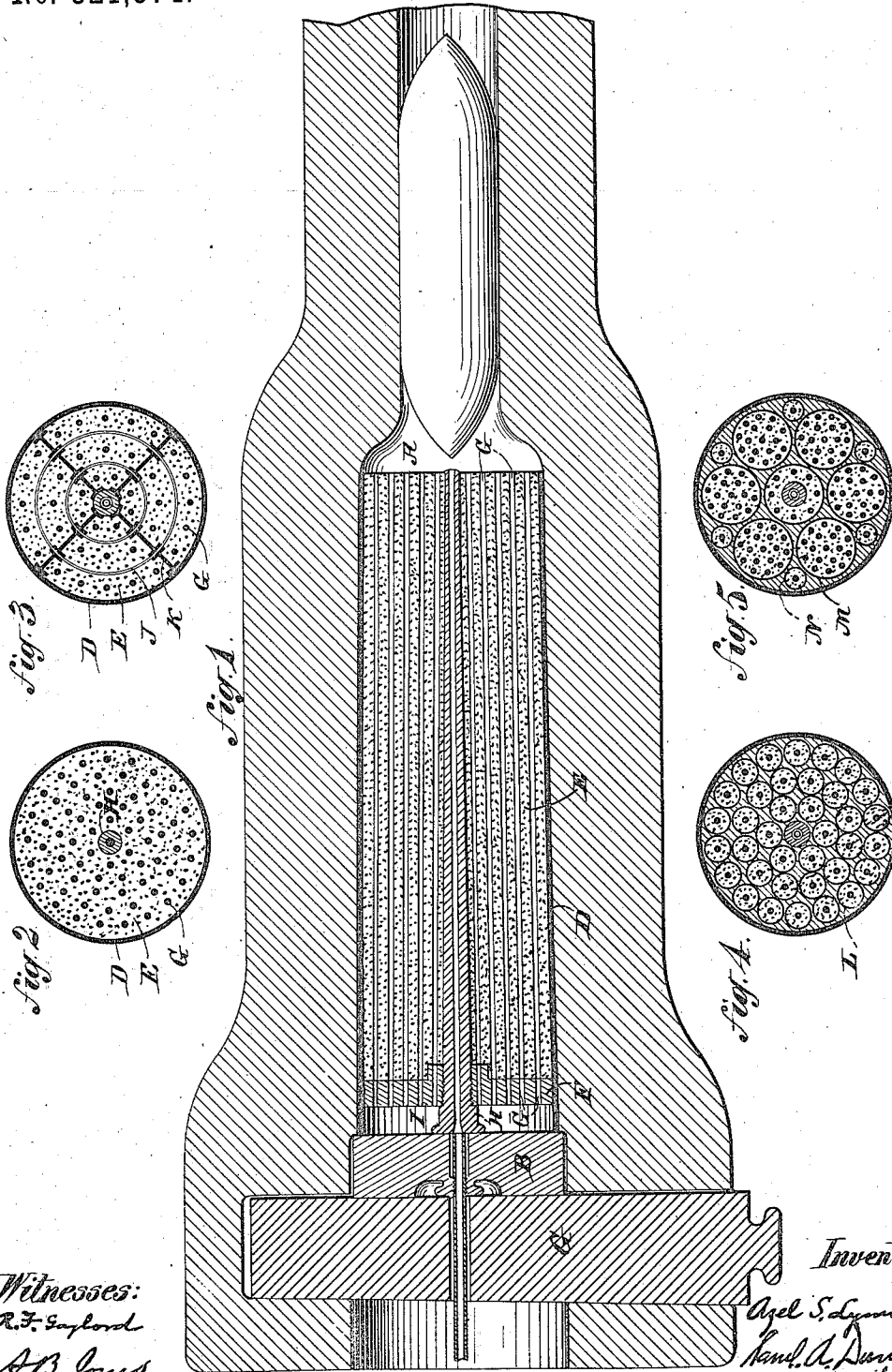


(No Model.)

A. S. LYMAN.  
CARTRIDGE.

No. 321,374.

Patented June 30, 1885.



Witnesses:  
R. F. Gaylord  
A. B. Jones

Inventor  
A. S. Lyman  
Rand. A. Duncan  
att'y

# UNITED STATES PATENT OFFICE.

AZEL STORRS LYMAN, OF NEW YORK, ASSIGNOR TO LIVINGSTON MIDDLEDITCH, OF BROOKLYN, N. Y.

## CARTRIDGE.

SPECIFICATION forming part of Letters Patent No. 321,374, dated June 30, 1885..

Application filed January 26, 1885. (No model.)

*To all whom it may concern:*

Be it known that I, AZEL S. LYMAN, of the city, county, and State of New York, have invented certain new and useful Improvements in Cartridges, of which the following is a full, clear, and exact description, and will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to cartridges for large guns.

The object of the invention is to so construct the cartridges used in such guns that when they are first ignited the fire-surface of the explosive material will be comparatively small and the maximum pressure developed correspondingly low, and so that the fire-area will so increase as to maintain the maximum pressure substantially uniform upon the projectile until the powder is about all consumed, the effect being to start the projectile easily and slowly, and communicate to it a rapidly-increasing motion throughout the entire bore of the gun, thus relieving the walls of the gun from the sudden and heavy strain that is necessarily exerted upon them when—as with the common forms of powder and cartridges—the fire-surface is greatest at the moment of ignition, and when, consequently, a very high maximum pressure is suddenly developed before the inertia of the heavy shot has been overcome.

The invention consists in a cartridge composed of powder or other explosive material packed in a dense solid mass or cake within a shell or case which protects its outer surface, or its outer surface and rear end, the cake of powder being pierced by holes running longitudinally through it from end to end; and it also consists in piercing the head of the shell with holes which shall correspond with those through the powder-cake, and arranging the head so that the holes can communicate with one another, for purposes to be hereinafter explained.

In the drawings, Figure 1 is a longitudinal section of the breech of a gun containing a cartridge embodying my invention in position for firing. Fig. 2 is a cross-section of the cartridge. Figs. 3, 4, and 5 show cross-sections of modified forms of the cartridge.

Referring to these views in detail, A is the chamber of the gun, B is the breech-block which holds the cartridge in place, and C is a wedge for securing the breech-block, which parts, it is to be understood, may be of any suitable construction. D is the cartridge shell or case, and E is the powder-cake, packed or otherwise placed in the shell, with its outer cylindrical and rear end surfaces protected from the action of fire by the shell and the head F of the shell. G represents longitudinal holes running through the powder-cake from end to end, and also through the head of the cartridge. H is a firing-tube passing centrally through the powder-cake, and designed to convey the igniting-flame to the front end of the cake. This tube projects rearwardly from the cartridge-head, and bears against the breech-block, thereby separating the cartridge-head from the breech-block, and leaving a space, I, between them. The cartridge-head is also located somewhat within the shell, so that the shell may bear upon the breech-block, as shown.

To fire the cartridge, a flame is forced down the firing-tube and ignites the front end of the powder-cake and flashes back down the perforations in the powder-cake, igniting the surfaces of all the holes at the same instant. The fire-surfaces at this moment are comparatively small, and the pressure is correspondingly low; but as the burning proceeds in a radial direction the holes in the powder-cake become constantly enlarged and the fire-area continuously increases, as also does the pressure upon the projectile, and the dead inertia of the projectile is gradually and slowly overcome. After the projectile has been started from its seat and as it passes through the gun the pressure exerted upon it is substantially maintained by reason of the continuously-extending fire-area, and this continues until the powder-cake is substantially all consumed, it being the design to construct the cartridge so that the powder will be all consumed before the projectile reaches the end of the bore. In this way a comparatively low maximum pressure may be substantially maintained upon the projectile for the greater part or the whole of the time it is passing through the barrel of the

gun, the effect being to relieve the walls of the gun from dangerous strains, and to give the projectile a greater velocity and effective power than is accomplished by cartridges of common construction.

The particular object of the chamber I behind the cartridge-head is to permit the perforations through the powder-cake to communicate with one another to insure their being instantly and simultaneously ignited throughout their whole extent. Thus if these holes were closed at their rear ends they might possibly become more or less filled with gases upon the first flash of ignition, which would tend to prevent their entire surfaces being instantly ignited, and thereby prevent the intended uniformity of the radial burning and increase of burning-surface along the whole length of each hole; but when these holes open into a common space, as shown, they cannot become so filled or obstructed, and their entire surfaces are simultaneously and instantly ignited, and the progress of the radial burning is practically the same in all parts of the powder-cake.

The distance of the perforations in the powder-cake from each other determines the time of the burning of the cartridge, and this distance should be proportionate to the length of the gun. The holes should meet some time before the projectile reaches the end of the bore. When the walls of the powder-cake are burned through, the burning of the then remaining fragments may raise the pressure slightly; but the space into which the burning gases expand has now become so large and the rapid onward movement of the shot increases it so rapidly that such increase in pressure is not material.

The powder is preferably packed in the shell while in a soft or plastic state, and allowed to dry and harden in the cartridge-shell; but the powder-cake may be formed outside of the shell and afterward inserted therein. It is essential that the powder-cake be hard and dense, so that the fire cannot penetrate into it, but will burn only on its surfaces—that is, as distinguished from cakes made of granular powder, which, though solid in form, are granular in structure and burn in all directions through their mass.

It is proposed to ignite the powder in the manner described; but it is quite possible—and in some cases may be found more desirable—to ignite it by throwing igniting-flames along the holes from the rear end of the cake. In such case, of course, the central firing-tube shown in Fig. 1 would not be required, and some form of priming material suitably arranged at the rear of the cartridge might be used. So, too, the firing of the charge might be accomplished from its front end in other ways than that shown. I do not, therefore, confine myself to any particular way or means for igniting the cartridge.

It will be seen by the foregoing description that the pressure exerted in a given gun and

with a given projectile may be varied by altering the form of the powder-cake; and I am aware that it is possible with this kind of cartridge to get a pressure that shall continuously increase from the time of ignition till the holes in the cartridge are burned through; but this is not regarded as either economical or safe or the most efficient manner of generating the pressure. It is the present intention to have the maximum pressure reached as quickly as is safe and practical, and then to maintain this maximum pressure through the greater length of the bore, when (by the burning through and disrupting of the powder-walls) there may be a slight increase in the pressure and then a slight gradual running down thereof till the ball leaves the gun.

Fig. 3 illustrates a modified form of cartridge for very large guns, in which there are inner tubes or cases, J, concentric with the outer case, D, and having braces K between them. These cases are charged with cakes of powder, E, which are perforated by longitudinal holes G, as in the form described, and there is a central firing-tube, as before. Fig. 4 shows a number of small cylinders, L, each charged with a powder-cake having a single perforation, and all packed solidly within the large or exterior shell, D. Fig. 5 shows large and small interior cylinders, M and N, packed solidly within the exterior shell, and each having one or more perforations, according to their size. The construction of the cartridge may be varied to a still greater extent; but the forms shown suffice to illustrate how in practice the invention may assume different forms.

I do not propose herein to claim, broadly, a cartridge consisting of a powder-cake packed in a shell and perforated by a single hole, in order that the fire-surface may continuously increase from the moment of ignition until the combustion is completed, as this forms the subject of another application for Letters Patent filed by me on the 8th day of September, 1884, and numbered 142,476, (Case B.) The cartridge shown in said application is provided with but one hole or perforation, and is specially designed for small-arms. For large guns a cartridge made on this plan would not serve the purpose of the invention as well as the forms herein described, and this is because the proper rate of increase of the fire-area cannot be had with a single perforation, but can be had with a number of perforations; nor do I claim herein the use of a cartridge having a perforated cake of powder, as this forms the subject of a pending application filed by me December 29, 1884, and numbered 151,420, (Case C;) nor the use of a cartridge depending, broadly, upon a continually-increasing fire-surface, as this forms the subject of a pending application filed by me April 20, 1885, and numbered 162,758, (Case D.)

What is claimed as new is—

1. A cartridge consisting of a shell charged with a solid cake of powder or other explosive

material having longitudinal holes running through it from end to end, and protected by said shell from the action of fire upon its outer surface, substantially as and for the purpose set forth.

2. A cartridge consisting of a shell charged with solid cakes of powder or other explosive material packed in the shell and extending from end to end of the shell, and each provided with one or more holes piercing them longitudinally, and being protected from the action of fire upon their outer surfaces, as and for the purpose set forth.

3. A cartridge consisting of a shell charged with a solid cake of powder, which is protected from the action of fire upon its outer surface by said shell, and at its rear end by the head of the shell, said cake and the head of the shell being pierced by longitudinal holes, as and for the purpose set forth.

4. A cartridge consisting of a shell charged with a solid cake of powder pierced from end to end by holes extending also through the head of the cartridge, the cartridge being provided with a projection extending rearwardly and adapted to bear against the gun, and thereby form an open space back of the head of the cartridge, as and for the purpose set forth.

5. A cartridge consisting of a shell charged with a solid cake of powder pierced from end to end by holes extending also through the cartridge-head, and provided with a firing-tube arranged to direct the igniting-flame to the front end of the powder-cake, as and for the purpose set forth.

AZEL STORRS LYMAN.

Witnesses:

T. J. KEANE,  
R. F. GAYLORD.