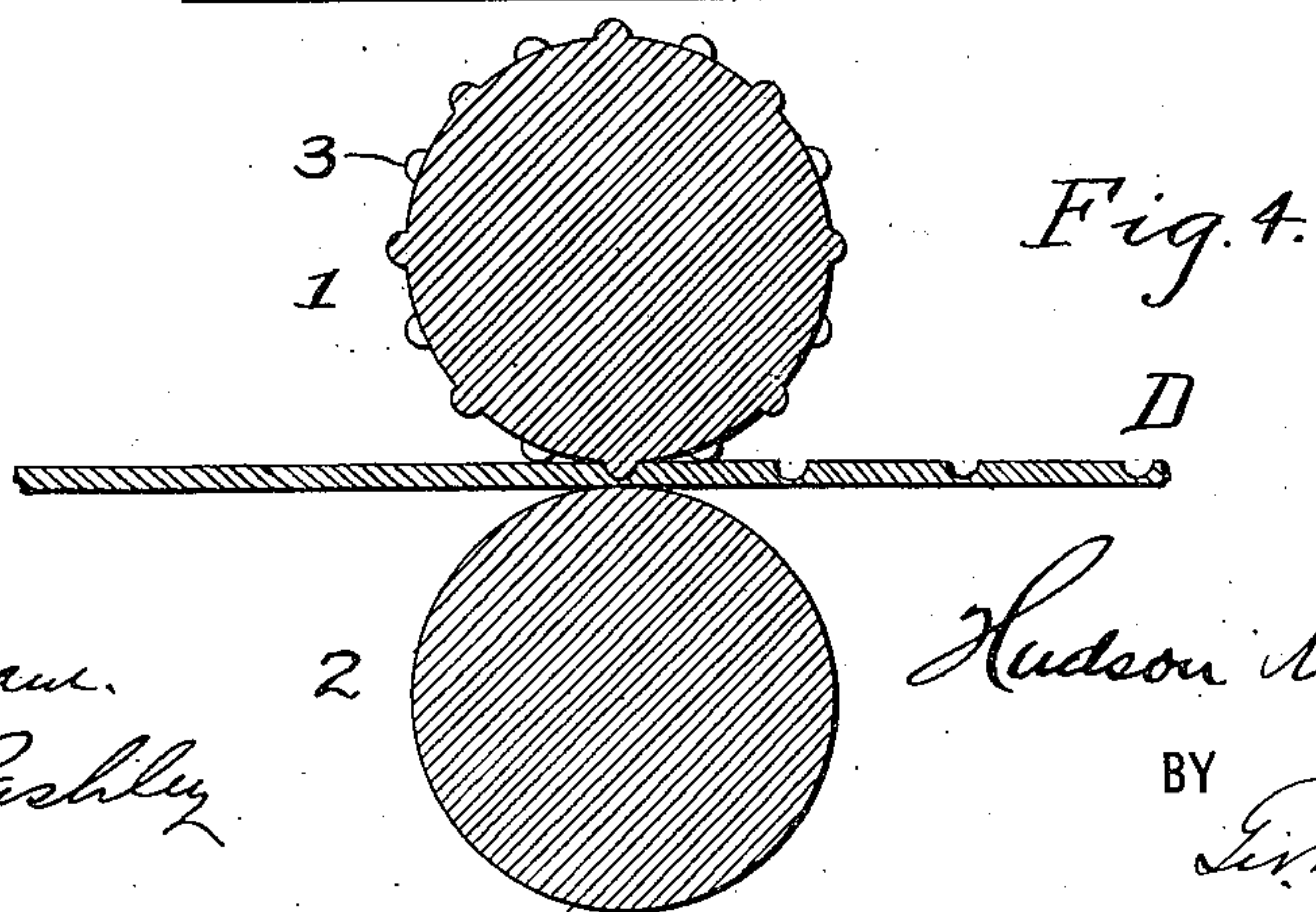
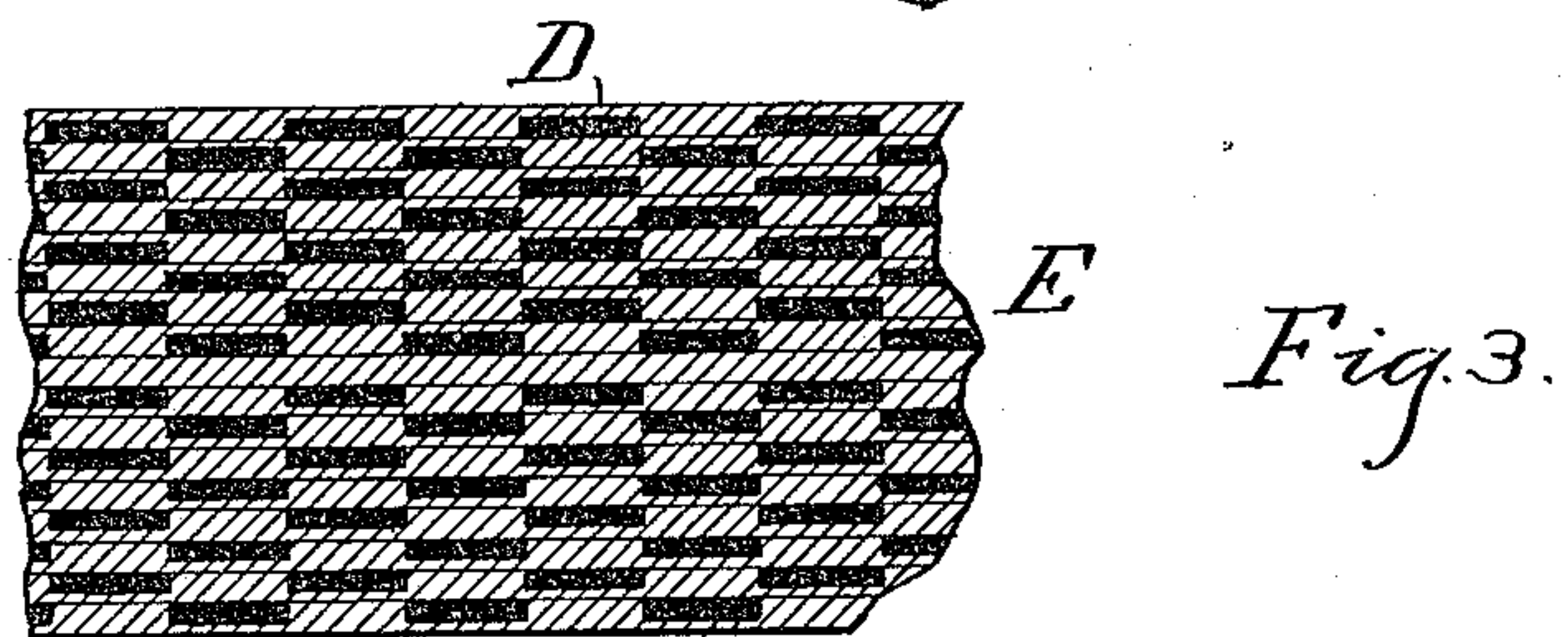
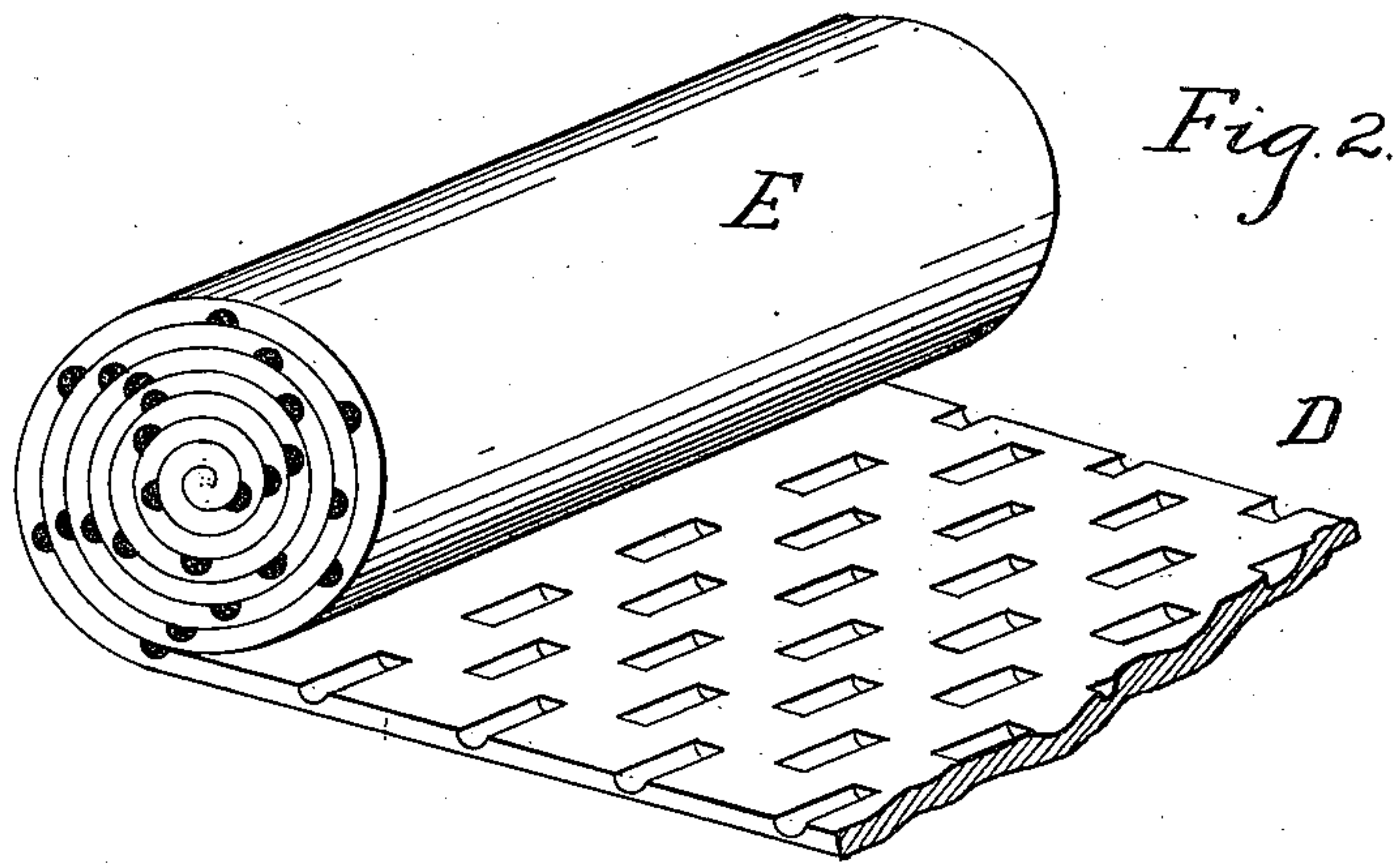
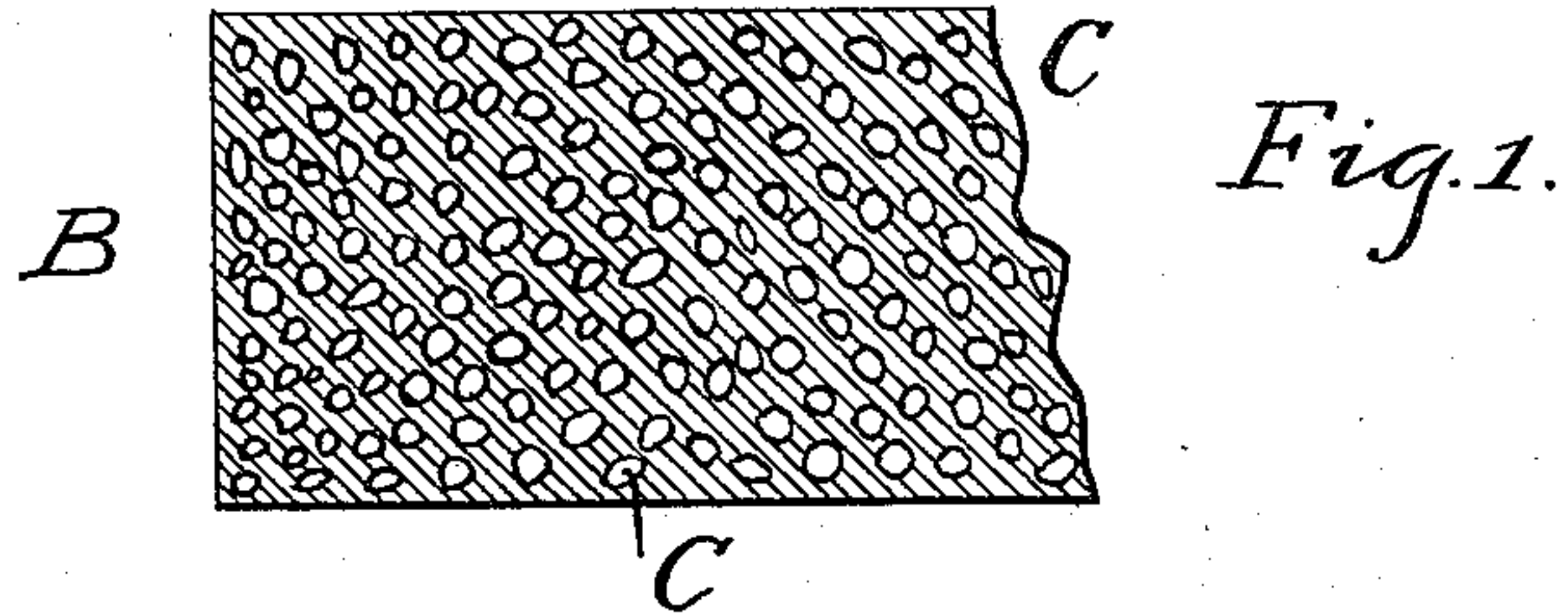


(No Model.)

H. MAXIM.  
CELLULAR EXPLOSIVE CHARGE.

No. 552,919.

Patented Jan. 14, 1896.



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# UNITED STATES PATENT OFFICE.

HUDSON MAXIM, OF PITTSFIELD, MASSACHUSETTS.

## CELLULAR EXPLOSIVE CHARGE.

SPECIFICATION forming part of Letters Patent No. 552,919, dated January 14, 1896

Application filed September 24, 1889. Serial No. 324,908. (No specimens.)

*To all whom it may concern:*

Be it known that I, HUDSON MAXIM, residing at Pittsfield, in the county of Berkshire and State of Massachusetts, have invented certain new and useful Improvements in Cellular Explosive Compounds, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an explosive compound adapted for use either as a propelling-charge for a cartridge or the like or as a bursting charge for a shell or projectile, and when used as a propelling-charge is particularly adapted for throwing high explosives from ordnance.

The object of the present invention is to adapt an amorphous explosive celluloid or colloidal nitro compound for use in mass or bulk, as distinguished from grains or particles, so that such mass or bulk may be utilized as a propelling or bursting charge with equal or more effectiveness than the granular form of such explosive celluloid.

It also has for its object to so form this amorphous explosive celluloid, when in bulk or mass form that its combustion or consumption will begin comparatively slow and gradually accelerate or increase as the burning continues by presenting additional or larger areas of burning-surface, whereby high explosives, sensitive to percussion, may be thrown from ordnance with safety; and also to produce an amorphous explosive celluloid, which may be used as a bursting charge, having within itself sufficient elasticity to counteract the liability to detonate where the use of a larger percentage of certain of its ingredients would tend to make it more susceptible to sudden shock.

Heretofore it has been attempted to prepare ordinary black granular gunpowder and the like so that its speed of combustion or explosion might be sufficiently lessened by reducing its burning-surface to permit of its being employed to throw high explosives from ordnance with safety; but, so far as experience has demonstrated, such methods have not proved efficient, no matter how massed or compressed, it being still too quick for such use, for the reason that because of its granular structure, whether it be sub-divided or par-

tioned or compressed, as the heated gases under the heavy pressure exerted by the explosion almost simultaneously penetrate and communicate through the entire mass, and thereby explode it throughout its substance, exerting a shock upon the projectile substantially as great as though the propelling-charge had not received any special preparation.

The present invention employs an explosive celluloid or colloidal nitro compound in which the distinguishing characteristics are that it is an amorphous, dense, horn-like, solid, colloidal mass. The peculiarities of this amorphous colloidal mass are that it is capable of partaking any form desired, and unless an undue quantity of nitroglycerine be employed in it, it is absolutely incapable of detonation from shock. Another important characteristic of this compound is that it is not hygroscopic and does not deteriorate by time or exposure by variations of temperature and moisture.

This explosive celluloid or colloidal nitro compound consists in the main of gun-cotton or of gun-cotton and nitroglycerine, any volatile solvent employed being evaporated out of the finished product, except in some cases gum-camphor may be employed, which is not sufficiently volatile to be readily evaporated. These ingredients, with or without the gum-camphor, are worked or stirred mechanically until the compound becomes thoroughly gelatinized, or is turned into a more or less plastic mass or colloidal solid, capable of retaining any shape which may be imparted to it, or which may have been imparted to it while in a plastic condition.

In the practice of the present invention I do not employ this amorphous explosive celluloid in grains or granular form resembling ordinary powder, but to use it in its solid or mass form and impart thereto a cellular structure which provides the single mass with a greatly-increased surface with which the flame of combustion may come in direct contact directly as the mass is consumed from its exposed surfaces and no faster without destroying its compact and single-mass form. Such a single-mass structure when confined and ignited may be made to present to the flame of ignition a comparatively large or



small area over which the combustion will take place and which area will be increased and fresh areas presented to the flame until the charge is entirely consumed. In this manner the amorphous and cellular compound as a single mass may be made to reduce the initial explosion, so that no dangerous shock is transmitted to the high explosive of the projectile, and which propelling charge, after the first ignition, will be consumed with a gradually-accelerating speed, whereby not only is the combustion of the charge kept up by reason of the maintenance of the initial pressure upon its first combustion, but the projectile is started easily and then gradually accelerated in speed until it finally leaves the gun at its maximum velocity.

The invention will be more readily understood by a detailed description thereof, aided by the accompanying drawings, in which—

Figure 1 is a longitudinal central section of one form of the porous, cellular, or spongy explosive celluloid. Fig. 2 is a perspective view showing a sheet of the explosive compound with the cells therein and the manner in which it may be rolled into compact form. Fig. 3 is a longitudinal section of the roll formed by said sheet. Fig. 4 is a detail or diagram of a form of sheet-rolling apparatus by which the explosive celluloid may be formed into a cellular sheet.

In the practice of the present invention I employ an amorphous explosive celluloid or colloidal nitro compound, formed in the main of gun-cotton, or of gun-cotton and nitroglycerine, which becomes thoroughly gelatinized or a more or less plastic mass, and after certain volatile solvents are evaporated out becomes a solid mass, which is peculiarly amorphous, dense, and horn like. Such explosive compound, when in a single mass sufficient to make more or less of a propelling-charge for a cartridge and the like, is incapable of use as such because the surface presented to the flame of combustion is not sufficient to make the explosion rapid enough to maintain the necessary pressure for the practicable throwing of projectiles. In order to enable such a solid amorphous explosive compound to be used in mass form as contradistinguished from grains or particles, I provide this amorphous explosive compound with cells, spaces, corrugations or the like, which impart to the amorphous explosive compound a greatly-increased interior surface, which thus presents to the flame of explosion or combustion a greatly-increased burning-surface, which surface increases as the material is consumed and a necessary pressure is created and maintained, as desired. Where the cells ramify through the interior of the mass of this amorphous explosive compound, the explosion or combustion will break the mass up into irregular pieces by degrees, so as to constantly present additional or fresh exposed areas to the flame of combustion, always

maintaining or more than maintaining the initial pressure due to its first ignition until the entire mass is consumed and the gases thereby generated have performed their work in propelling the ball or shell, as is usual.

The drawings illustrate two of the various forms the cellular compound may take, and different forms of the cells, spaces, or corrugations with which the compound is provided, together with a device for producing one of the forms of the cells, spaces, or corrugations in the explosive compound.

Primarily the amorphous explosive compound may be of any form according as it is desired to use it in practice, and the cells therein may be produced in a variety of ways—as, for example, by forcing air into a gelatinous mass of it while in a plastic condition, or small hollow capsules or bits of sponge may be placed in the viscid mass, or the compound while in a fluid state may be poured over or onto a plate or form provided with projections and molded to shape, the projections forming the cells in the mass. Thus in Fig. 1 the cellular or spongy structure B of explosive celluloid has the multiplicity of small cells C, which may have been formed by forcing air into the compound before cooling or by embedding hollow capsules or supplying it with a quantity of pieces of sponge, as before described. And, again, the explosive celluloid or colloidal nitro compound may have its cellular character imparted to it by forming it into sheets or a continuous sheet and thereafter or simultaneously making depressions or corrugations in the surface of the sheet. Thus, as shown in Fig. 4, the compound is drawn between a pair of rolls 1 2, the upper one of which is provided with suitable projections 3 on its surface while the lower roll 2 is a plain one. In passing between the pair of rolls 1 2, the surface of the resulting sheet D is provided with a number of depressions corresponding to the projections on the roll 1. Of course the character of these depressions may be varied widely. In this cellular sheet form of the explosive celluloid it may be rolled up into a cylindrical form, as shown in Fig. 2, enough of the sheet being used to make a cylinder of the desired diameter and any suitable length suited to the purpose for which it is to be used. The sheet D will be rolled so that the depressions are turned inwardly, the plain portion of one layer of the sheet underlying the depressions of the superimposed layer, the exterior surface of the finished cylinder E being unbroken. The cylinder E thus provides the cellular structure represented in section in Fig. 3, which when ignited and as it is being consumed and continually breaking up will constantly present or expose additional surfaces or areas to the flame, thereby increasing its rapidity of consumption, and cause an accelerating pressure upon the projectile.

With this cellular explosive celluloid or



cellular explosive nitro compound any ordinary powder, as granular powder, may be used, the powder filling the cells, spaces, interstices or depressions of the structure.

5 As before stated, the cellular compound may be employed in any manner deemed desirable by the user. In this cellular mass form it may be inclosed within an ordinary metallic cartridge-case to form the explosive  
10 charge therefor. If this charge be ignited, say from the front, the initial explosion will break up a portion of the cellular body into irregular pieces, the pieces being defined by the interspersed cells which expose still fur-  
15 ther additional surfaces to the flame, so that it will burn with accelerating rapidity, and the portions toward the rear of the charge will be successively broken up and similarly consumed.

20 The cellular compound when in sheet form may be formed in a roll or cylinder E, Fig. 2, and itself form the cartridge either for gun or blasting purposes, the cells, of course, being of any size or length, and extending  
25 entirely through the sheet, and such cells may form any desirable proportion of the mass.

The porous mass or cylinder may be coated with a waterproof coating of the nitro compound that is difficult of ignition.

30 By means of the cellular structure of this explosive compound any desired quantity of the explosive material less than the cubical contents of the chamber of a gun may be made up into a charge.

35 By regulating the size and location of the cells in a charge of this amorphous explosive compound, I am able to largely regulate the rapidity of combustion. Thus between regulating the composition or quality of the com-  
40 pound and determining its cellular structural character I am able to cover a very large range as to the explosive force of the compound, the rapidity of combustion, &c., so that a slow-burning explosive agent may be  
45 made for heavy guns, or a quick and powerful detonator for mines, torpedoes, and the like. The material for the coating or covering can be made very difficult of ignition. It may be a mere varnish or a coating of con-  
50 siderable thickness.

I am aware that celluloid, practically a non-explosive substance, has been corrugated for ornamental purposes, and that it accidentally

has air-bubbles in its mass from being improperly made, but it is obvious that such is 55 not my invention.

What is claimed is—

1. The herein described explosive colloid charge having in its interior a multiplicity of cells, substantially as and for the purpose 60 described.

2. An explosive colloid charge of the character described having throughout its structure uniformly arranged cells, substantially 65 as and for the purpose described.

3. The herein described amorphous explosive charge having in its interior a multiplicity of cells, spaces or depressions, or the like, and a filling of granular gunpowder in said cells or spaces, substantially as and for the 70 purpose described.

4. The herein described amorphous explosive charge in a single mass having an interior cellular structure composed of a multiplicity of separated cells and exteriorly coated 75 with a coating of celluloid or varnish difficult of ignition with respect to the interior amorphous mass, substantially as and for the purpose described.

5. The herein described amorphous explosive charge provided in its interior with a multiplicity of separated cells, depressions, or the like, a filling of granular gunpowder in said cells or depressions and exteriorly coated with a coating of celluloid or varnish difficult 80 of ignition with respect to the interior of the amorphous mass, substantially as and for the purpose described.

6. An amorphous explosive charge of the character described in sheets having through- 85 out its structure a multiplicity of uniformly arranged cells, substantially as and for the purpose described.

7. An amorphous explosive charge of the character described in a continuous sheaf, 90 having a multiplicity of interior separated cells therein and rolled into a cylindrical form, substantially as and for the purpose described.

In testimony whereof I affix my signature 100 in presence of two witnesses.

HUDSON MAXIM.

Witnesses:

W. A. BARTLETT,  
T. W. JOHNSON.