(No Model.) 2 Sheets—Sheet 1.

J. W. GRAYDON.

SHELL.

No. 382,226. Patented May 1, 1888.

Fig. 1.

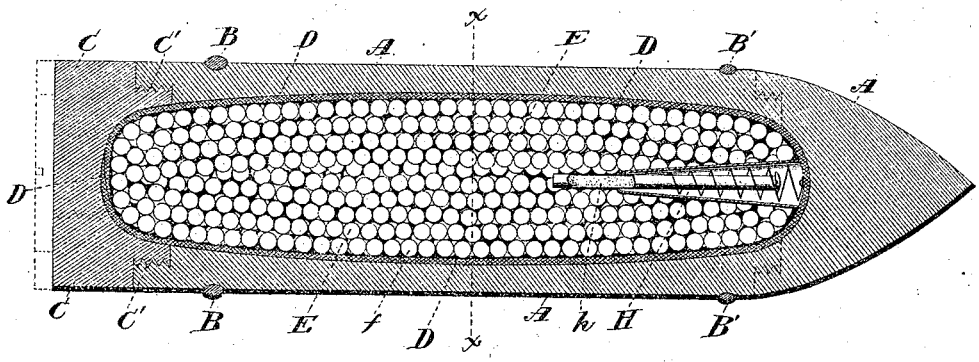
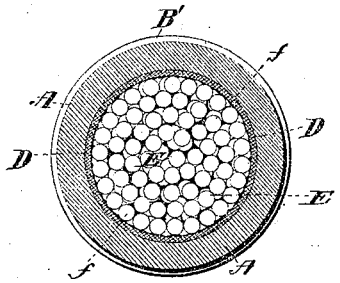


Fig. 2.



Witnesses:
Chas. J. Williamson.
Henry C. Hazard

Inventor.
James W. Graydon.
by Pindle and Russell
his Attorneys

(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

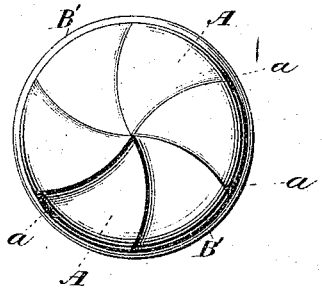

Fig. 4.

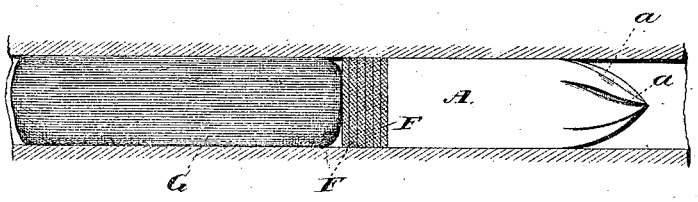

Fig. 5.

Witnesses
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his attorneys.

UNITED STATES PATENT OFFICE.

JAMES W. GRAYDON, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GRAYDON DYNAMITE PROJECTILE CARTRIDGE AND HIGH EXPLOSIVE COMPANY, OF SAME PLACE.

SHELL.

SPECIFICATION forming part of Letters Patent No. 382,226, dated May 1, 1888.

Application filed May 7, 1887. Renewed February 15, 1888. Serial No. 264,142. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. GRAYDON, of Washington city, in the District of Columbia, have invented certain new and useful Improvements in Shells; 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—

Figure 1 shows a central longitudinal section of my shell; Fig. 2, a transverse section of the same on line *x x* of Fig. 1; Fig. 3, a front end view of the shell; Fig. 4, a detail view showing a shell in the gun with asbestus wads between it and the propelling-charge, and Fig. 5 an enlarged detail view of one of the pellets with which the shell is shown as loaded in Fig. 1.

Letters of like name and kind refer to like parts in each of the figures.

The object of my invention is to provide improvements in explosive shells; and to this end my invention consists in the shell and in the construction, arrangement, and combination of the parts thereof, as hereinafter specified.

In the drawings, A designates the shell-casing, which, as usual, is preferably made of metal. The metal which I prefer is steel, as with that material a good penetrating-point can be formed on the shell. On the exterior of the casing are two rings, B and B′, of brass or other soft metal, set or let into annular grooves, as indicated in Fig. 1 in the drawings. Of these rings the rear one, B, is thicker than the other, so as to take the rifling of the gun strongly. The front ring, especially where the projectile used is a long one, is of less diameter than the other ring, so that it does not project so far beyond the casing A, and only takes the rifling slightly.

In order to increase the interior capacity of the shell for the reception of the explosive, I desire that the shell should be as long as possible, and intend, where the shells are specially manufactured, to make them longer than they have usually heretofore been made.

I have only shown two of the soft-metal rings; but a greater number of them can of course be used if desired.

For facility in loading the shell, I prefer to make the rear end of the shell removable, as shown in full lines in Fig. 1. Such rear end there shown consists of the heavy and strong piece or block C, having the threaded forwardly-projecting portion C′ screwed into the rear end of casing A. Instead of this construction, I can, as indicated in dotted lines at the rear end of the shell in said figure, have a smaller opening in the casing end, with a mere plug screwed into the same. The rear end of the casing must then be particularly strong to prevent the plug being blown into the shell by the explosion of the propelling charge in the gun. The plug can have a flange or head adapted to engage the end of the casing, or an annular shoulder thereon around the plug-hole. I also contemplate, if desired, having the loading-opening at the forward part of the casing, as indicated in dotted or broken lines, instead of at the rear, as already described. In such case I do not, as has heretofore been done, make the opening extending from the extreme point of the shell rearward into the shell-casing interior, as such a construction interferes with and spoils the sharp penetrating-point which it is desirable to have.

The whole front end of the shell, with its thick solid portion and penetrating-point, is screwed or otherwise fastened to the front portion of the cylindrical or main portion of the shell. When this front end of the shell is unscrewed or removed, it leaves the chamber end open, to be freely and easily loaded.

I have shown the charge-containing chamber made not cylindrical, but enlarged from each end toward the central point so as to increase its carrying capacity; but I do not limit myself to such construction or to any particular shape.

A great cause of danger in the use of shells, and especially those containing high explosives—as gun-cotton, dynamite, &c.—has been the transmission or passage of heat from the fire of the propelling-charge in the gun through the walls of the projectile to the shell-exploding charge. The great heat from the propelling charge reaching the shell charge through the shell-casing is liable to explode the shell before it leaves the gun, even where ordinary black powder is used in the shell, and is very certain to do so where the charge within the

shell consists of one of the high explosives. To guard against this great source of danger of premature explosion of the shell and consequent bursting of the gun, I line the interior of the shell-chamber D with a lining of some material which is a non conductor of heat—that is, I interpose between the charge E, within the shell and the inner walls of the casing, a layer or layers of material which will effectually prevent the heat from the outside of the shell reaching the charge.

The material which I prefer for lining the shell-chamber is asbestus felting, paper, or cloth; but I do not limit myself to any particular material therefor. Mineral wool or any of the well-known non-conductors of heat can be used. Whatever the material is it should of course be in itself not capable of being burned or destroyed by the heat reaching it.

As dynamite and other high explosives are fired by 360° of heat, it will be readily seen that without some non-conducting material interposed between the shell-charge and the walls of the shell the charge is liable, in fact very certain, to be fired by heat coming from the intense flame of the propelling-charge in the gun.

In practice, before placing the exploding charge within the shell-chamber I put the asbestus or other lining in place, then fill in the explosive, and lap the ends of the lining over the charge, as shown Fig. 1. The end or plug to close the open end of the chamber is then screwed in place.

To make most sure that the charge shall not come in contact with the walls of the shell where the lining is lapped over, I sometimes fill in a space between the charge and the end of the chamber with scraps or pieces of the asbestus or other non-conducting material used. Where desired, asbestus or other wads, F F, of material which is a non-conductor of heat can be placed between the rear end of the projectile and the propelling-charge G in the gun, as shown in Fig. 4.

Another great source of danger in the use of dynamite and other high explosives, especially the "nitro-glycerine compounds," so-called, in projectiles has been the concentration of the actively explosive portion of the material by the shock of the propulsion of the projectile in the gun. Dynamite, which is one of the most convenient of the high explosives to make and handle, consists, as is well known, essentially, of nitro-glycerine and absorbent material used to take up and absorb the nitro-glycerine.

If dynamite be squeezed or pressed, the nitro-glycerine "concentrates out" of it. This is what occurs if a body or mass of dynamite is subjected to a blow or to a shock, such as it would get from the sudden starting of a projectile containing it in a gun. The nitro-glycerine, which by itself is, as is well known, far more sensitive than when it is absorbed and held by the absorbent material in dynamite, is concentrated out of the dynamite by the shock. The charge in the shell is thus put in a too highly sensitive and very dangerous condition, and is quite certain to be fired by any shock by friction, or by 360° of heat reaching any portion of the nitro-glycerine before the projectile has time to leave the gun. To prevent this concentration and dangerous change in the nature of the explosive charge, I separate the charge into a number of small portions, each wrapped in an envelope, so as to make a number of balls or pellets, *f f*, of any desired shape.

In practice I have put up the high explosive, preferably dynamite, in packages of thin strong paper, and then have dipped the packages in paraffine to hermetically seal them and render the paper non-absorbent. The size that I have found best for dynamite packages is a half inch tube. The shape is, as indicated above, immaterial. Where each package is made up into a ball, *f*, as shown in Fig. 5, the open end of the paper package is tied up with a thread or string, *f'*, and the ball is then dipped in paraffine. Other material besides paper can obviously be used, such as cloth made non-absorbent and impervious by means of paraffine or other substance; or the explosive, being gathered or made into pellets or balls, can be dipped in or coated with some substance adapted to form a thin, tough, non-absorbent and impervious film to inclose and hold the explosive in the same way as the paraffine-treated paper described hereinbefore. With the dynamite or other high explosive thus separated into a number of small portions held in pellets or packages there is no concentration of the nitro-glycerine even by such a shock as the charge would get if in a projectile thrown from a gun by ordinary black powder. The charge is not then put in a highly-sensitive condition while in the gun.

With the wrapping material of the packages or pellets made of a substance non-conductive of heat, the non-conducting lining of the shell or wrapping of the whole charge could be dispensed with; but I prefer to make assurance doubly sure by using such lining or charge-wrapper.

The shells loaded as described will explode upon striking an object, as is desirable; but I prefer to use with them either a contact or time fuse. Any of the ordinary time or contact fuses can be used instead of the special form that I show at H in Fig. 1 of the drawings. Such special form of contact-fuse I do not intend to cover by claims in the present application, as it is more fully shown and described, and is covered by claims in another application for patent executed on even date with this case.

Whatever kind or construction of fuse is used, it should have connected with it, so as to be fired therefrom, a charge, *h*, of powder sufficient to shatter the envelopes or wrappings of the pellets *f f*, forming the bursting-charge. This insures the sudden explosion of

every one of the pellets together, thus securing the desired maximum effect of the shell-charge.

I deem it best where a fuse extending from the outside to the inside of the shell is used to protect the explosive charge from transmission of heat along the fuse-plug from the propelling-charge to put some of the asbestus or other non-conducting material used between the charge in the shell and the sides of such plug.

The point of the shell can be either the ordinary plain conical one, or, as I prefer, it can be formed like the end of a bit or drill, as shown in Fig. 3, so as to cut its way into iron or steel armor as the shell rotates. With this purpose in view, the point of the shell is provided with the series of spirally and rearwardly extending grooves *a a*, starting from the extreme forward and central part of the shell-point. Each groove is, as shown, ratchet-shaped in cross-section, so as to form a series of sharp spiral cutting-shoulders to bite and cut into the object struck.

Having thus described my invention, what I claim is—

1. In an explosive shell, in combination with the shell-casing and the charge of explosive, one or more layers of material non-conductive of heat entirely inclosing the charge, substantially as and for the purpose shown.

2. In an explosive shell, in combination with the charge of explosive, a wrapping made of asbestus around the charge and entirely inclosing the same, substantially as and for the purpose described.

3. In combination with the casing of an explosive shell, a charge consisting of a number of pellets or packages made of small portions of high explosive, each portion inclosed by a flexible envelope and separated from the other portions only by a flexible medium, substantially as and for the purpose shown.

4. A shell loaded with a mass of rounded pellets, each pellet consisting of a portion of high explosive inclosed in a flexible wrapping or envelope, substantially as and for the purpose described.

5. In combination with a suitable casing, an explosive charge for shells and the like, consisting of portions of high explosive wrapped in paraffine-treated paper, substantially as and for the purpose specified.

6. In an explosive shell, in combination with the charge made up of portions of high explosive inclosed in envelopes or wrappings, a fuse for firing the charge, provided with a quantity of explosive to shatter the envelopes of the separate portions of the shell-charge, substantially as and for the purpose set forth.

7. In an explosive shell, in combination with the shell-casing having the charge-chamber, the lining of material non-conductive of heat, and the pellets or packages of explosive inclosed in envelopes, substantially as and for the purpose shown and described.

8. In an explosive shell, in combination with the shell-casing having the charge-containing chamber, the lining non-conductive of heat and the bursting-charge made up of separate small portions of dynamite inclosed in wrappings or envelopes, substantially as and for the purpose specified.

9. In an explosive shell, in combination with the shell-casing having the charge-receiving chamber, the lining of asbestus within the same, the bursting-charge of dynamite separated into small portions, with each portion separately inclosed in an envelope, and a fuse provided with a charge of explosive to shatter the envelopes inclosing the portions of dynamite and fire the whole charge, substantially as and for the purpose shown.

In testimony that I claim the foregoing I have hereunto set my hand this 3d day of May, 1887.

JAMES W. GRAYDON.

Witnesses:
GEO. S. PRINDLE,
PHILIP G. RUSSELL.