

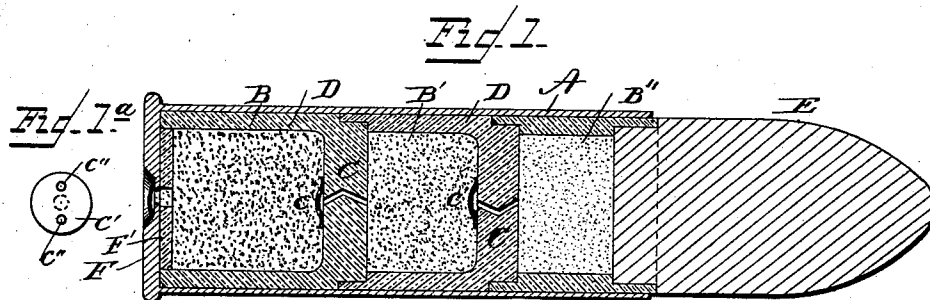
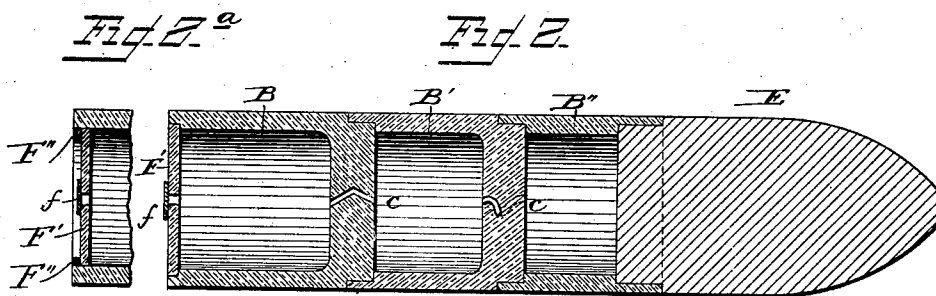
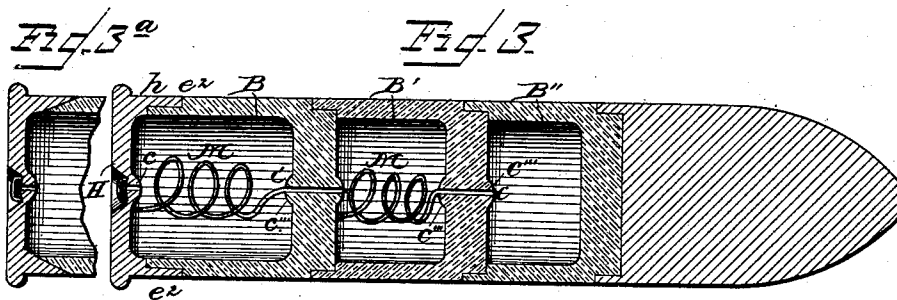
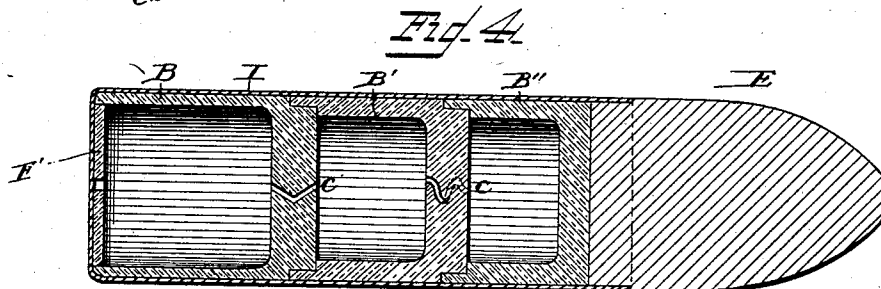
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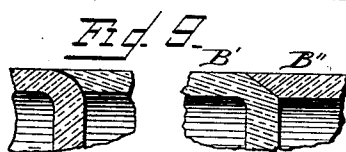
J. W. GRAYDON
ACCELERATING PROJECTILES.

No. 352,125.

Patented Nov. 9, 1886.



WITNESSES
Frank L. Ourand
Henry L. Hazard



INVENTOR
James W. Graydon
by *Smith & Russell*

Attorneys

(No Model.)

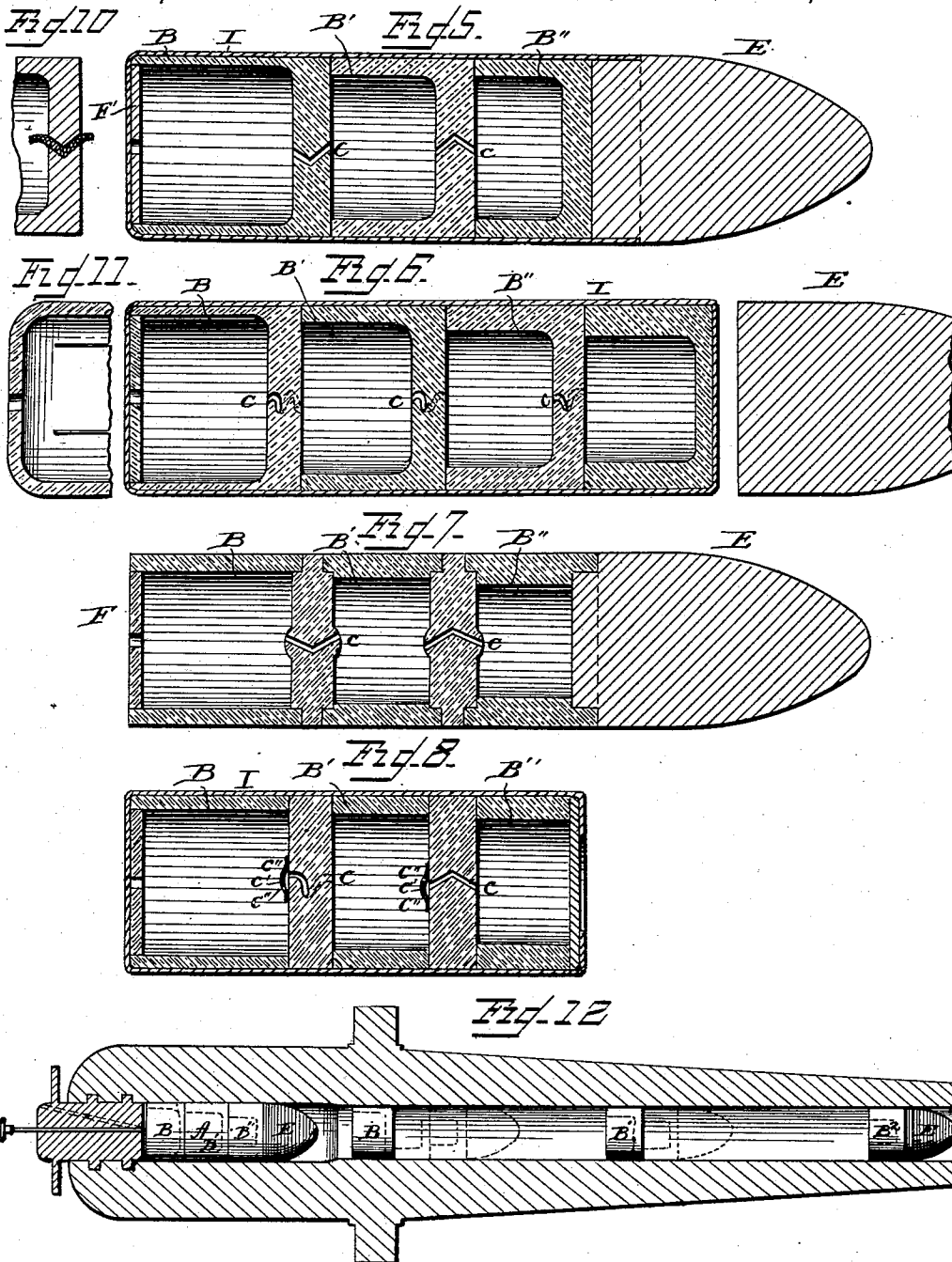
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INVENTOR
James W. Graydon
by *Prindle & Russell*
Attorneys

UNITED STATES PATENT OFFICE.

JAMES W. GRAYDON, OF WASHINGTON, D. C., ASSIGNOR OF ONE-HALF TO
GEORGE S. PRINDLE AND PHILIP G. RUSSELL, BOTH OF SAME PLACE.

ACCELERATING PROJECTILES.

SPECIFICATION forming part of Letters Patent No. 352,125, dated November 9, 1886.

Application filed September 21, 1883. Renewed March 19, 1885. Again renewed April 7, 1886. Serial No. 198,165. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. GRAYDON, of Washington, in the District of Columbia, have invented certain new and useful Improvements in Means for Accelerating Projectiles; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

10 Figure 1 shows a central longitudinal section of my accelerating projectile, with inclosing cartridge-shell; Fig. 1^a, a detail view of the fuse-hole covering-cap; Fig. 2, a central longitudinal section of the projectile with its accelerating charges and their chambers adapted
15 for use without the inclosing cartridge-shell shown in Fig. 1; Fig. 2^a, a detail view of the rear end of the rear chamber or section shown in Fig. 2, showing a modification of the manner of fastening the closing wad or disk in
20 place; Fig. 3, a longitudinal central section of a modified form of my invention with a central-fire cartridge head applied thereto; Fig. 3^a, a detail view showing another manner of attaching the cartridge-head to the rear section. Figs. 4, 5, 6, 7, and 8 show sectional views
25 of other modified forms of my invention. Fig. 9 shows a detail view of the different forms of dovetailing for the front and rear ends of the charge-chambers; Figs. 10 and 11, similar
30 views of one of the chamber-heads with its fuse-hole and one form of fuse applied thereto, and of a modified form of charge-chamber having split sides. Fig. 12 shows a longitudinal sectional view of a gun with my invention
35 illustrated as being in operation therein.

The object of my invention is to provide an improvement in the means for applying the accelerating force of a series of successive dis-
40 charges of explosive material to a projectile; and to this end it consists in the construction, combination, and arrangement of parts, as hereinafter set forth, and specifically pointed out in the claims.

45 In the drawings, A in Fig. 1 designates a central-fire-cartridge shell. This, as shown, incloses a series of shells, B B' B". The shells B and B' are cup-shaped, and are provided at their front ends with thick portions C, forming
50 the bottom of the cups or shells. These bottoms C are of material strong enough and

thick enough to stand the force of the discharge of the explosive contained in the chambers within the shells, so that by such explosion each one of the shells will be blown forward unbroken in the gun. The sides D of each shell are preferably to be of the same material as the rest of said shell. Because of the support of the walls of the bore of the gun these sides need not be made so thick as the
55 shell ends; but they are to be made thick and strong enough to take the grooves of the rifling well without being shattered and torn. They are, as shown, thick enough so that the rear end of each succeeding shell forms a material
60 support for the front end of the preceding one when the powder in such preceding shell is exploded.

The front shell, B", is, as shown, made open at both ends. Its front end overlaps and holds
65 the rear end of the ball or projectile E. The rear end of the projectile is reduced in size, as shown at e, and the front end of the shell B" is correspondingly cut away, so as to fit over the end of the projectile, and yet have its external
70 surface flush with that of the projectile. Instead of this construction the front end of shell B could be made of the same thickness as the rest, and the rear end of the projectile be more reduced in size.

75 The front end of each of the rear sections, B B', is reduced in size, as shown, so as to fit within the rear open end of the succeeding one, such rear end being correspondingly recessed or reduced in thickness, so as to make a close
80 joint. The abutting portions or shoulders of the shells are preferably made squared, as shown. Each of the closed portions or shells is preferably rounded within and at their bottoms, as shown, so as to have the point of con-
85 nection between the bottom and sides made as thick and strong as possible.

The rear end of the rear section may be closed by a thin centrally-perforated wad or diaphragm, F, to facilitate handling in the
90 operation of loading the separate chambers. If desired, the other chambers or sections can also be similarly closed for the same purpose. Through each of the shell or chamber bottoms is a small opening or passage, to allow of the
95 transmission of fire from one chamber to the succeeding one, as hereinafter to be set forth.

These openings can be straight, but are preferably made zigzag or spiral, to prevent the fire from the explosion in one chamber blowing through directly and too quickly into the succeeding one. To more surely prevent such blowing through, I intend to cover each passage *c* with a cap, *c'*, as shown, having an opening or openings, *c''*, cut through it at an angle to or out of line with said passage.

It will be observed that the shell-sections are of the same size as the projectile, so as to fit the bore and take rifling in the same way as the projectile does.

The cartridge shell *A* fits over all, and at its front end is made to hold firmly the front end of the front shell-section, *B''*, down upon the rear end of the projectile, so that the latter will be held in place.

If desired, the cartridge-shell can be extended beyond the end of the section *B''*, so as to clamp and hold the projectile itself directly within its front end.

The cap *c'* can be made of the same material as the shell-sections, or of other material, as desired. Where the shell-sections are made of paper, papier-maché, or similar material, of which I contemplate making them, the perforated caps would be best made of metal, so as to act to strengthen or re-enforce the section-head around the central aperture. Where, as may be found advantageous under certain circumstances, the shell-sections are made of copper, phosphor-bronze, or brass, such strengthening is not so necessary, and the caps can be made of more light material. I contemplate, also, re-enforcing the section-heads, as shown in Fig. 3, by thickening said heads around the apertures therein.

In Fig. 2 the projectile, with its attached accelerating-charge-containing chambers, is shown as adapted for use in guns where a flanged cartridge-shell cannot be used. In this form the shell-sections are best made of one of the metals specified above, though I do not limit myself to the use of these metals only, as the sections can be made to hold together more securely. Papier-maché, however, can be used here as in the form shown in Fig. 1. In that illustrated in Fig. 2, without the inclosing cartridge-shell, a wad of paper, papier-maché, or a disk of metal, *F'*, is necessary to keep the rear charge in place. This plate or wad can be fastened in place in the shell-section in any desirable manner, as by screwing it in, by forcing a ring, *F''*, in behind it, as shown in Fig. 2^a, or by cementing its edges to the inside face of the walls of the rear chamber. Said plate or wad is centrally perforated, as shown, and the aperture therein is covered by a cap, *f*, which can be torn off when the projectile is ready to be fired; or where it may be found desirable to suit certain kinds of guns, this central passage or aperture can be provided with a suitable anvil or nipple to receive a percussion-cap, to be fired by a firing-pin.

In Fig. 3 is shown a modified form of my in-

vention as suited for guns where a flanged cartridge-head is necessary. In this form the cartridge-head *H* has a short flange, *h*, attached to the rear end of the rear shell-section. As shown, it overlaps the reduced portion of the section. The sections are formed substantially like those shown in Figs. 1 and 2, and described above. The front one, however, instead of being open at its front end and overlapping the rear end of the projectile, is in this case shaped at that end like the other sections. A rearward-extending flange, *e''*, on the projectile overlaps and is fastened to the reduced portion of the section end.

The flange can be extended farther along the outside of section, as the front section being the last to be fired does not need to be made as thick or strong as the others. The front end or bottom of the section need not be as thick as the other, as such end is not to form the bottom of chamber in the gun into which a succeeding charge is to be exploded. In this figure are shown the re-enforcements *c'''* *c'''* around the central communicating apertures through the section-heads.

In Fig. 3^a is shown a slightly different form of attachment between the rear section and the flange of the cartridge-head. In Fig. 4 is shown a further modification of my invention. Here the shell-sections are shaped like those already described, and shown in Fig. 1, with the exception of the front one, which has a squared head or front without any reduced portion. The sections in this form are made slightly smaller than the projectile and of the same size as the reduced rear end of the latter. A thin covering, *I*, of tough water-proof material, as paper, is wrapped around all the sections and the reduced rear end of the projectile. This covering overlaps and covers the rear end of the rear shell-section which is closed by the centrally-perforated disk *F*.

The covering *I*, instead of being made of paper, can be made of some soft metal, strong enough to hold the sections together, but which will easily be torn apart between the sections when the successive explosions of the charges take place. Of whatever material it is made, said covering is designed to be of such a thickness that the sections and the rear end of the projectile covered by it will be of the same size, and fit as closely the bore of the gun as the main portion of the projectile. The envelope or covering is not merely wrapped around the shell-sections, but is also attached thereto by fastening or in any other suitable way, so that when the sections are separated from each other by the explosions of the contained charges the portion of the envelope around each section remains with it and forms a part of it, so that said section will continue of the same size as before use, and will fit the bore of the gun closely.

In Fig. 5 is shown a further modification of my invention. In this form each section-head is formed squared or flat on its front face and abuts squarely against the rear end of the suc-

ceeding section. The end of the front section, as is the case in the form shown in Fig. 4, abuts squarely against the rear end of the projectile.

5 In Fig. 6 is shown a modification which is adapted for use where it is desirable for convenience in handling, or for other reasons that the accelerating-charges should be separated from the projectile. In this form the sections
10 are formed as in Fig. 5, but the envelope or covering I covers the front end of the series of shell-sections as well as the rear. Each charge-chamber is provided with a perforated wad or disk for closing its rear end. Instead
15 of making the section side walls and heads in one piece they can be separate, as shown in Figs. 7 and 8. The cylinders forming the chamber or shell section sides are made open-ended and circularly-recessed at each end to fit
20 over the reduced ends of the division-heads, as shown. The cylinder forming the walls of the rear chamber may be made much thinner than the other cylinders, as shown in the figure, and without any circular recess at its
25 ends.

In Fig. 8, each cylinder is made of the same thickness throughout, and the cylinders and division-heads abut squarely against each other without dovetailing joints. The sections are
30 held together by means of an external wrapping or envelope of paper or other material, preferably made water-proof. This envelope or wrapping is pasted or otherwise fastened to the outside of the section cylinders and
35 heads. Each explosion as it takes place will tear the envelope asunder between the rear end of the cylinder in which the charge is contained and the division-head at the rear end of such cylinder.

40 In Fig. 9 other forms of dovetailing for connecting the front and rear ends of the shell-sections together are shown. The sides of each shell-section, where such sides and the section-head are made in one piece, can be split, as
45 shown in Fig. 10, so as to facilitate and make certain of the sides taking the grooves of the rifling.

The shell-sections can, as indicated above, be made of paper, papier maché, brass, copper, phosphor-bronze, or other analogous
50 metal or alloy, or of a combination of metal and paper, with the metal forming either the interior or exterior of the shell-section.

I do not intend to limit myself to the materials for the sections as set forth above. Instead of them, hard wood or any other light and tough fibrous or non-fibrous material strong enough to stand the force of the explosions of the accelerating-charges can be
60 used.

The heads of the sections may, if desired, be surrounded or provided with an external ring of soft metal capable of taking the grooves of the rifling easily and accurately. The rest
65 of each section, besides the head thereof, can also be provided with similar rings of soft metal for the same purpose, such rings being

let into grooves around the body of the section.

In order to properly regulate the transmission of fire from one charge to another, so as to make such transmission more rapid, as the successive charges are exploded, the size of the openings through the successive section-heads can be increased, or the number of such openings can be increased in each successive head. I contemplate also regulating the rate of transmission of fire by means of fuses or by making the passages zigzag or spiral, and so of different lengths. Passages so shaped are desirable, as preventing any direct blowing through of the fire from one chamber to the other. The chambers in the sections are to be filled with powder or other explosive of different rates of burning. The chamber in the rear section is filled with a slow burning, that in the next section with quicker burning powder, and that in the front with powder capable of burning still more rapidly.

I do not limit myself to three or any number of chambered sections. The number can obviously be increased or diminished, as desired. In the form of my invention shown in Figs. 6 and 8 the number of sections can be changed quickly and easily, by cutting off one or more of the front sections. The wad or disk shown as closing the rear end of each section will keep the charge in its chamber after any section is removed. The charges in the successive chambers can be composed of relatively stronger and stronger explosive or explosives, the size of the chambers in the sections being varied, as desired, or found suitable for the explosives used.

With my accelerating-projectile, as constructed with its successively-exploding charges, the front charge—the one last exploded—can be composed of an explosive of greater strength than it would be a safe use in a single-charge gun with the projectile at rest. A cartridge-shell, such as is shown in Fig. 1, can be used to inclose and hold the series of connected charge-containing sections shown in Figs. 4, 5, and 6. The inclosing-envelope is then of course suitably perforated at the rear, so as to admit the fire from the cap on the cartridge-shell to the rear chamber.

Where it is found desirable, the disk or wad which closes the rear end of this chamber can be provided with a suitable anvil or nipple adapted to receive a percussion-cap.

The sides of the shell-sections can of course be made proportionately thicker than as shown in the figures in the drawings. They are intended to be made so thick and of such strong material as to stand the crushing force exerted upon them from the rear as the charges are exploded and the sections driven forward. This is necessary to prevent the front charges being fired by compression in their chambers by the heads of the rear sections.

If desired, the rear shell-section can be made an open-ended cylinder, and the other sections open in front, instead of the rear, as already

described. Such construction and arrangement would perhaps more effectually prevent any of the front charges expanding backward past the sides of their respective chamber-sections, so that the bottom of each section would form a close bottom of the bore for its respective charge; but with the construction already described and shown, the sections are intended to fit so tightly within the bore of the gun as to prevent such expansion of the gases from one charge back into that portion of the bore of the gun which is behind the shell-section next in the rear of the one containing such charge. Any of the well-known forms of fuse can be used in the openings through the section-heads.

The operation of my invention is as follows: When the charge in the rear chamber, which charge is to be of slow-burning powder, or other explosive is fired, the series of charge-containing sections is blown forward in the gun with the projectile. By the slow-burning explosive the sections and projectile are gradually started forward without a great strain on the gun. After the sections have traveled a certain distance along the bore, the charge in the second chamber is exploded and accelerates the motion of the projectile and the remaining sections. The time of explosion of the charges is regulated, as described above. The charge in this second chamber is preferably of quicker-burning explosive than that in the first, and may also be of greater strength. By such quicker-burning or stronger explosive the strain on the gun need not be increased, as the projectile and remaining sections have already attained great speed from the action of the first charge. At a point or points farther on in the gun the other charges are successively exploded, each giving greater and greater velocity to the projectile. These charges are to be successively quicker-burning or stronger kinds of explosives. With my construction the last charge can be made of an explosive of such strength as could not be used where a single charge is employed. It can be made of gun-cotton, for instance, which is too quick-burning and strong to be safe where a single charge is used to start and give speed to the projectile. The explosion of each successive charge forces the sides of the containing-shell section out into the grooves of the rifling, so that all windage is prevented, and the fire from one charge cannot pass around the head of the shell-section into the chamber in front. Fire must then be communicated from one section to another only through the fuse-openings in the heads. The sections and heads also fit so tightly in the bore of the gun as to effectually prevent any of the gas from the explosion of one of the succeeding charges from expanding back into the portion of the bore of the gun behind the section next in the rear of such charge. Each section-head will then act as the bottom of the bore for the succeeding charge. As such bottom is being forced forward by the expansion of the gas from the

charge previously fired behind it, it is obvious that the projectile and remaining sections will be driven forward by each succeeding charge with the greatest possible acceleration of speed.

With this arrangement, construction, and operation of parts, the successive charges can act to greater advantage in accelerating the projectile than where they are exploded into the same constantly-increasing space or portion of the bore behind the projectile, as in the multicharge gun, with its series of charge-chambers opening into the bore. Another great advantage in the use of my invention is that there need be no special construction of gun. Any of the ordinary forms of gun can be used without change. There is also the same advantage in the use of my invention over that of the multicharge gun, with its chambers which have to be loaded separately, that there is in using a breech-loading gun instead of a muzzle-loader. The compound accelerating-charge is prepared as shown and described, ready for insertion in the gun as quickly and readily as an ordinary cartridge, and is always ready for immediate use. In using the multicharge-chambered gun much time must necessarily be consumed in loading up the chambers, and this, too, when much time cannot be spared, but rapidity of loading and firing is especially desired.

My invention does away with the necessity of much delay, and, as set forth above, renders possible the attainment of better results in acceleration of the projectile than is possible where, as in the gun referred to, the successive charges explode into the single constantly-increasing space behind the projectile.

If it is desired to diminish the number of accelerating-charges, some of the front or rear chambers or shell sections, with their contained charges, can easily and quickly be removed, especially with the construction shown in Figs. 4, 5, and 6. With these constructions the envelope or casing holding the sections together could be cut through and some of the sections removed, as already described.

My invention is obviously adapted for use in connection with charges of shot, as well as where a solid projectile is used.

The series of chambers, either ready-loaded or to be loaded, as desired by the user, can be manufactured and sold separate from the projectile, and adapted for use in connection with any kind or form of projectile.

Instead of using the cylindrical portions of the sections to keep the division-heads apart and prevent the explosion of the charges between them by undue compression when the explosion of a charge in the rear takes place and acts to drive the series of sections and projectile forward, other means may be used for the same purpose. For instance, a central solid cylinder or rod could be placed between the heads to act as a distance-piece, or several distance pieces or blocks could be used, as found desirable. Increase in the twist of the rifling does not interfere with the successful use

of my invention, although the sections containing the accelerating-charges are made to take the rifling closely. The connections between the sections will yield to allow each section to follow the groove independently of the others to a sufficient extent. Such possible loosening of these connections after the sections are started, and as they travel through the gun, is not at all objectionable, but may be an advantage.

As a means for providing for the firing of the charges successively and at predetermined intervals along the bore of the gun, I contemplate using, as shown in Fig. 3, a coiled wire, M, in each rear chamber. As indicated, the wire in the rearmost chamber is to be attached at one end to the cartridge-head, and at the other fits into and closes the small opening through the section-head. Such coiled wire is placed in all the chambers, except the front one, where none is needed. The wire forming each coil is attached at its rear end to the head of the section next in the rear, and at its front end is inserted in the opening through the head of the section or chamber containing the coil, as described above. The length of the wire in any particular coil of course determines the time and point at which the passage from one section to the next in front of it will be opened as the section containing the coil is blown forward and separated from the one in its rear. As soon as the end of the wire is pulled out of the opening, the fire from the exploded charge in the chamber will communicate with the explosive in the section next in front, and so on.

If desired, a friction-primer can be placed in the passage through the division-head, or on the front of such head, to be fired by the pulling back of the wire as the sections separate. The front ends of the wires fit the openings very closely, and should also be fastened therein strongly enough to keep them in place until pulled upon with some force.

Where no cartridge-head is used the rear end of the wire coil in the rearmost chamber can be attached to the disk closing such chamber to the breech-block, or to some projection or immovable portion of the gun; or the breech-closing device, as it is brought into place, may be arranged to clamp and hold the end of the wire.

I do not claim herein as my invention a series of charge-containing chambers having heads which do not fit closely, but are smaller than the bore of the gun and provided with means whereby the charges are fired from the front to the rear of the series, as such a construction and arrangement, as I am aware, is not new, and is neither desirable nor productive of the best results in the acceleration of projectiles.

Having thus fully set forth the nature of my invention, what I claim is—

1. In combination with a projectile, the series of chambered sections containing charges of explosive material and fitting the bore of the gun so closely as to prevent the passage of

gases or fire from the charges by their sides, said sections being constructed with their heads separating the charges strong enough to withstand the force of the explosion of such charges, with their sides strong enough to protect the inclosed charges in front from being compressed between the section-heads as those in the rear are exploded, and with openings or passages for allowing the communication of fire through the section-heads from one charge to another successively from rear to the front of the series, substantially as and for the purpose set forth.

2. In combination with a projectile, the series of shell-sections containing the separate accelerating-charges of strength or rapidity of fire relatively increasing from the rear to the front of the series, said shell-sections being constructed with their sides strong enough to protect the contained charges from compression between the section-heads, and their heads strong enough to withstand the force of the explosion of the charges, and fitting closely within the bore of the gun, and provided with openings or passages to allow the communication of fire through the section-heads from charge to charge successively from the rear to the front of the series, substantially as and for the purpose set forth.

3. The series of chambered sections containing charges of explosive material, made of material strong and thick enough to withstand the force of the explosion of the charges within them without being shattered, and fitting closely the bore of the gun, in combination with the communicating-passages through the section-heads separating the charges, and means for regulating the transmission of fire through such passages from charge to charge successively from the rear to the front of the series, all so combined and arranged that the successive explosions of the charges will take place separately and at predetermined points along the gun, substantially as shown and described.

4. The series of cup-shaped shell-sections abutting against and attached to each other, made of material strong and thick enough to withstand the force of the explosion of the charges within them without being shattered, fitting closely the bore of the gun and provided with openings or passages for allowing the communication of the fire from the charge in each rear section to that in the one in front, all so combined and arranged that the successive explosions of the charges will take place at distinct intervals along the gun, and the explosion of each charge will drive forward the sections in front of it and the projectile with accelerated speed.

5. In combination with the projectile, the rear cup-shaped shell-section containing a slow-burning explosive, the similarly-shaped section or sections in front thereof, containing relatively quicker-burning or stronger explosive or explosives, the open-ended cylindrical shell at the front end of the series of sections

containing a still more powerful explosive and at its front end holding the projectile, and communicating passages through the section-heads between the charges, adapted to allow
5 of the communication of fire from each charge to the one next in front of it and to retard or regulate the rapidity of such communication, substantially as shown and described.

6. The series of shell-sections containing
10 charges of explosive and having their heads provided with fuse openings or passages communicating from one charge to another, in combination with the perforated caps covering such openings and serving to prevent direct
15 blowing of the fire from one charge through the fuse-opening to the next charge, and also to strengthen and re-enforce the heads around the openings, substantially as and for the purpose set forth.

7. In combination with the series of accelerating-charges, the division-heads separating them, made strong enough to withstand the force of the explosions of the charges without breaking, fitting closely the bore of the gun, and provided with openings or passages to allow
25 the transmission of fire from charge to charge successively from the rear to the front of the series, and means for holding the separating-heads apart, so as to prevent undue compression of the charges between them,
30 substantially as and for the purpose described.

In testimony that I claim the foregoing I have hereunto set my hand this 19th day of September, A. D. 1883.

JAMES W. GRAYDON.

Witnesses:

PHILIP F. LARNER,
HENRY C. HAZARD.