No. 766,455. PATENTED AUG. 2, 1904.

H. MAXIM.

SMOKELESS POWDER GRAIN.

APPLICATION FILED MAY 1, 1901.

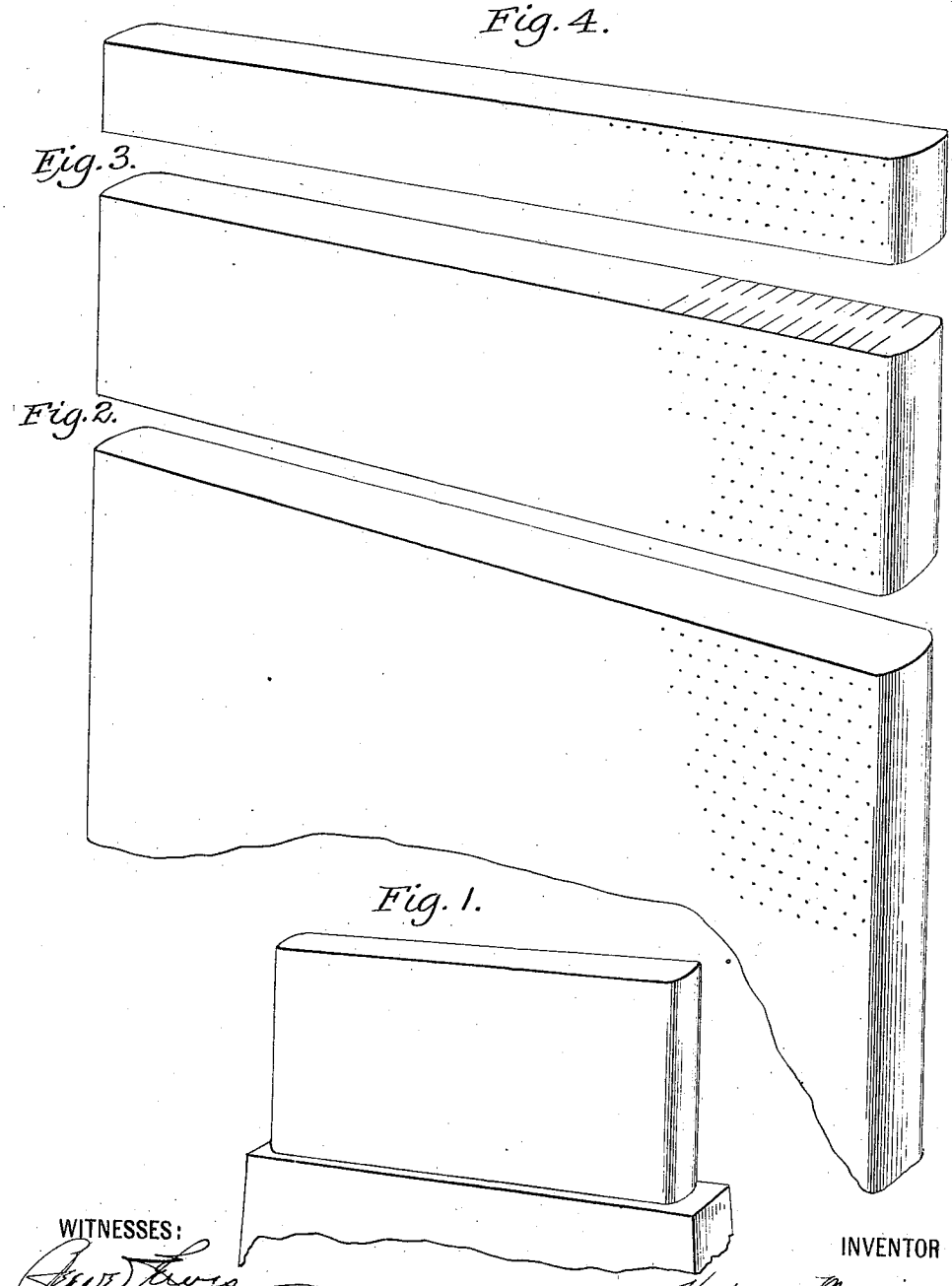
NO MODEL. 3 SHEETS—SHEET 1.

Fig. 4.

Fig. 3.

Fig. 2.

Fig. 1.



WITNESSES:

INVENTOR

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 7.

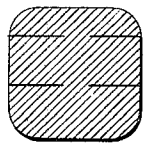


Fig. 6.

Fig. 5.

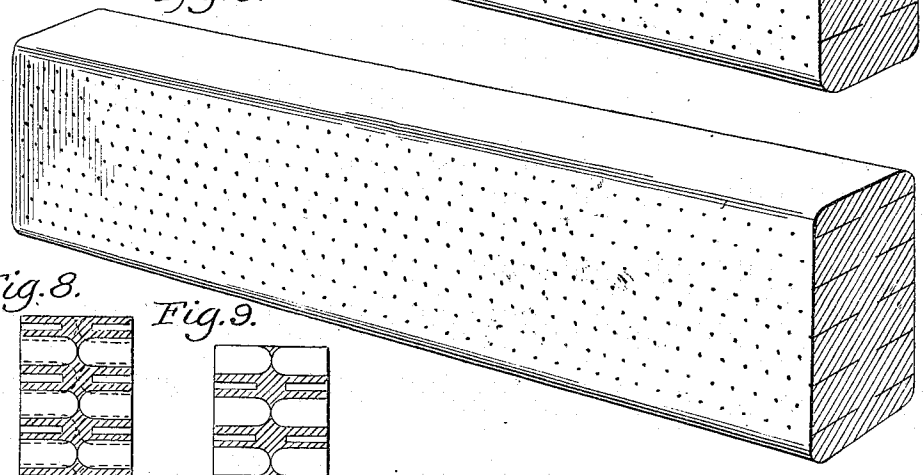


Fig. 8.

Fig. 9.

Fig. 10.

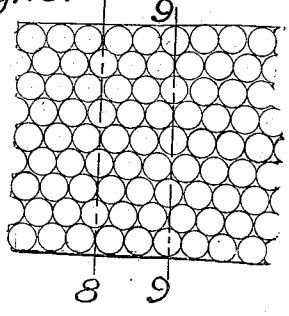


Fig. 11.

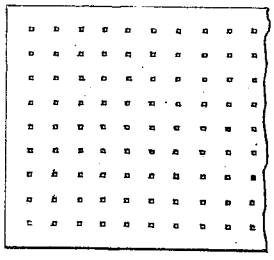


Fig. 12.

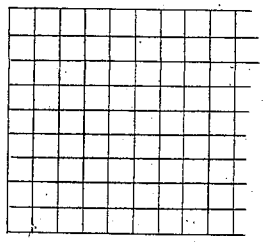
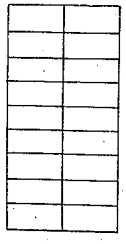


Fig. 13.



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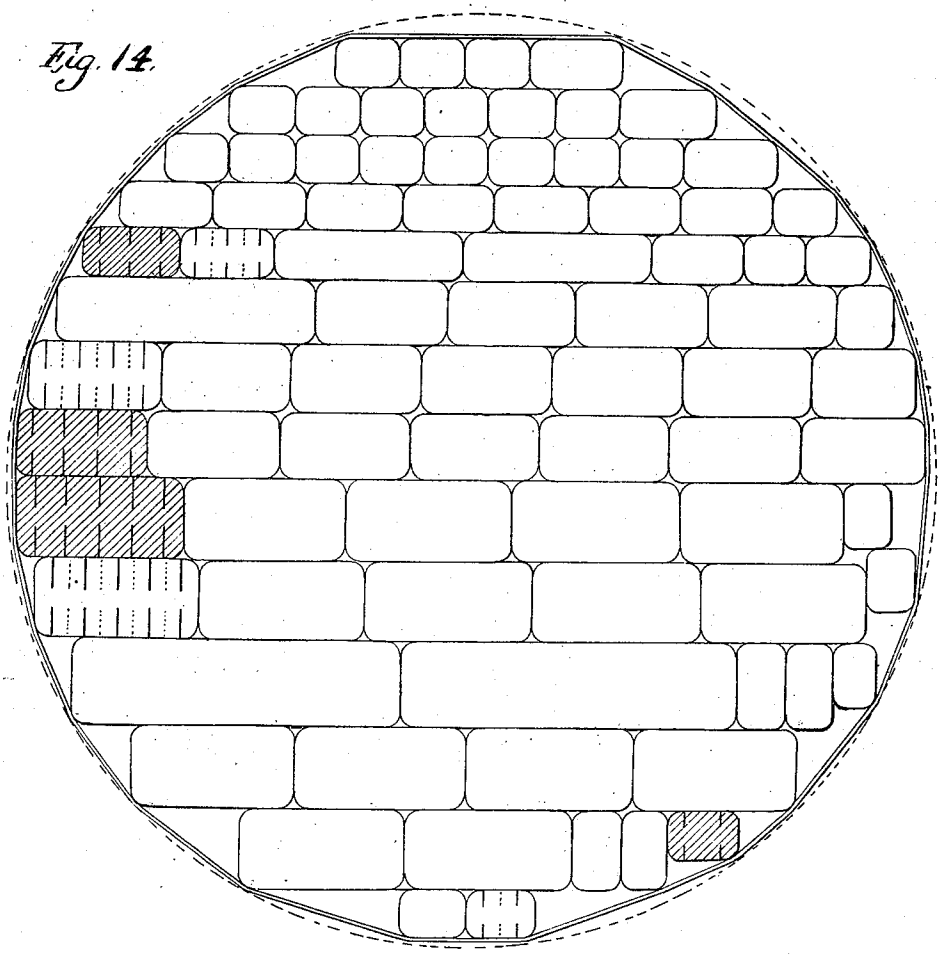
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SMOKELESS POWDER GRAIN.

APPLICATION FILED MAY 1, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 14.



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No. 766,455. Patented August 2, 1904.

UNITED STATES PATENT OFFICE.

HUDSON MAXIM, OF BROOKLYN, NEW YORK.

SMOKELESS-POWDER GRAIN.

SPECIFICATION forming part of Letters Patent No. 766,455, dated August 2, 1904.

Application filed May 1, 1901. Serial No. 58,372. (No specimens.)

To all whom it may concern:

Be it known that I, HUDSON MAXIM, of 891 Sterling Place, Brooklyn, city and State of New York, have invented new and useful Improvements in Smokeless-Powder Grains, which invention is fully set forth in the following specification.

The present invention relates to improvements in smokeless-powder cartridges and charges especially adapted to use in large guns.

The object of the invention is mainly to provide a powder charge which shall be consumed in the gun by accelerating combustion.

To this end the invention provides a rod or bar of gunpowder or unit of a powder charge which per unit of weight provides the minimum of area to the flame of ignition and the maximum of area at the instant before the complete consumption of the charge.

A further object of the invention is to provide great density of loading, whereby the maximum of smokeless-powder material may be got into the powder-chamber of the gun and which shall, owing to the reduced initial burning surfaces, not give excessive pressures.

In carrying out the invention in the preferable way the smokeless-powder material while in a plastic state due to a contained volatile solvent is forced through a forming-die, whereby sheets or slabs of the material are produced. These sheets or slabs are then allowed to lose a portion of their solvent by evaporation to facilitate handling without distortion and, further, to secure a certain and desired amount of shrinkage before proceeding further with the practice of the invention, as hereinafter specified. When a certain amount of drying has been effected, the "sheets" or "slabs" or "rods" or "bars," as they may be termed, are then passed through any suitable cell-forming device having the cell-forming pins of such length that the sheets of material shall be punctured from both sides—that is to say, from opposite sides—to a certain desired depth, leaving such thickness of material between the bottoms of the cells on one side and the bottoms of the cells on the opposite side as to constitute what may be termed a "burning" thickness of material—that is to say, such a thickness of material as will just be burned through before the projectile leaves the gun from the consuming flame acting from opposite surfaces, so that the bottoms of the cells on one side of the sheet shall be deepened by combustion and the cells on the opposite side shall be deepened by combustion, so that the thickness of material between the bottoms of the said opposing cells shall be burned through and the cells made to connect and form continuous perforations extending transversely through the powder-grain at the instant before the complete consumption of the charge. To produce maximum effects, the material between the bottoms of the opposite cells should be made of the same thickness as the material between the sides of the cells pierced in one face of material, so that by the enlargement of the cells from combustion the bottoms of the cells on the one side of the material shall burn through and into the likewise-deepened cells on the opposite side at the exact instant that all of the cells burn together on one face of the material.

It is obvious that as the bottoms of the cells burn deeper they likewise burn wider, thus producing an accelerating effect to the combustion and an effect identical with that produced by the enlargement of the cells in a lateral direction upon one face or side of a rod or bar of the material, and at the instant of intersection or burning together of the cells at their bottoms there will be a small quantity of material unconsumed about the bottoms of the cells where they burn together, and this body of unconsumed material will correspond in thickness and size with that left unconsumed between the cells or perforations in a lateral direction in one face of the material or powder-grain. I therefore secure between the bottoms of the cells the effect of accelerating combustion without perforating the material between the bottoms of the cells, and thereby am enabled to lessen the amount of initial area exposed to the flame of combustion which would be the case if the cells passed clear through the rod or bar of powder material before ignition. It is furthermore ob-

vious that, owing to the shortness of the cells, they may be made correspondingly smaller without endangering disruption of the rod or bar of powder material due to pressure of gases generated in the cells.

Owing to the small size of the cells, there will be a further advantage due to reduction of initial burning areas. This will give correspondingly greater increase of burning areas as the perforations become enlarged, because the ratio of increase between the original diameter of a small cell and of the cell enlarged to the point of intersection with the neighboring cell is much greater than when the cells are made larger, especially of such size as the cells in multiperforated powder rods or bars now in use.

The preferable way of forming the rods or bars is to stuff through a forming-die the material in such form of rods or bars as shall be desired in the final product without further cutting, except to cut them into desired lengths. These rods or bars are preferably rounded at the edges—that is to say, the die is made of such shape that the rods or bars are made without corners or edges. This rounding of the edges lessens the initial burning area and at the same time provides channels through which the flame of ignition may freely pass through a charge made up of such rods or bars of material and between the rods or bars.

An important advantage of this invention is that the rods or bars or slabs of smokeless-powder material may be made much thinner and smaller in cross-section than the usual form heretofore employed for a given size of gun and still by presenting less initial area will give less initial pressure as well as greater acceleration of combustion. In other words, if we assume the use of a given initial pressure for a powder charge of given weight then by means of the present invention we are enabled to employ rods or bars of powder of much smaller cross-sectional thickness or diameter in one direction. It is the amount of initial area per unit of weight of material that gives initial pressure. Therefore it is obvious that by using a form of rod or bar adapted to present to the flame of ignition a smaller initial area per unit of weight then to produce a given pressure we may make our powder rods or bars correspondingly smaller. This feature of this invention has particular advantages in facilitating blending of powder.

It is furthermore obvious that we may, if desired, make by means of this invention our rods or bars of the material very large and massive and still more lessen the initial area to the flame of ignition.

In practicing the invention an advantage is secured by sometimes using powder rods or bars of varying cross-sectional dimensions for building up a charge for a gun, the body of the charge being built up of the larger rods or bars and the smaller rods or bars used to fill out the spaces at the periphery of the charge left unfilled by the larger bars, thereby facilitating the work and effecting a very dense form of loading.

The preferable form of powder rod or bar for use in high-power guns where pressures of about thirty-five thousand pounds are permissible is one in which I make the rod or bar or slab of material about three burning thicknesses thick and about twice as wide as thick. In a ten-inch gun one burning thickness with this powder would be about an eighth of an inch. Therefore I prefer to make for use in ten-inch guns a rod or bar of material three-eighths thick and three-quarters of an inch wide, the depth of the cells being one-eighth of an inch and the cells being one-eighth of an inch apart in the direction of the longitudinal axis of the rod or bar and in a direction transverse to that axis on the same plane, and the thickness of the material between the bottoms of the cells on one side and the bottoms of the cells on the other side being also one-eighth of an inch.

I may also, of course, make the rods or bars or slabs an inch and a half wide and three-eighths of an inch thick, or I may build up a charge consisting of part of one dimension and a part of the other dimension—that is to say, I may use some rods or bars of one width and some of another width in the same charge and rods or bars of different thicknesses, if desired.

It is obvious that by making the rods or bars smaller and thinner, especially by making them thin in one direction, it will facilitate the drying of the material and at the same time tend to minimize a tendency to warp or crack.

While the preferable manner of procedure is to mold the rods or bars into definite shape by stuffing them through a forming-die, still when making powder for certain purposes I may stuff the material into broad sheets and then form the cells in the sheets and then cut them up into rods or bars equal in length and thickness to the cross-sectional dimension of the sheet and of such width as may be desired. The rods or bars may have the cells formed therein before or after they are cut from the sheet.

There is obviously another especial advantage of this invention owing to the shortness or shallowness of the cells, and it is that the cells may be made with a much simpler and less expensive device and with less distortion of the cells in forming them than if they were made continuous extending through the rod or bar of smokeless-powder material. If cell-forming wheels be employed armed with pins, the wheels may be made smaller and still more effectually do the work than if the cells were made long enough to extend through the material. Consequently a correspondingly smaller

number of cell-forming pins will be necessary to do the work.

Referring to the drawings, Figure 1 shows a forming-die with a sheet or slab or bar or rod of the material being forced from the same. Fig. 2 shows a slab or sheet of material after the cells have been formed therein, and Figs. 3 and 4 show rectangular sections which have been cut from the cellular sheet of material. It is obvious that the cutting of these rods or bars from the main sheet may be done along the lines of the cells, or it may be done between the said lines, one side of Figs. 3 and 4 being cut on the lines of the cells and the other side between the lines of the said cells. Figs. 5 and 6 show rods or bars made by stuffing them lengthwise from a die similar to that shown in Fig. 1 instead of forming the material into sheets in the manner already described and then cutting them into rods or bars. An obvious advantage of making the bars in the forms shown in Figs. 5 and 6 is that they may be made with rounded corners or edges. This method also saves one operation in cutting. Fig. 7 is a cross-section of Fig. 6. Figs. 8 and 9 are cross-sections through Fig. 10 on lines 8 8 and 9 9, respectively. Fig. 10 is a plan view of the cells on one side of the bar shown in Fig. 5 at the instant before the cells burn together. Fig. 11 shows the side of a bar like that of Fig. 5, but with the cells made square instead of round. Fig. 12 is a diagram showing the cells at the instant before they burn together, illustrating how rectangular cells retain their angular form. Fig. 13 is a cross-section through Fig. 12. Fig. 14 is an end view, partly in cross-section, of a charge made up of rods or bars of different sizes and widths, but all having cells formed therein in such wise as to cause them all to be consumed at the same instant, because all of the sizes are provided with cells arranged in such wise that the same burning thickness of material exists between the cells and the same time is required for the perforations to burn together. Fig. 14 is an end view of a cartridge charge for a six-inch gun, full size. Some of the different sizes, thicknesses, and widths of the bars of smokeless-powder material are shown in cross-section. In some of the cross-sections the section-lining has been omitted in order to show more clearly the arrangement of the cells, the perforations cut by the section being shown in full lines, while the adjacent line of perforations standing in staggered relation to the same are shown in dotted lines.

What is claimed is—

1. An integral mass of explosive material of uniform thickness provided with a plurality of uniformly-distributed cells whose depth exceeds their transverse dimension, said cells extending from opposite sides of the mass into but not through the same.

2. An integral mass of explosive material of uniform thickness provided with a plurality of uniformly-distributed transverse laterally-opening cells extending from diametrically-disposed points on the opposite sides of the mass into but not through the same, each pair of diametrically-disposed cells having their bottoms separated by a thickness of material equal to the uniform distance between the several holes on the surface of the mass.

3. An integral unit of smokeless powder, in the form of a rod or bar or slab, provided with cells extending thereinto from opposite sides, to a distance less than half of the diameter of the said rod or bar, taken on a line through the cells.

4. An integral unit or body of smokeless-powder material, provided with a plurality of cells in opposite faces, the depths of the cells being less than half the diameter of the body.

5. An integral mass or body of smokeless-powder material, provided with a plurality of cells in opposite sides, and provided with a thickness of material between the bottoms of the cells substantially equal to the thickness of the material forming the other walls of said cells.

6. An integral rod or bar of smokeless-powder material, provided with a plurality of cells in opposite faces thereof, the said cells being each substantially in line or concentric with a corresponding cell in the opposite face of the rod or bar, substantially as described.

7. A cartridge charge, composed of integral rods or bars of smokeless-powder material of varying cross-sectional dimensions, but provided with uniformly-distributed cells arranged in such wise as to effect the simultaneous consumption of all parts of the charge.

8. A cartridge charge, consisting of smokeless-powder rods or bars of different sizes, each of which has a series of multicells, but with uniform thickness of material between said multicells, whereby the larger rods or bars will be consumed in equal time with the smaller ones.

9. A rod or bar of explosive material having parallel sides or faces and rounded corners and uniformly-distributed laterally-opening cells formed in two of the oppositely-disposed faces.

10. A cartridge charge composed of a plurality of sizes of rods or bars of explosive material having parallel sides and rounded corners, each of the said rods or bars having a plurality of cells on opposite faces thereof and the burning thickness of material between all the cells in all the rods being the same.

In testimony whereof I, HUDSON MAXIM, have signed this specification in the presence of two subscribing witnesses.

HUDSON MAXIM.

Witnesses:
C. A. L. MASSIE,
ELISHA K. CAMP.