating structure connecting the head 62 to the tube or shaft 6.

60 is the depressible apex, and 79 the stem connecting the same with the delay-action detonator 30.

15 are the hammers of the instant-action detonator.

16 are fulminate caps, and 17 the firing-pins.

In the instance of Fig. 1 the case 100 is filled with gun-cotton and the nipples 101 with fulminate. The thimbles 102, in which the hammers 15 slide, are fixed to the case 100. There are pins 103 projecting from the stationary portion of the shell or removable cap therein through slots 104 in the thimbles 102, and into corresponding grooves in the hammers, as shown, forming shoulders in the latter, whereby the pins retain them out of access to the caps or firing-pins as long as the case 100 remains forward. When the tube 6 is driven back by collapse of the head 62, the hammers 15 remain inert while the case is driven toward them. By this particular construction accident is prevented should the case 100 be moved or located too near the cap 105 or stationary portion of the shell in placing the parts together.

In the instance of Fig. 12 the instant-action detonator is composed of a multiple circular series of hammers 15, such as described by me in a separate application filed July 26, 1888, Serial No. 281,067. The tube 6 bears the casing 31, which contains these multiple hammers, and contains also the groove 29, filled with detonating compound. The retaining-spindle 14, bearing the hammer-retaining shoulders 71, is in this instance held back by means of a locking device at the rear of

the said spindle. (See also Figs. 13 and 14.)

7 is a socket in which the tube 5 is supported, and it forms a cylinder into which the tube 6, the case 31, and locking device are inserted or withdrawn when the shell-head 62 is removed by disconnection of a separable joint at 43.

13 is a foot attached to the spindle 14.

19 are locking-segments fastened together upon curved springs 20 that tend to open. Fig. 13 represents the segments in a contracted position corresponding with Fig. 12. Fig. 14 represents the segments in an expanded position. The segments are retained in this contracted position by means of a staple 21 entering holes in the terminal segments of the series. When the projectile is shot forward, a hammer 22, which is fulcrumed at 23 and has a reacting-spring 24, is thrust backward by inertia, and as the projectile leaves the gun said hammer is thrust forward by its spring with the requisite force to unseat the staple 21 and release the segments. The case 31 is then free to move back at the proper time by the concussion of the shell, the spindle 14 being still retained by the segments, and the hammers 15 remaining inert when the concussion occurs, as in the instance of Fig. 1.

The radiating structure 64, Fig. 1, for connecting the tube 6 to the shell-head, is composed of an integral piece. This piece comprises a system of transmitting-arms, which are inclined obliquely to the axis of the shell in the direction of collapse of the head toward the center and rearwardly of the shell.

63 is a ring or thickened portion of the head, from which the radial arms of the structure converge.

In Fig. 12 the arms 64 are made of separate pieces pivoted to the end of the tube 6, allowing greater independence of action of the arms relatively to one another, and the ring 63 is in this instance of a separate piece fastened to the interior of the head. The arms 64 are fastened to the rings by means of pins in Fig. 12, which shear off and release the remaining arms when one or more of them are driven in by collapse of one side of the head.

The depressible apex 60 is kept forward against accidental depression by a strong spiral spring 61, in both instances of Figs. 1 and 12, the detonator-case 30 being prevented from forward movement by resting against a stationary part of the shell. In the instance of Fig. 12, which shows the apex in its simplest form, the fuse-cases 11, connected thereto, contain hammers 80, which remain inert when the cases 11 and apex are driven back. The hammers 80 in this instance being light will not endanger explosion in the ordinary handling of the shell.

In the construction illustrated by Figs. 1, 4, and 6 to 11, inclusive, I employ a multipe set of caps 16 and firing-pins 17, converging toward a common center. At the central point, toward which the firing-pins converge, I locate a ball of metal 120, which seats in a concave back 121. When the ball is left free, either a longitudinal or a lateral displacement of the same will insure a blow on some of the pins, rendering discharge certain should the shot tumble in its course and strike sidewise upon the surface of a body of water or other target.

The safety device for retaining the ball consists as follows: The head or apex 60 and its spindle 79 contain a rod 140, screw-threaded therein, which normally retains the ball. The screw-thread extends throughout the length of the said spindle 79, but part way only of the length of the rod. The smooth part of the rod is provided with a longitudinal groove 141, Fig. 8, and there is a spirally-bladed wheel 143, bearing a spline 142, which engages with the said groove. The blades of the wheel 143 are so inclined as to unscrew the rod 140 when the projectile is shot through the air by atmospheric pressure on the said blades, the wheel remaining in contact with the head 60 while the rod is screwed out. When the screw-threaded part of the rod 140 reaches the hub of the wheel 143, the whole then advances and is dropped off, leaving the apex 60 clear to be depressed in event of water concussion. In order that the windwheel may not be rotated prematurely, the same is housed in the bore or cavity of the apex previous to firing, and is prevented from turning by engaging with the key 159. The wheel and movable apex 60 are preparatorily pressed back by hand against the spring 61 until the face of the wheel is flush with the margin of the shell-apex. A latch 144, having a beveled tooth, engages with the notch 145 on the head 60, thus retaining it. The acceleration of the projectile in the gun drives the case 150 and head 60 back beyond the position of depression shown in Fig. 6, whereby the beveled surface of the notch 145, acting on the latch 144, pushes it out of position, permitting the said case and head to fully advance by the subsequent reaction of the spring 61. In order to permit these various longitudinal movements and maintain communication of the caps 16 with the detonating compound in the groove 151, the case is made in the two parts 30 and 150. The part 150 has longitudinal channels 152, filled with powder, communicating with the fire of the caps at 153, Fig. 9. The material is retained in the channels 152 by the envelope 154, having narrow slots 155, partly covering the channels and permanently communicating with certain members of the openings 156 in the case 30, irrespective of the longitudinal position occupied by the case 150.

158 are channels connecting the holes 156 with the detonator 151. These channels 158 are partly filled with a slow-burning compound—such as meal-powder—and partly with fulminate (at the portions 157.) According to the proportionate lengths of the channels occupied by the fulminate and meal-

powder, or according to the situation of the holes 156, the time of action may be determined.

As a feature of my invention I employ a plurality of channels 158 for each channel 152, as more clearly illustrated in Fig. 7. Different sets of channels 158 are charged with variously-timed fuses or have their holes 156 variously located, as illustrated in Fig. 6. The case 150 is made to slide longitudinally without turning from its adjustment by means of a key 159, engaging with a groove 160 in the head 60. Corresponding with different members or sets of channels there are grooves 161 162 163, into one or another of which the key 159 can be adjusted to determine the position of the case 150 and period of delay action of the detonator 151.

The space 170 is filled with gun-cotton retained by the cap 171, which bursts through the spaces between arms or webs 64 when discharged.

The air-cushion confined in the chamber immediately in front of the detonating-case 150 checks the same from a too violent forward movement at the time of discharging the projectile from the gun, insuring against possibility of the ball-hammer prematurely exploding the caps in the event of the said hammer being insecurely retained.

I claim as my invention—

1. In an explosive shell, the combination of a collapsible head, a detonator exploded by an abrupt movement thereof endwise of the shell, a longitudinal shaft within the shell bearing the detonator, and a radiating structure composed of arms or members that diverge obliquely from the said longitudinal shaft toward and connect with various portions of the said collapsible head.

2. The combination, in an explosive shell, of a detonator, a movable primer-case, an inertia-actuated hammer therein in rear of the primers, and a pressure-actuated piston exposed at the head of the shell connected to the primer-case, whereby to be depressed and cause an abrupt movement of the primers in opposition to the hammer by the blow of immersion upon a water-target.

3. The combination, in an explosive shell, of a detonator, a movable primer-case, an inertia-actuated hammer therein opposite the primer, and a pressure-actuated piston depressible within a cylinder at the head of the shell connected to the primer-case, within which cylinder the abutting column of water is confined against lateral deflection at the time of the blow of immersion to effectuate the abrupt movement of the primers in opposition to the hammer.

4. The combination, in an explosive shell, of a detonator, a movable primer-case, an inertia-actuated hammer therein opposite the primers, a pressure-actuated piston exposed at the head of the shell connected to the primer-case, a spring for advancing the piston after the shell is projected preparatory to its depression by pressure, and a latch for holding the piston normally in a retired position, which latch is disengaged by the initial projection of the shell.

5. In an explosive shell, the combination of a collapsible head capable of resisting the blow of immersion upon a water-target, an instant-action detonator exploded by an abrupt movement thereof with reference to the shell, a shaft bearing said instant detonator terminating with radiating arms such as described, oblique to the axis of the shell, connected with various parts of the said collapsible head, a movable apex in the head depressible by the blow of immersion, and a time-action detonator connected to said apex actuated by an abrupt movement thereof with reference to the shell.

6. The combination of the collapsible head, the detonator-shaft, the radial structure of arms or webs secured to the shaft and diverging therefrom, and a ring interior to the head, to which the radiating extremities of the said arms or webs are connected.

7. In an explosive shell, the combination of a detonator composed of a case movable lengthwise of the shell and a safety discharging device consisting of thimbles projecting rearwardly from the case containing hammers opposite the percussion-primers of the detonator, shoulders in the hammers, and studs projecting from a stationary part of the shell through slots in the thimbles, so as to engage with the shoulders of the hammers and prevent contact of the latter with the primers, except by a rearward thrust of the case.

8. The combination, with an explosive shell, of a detonator, percussion-primers thereof disposed from various directions toward a common center, and a spherical or other hammer occupying a free or releasable position at the said common center, whereby to invariably discharge one or more such primers irrespective of its direction of movement imparted by an endwise or lateral concussion of the shell.

9. The combination, with an explosive shell, of a detonator, percussion-primers thereof disposed from various directions toward a common center, a spherical or other hammer occupying a free or releasable position at the said common center, and firing-pins radiating toward the primers interposed between the same and the said hammer.

10. In a detonator for explosive shells, the combination of a spherical or spheroidal concussion-hammer, a case for the same provided with a concave seat or socket at its rear part as situated in the shell, for the partial reception of the hammer, and percussion-primers (or their firing-pins) in front of the hammer converging from various directions toward the same, for the purpose set forth.

11. In a detonator for explosive shells, the combination of a spherical or spheroidal concussion-hammer, a case for the same provided with a concave seat or socket at its rear part

as situated in the shell, for the partial reception of the hammer, percussion-primers (or their firing-pins) in front of the hammer converging from various directions toward the same, and a retaining-rod screw-threaded through the forward part of the case provided with an automatic wind-wheel for unscrewing said rod when the shell is projected.

12. The combination, with the detonator-case 30, having a cylindrical interior, and openings 156, communicating with the detonating compound, of the longitudinally-movable hammer-containing case 150, fitting said cylinder and provided with longitudinal fuse-channels 152, communicating with the percussion-primers, and maintaining connection of the same with the detonating compound irrespective of the advanced or retracted position of the hammer-case.

13. The combination of the cylindric detonator-case having a plurality of differently-timed fuse-channels, the percussion-primer case provided with a longitudinal fuse channel or channels, and means—such as the key 159—whereby the percussion-primer case may be rotatively adjusted and its channel or channels brought into coincidence with one or another of such differently-timed fuse-channels, for the purpose stated.

HENRY P. MERRIAM.

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