

1,011,863.

Patented Dec. 12, 1911.

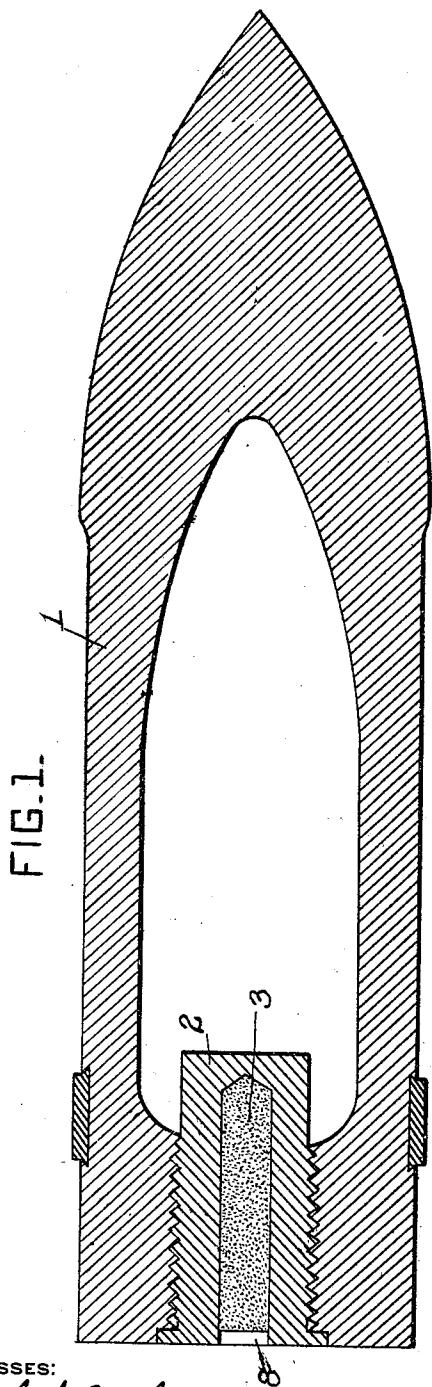


FIG. 1.

WITNESSES:

*J. Herbert Bradley.*  
*Frederic J. Tomlinson*

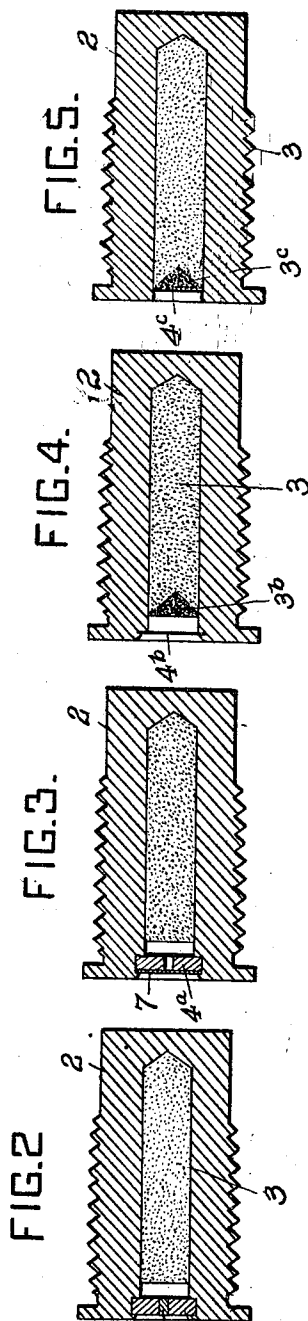


FIG. 2

FIG. 3.

FIG. 4.

FIG. 5.

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# UNITED STATES PATENT OFFICE.

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## TRACER FOR PROJECTILES.

1,011,863.

Specification of Letters Patent.

Patented Dec. 12, 1911.

Application filed April 24, 1911. Serial No. 622,960.

*To all whom it may concern:*

Be it known that I, JOHN B. SEMPLE, residing at Sewickley, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Tracers for Projectiles, of which improvements the following is a specification.

In Letters Patent of the United States, No. 581,946, granted to me May 4th, 1897, I have shown and described a "tracer" for projectiles. The tracer consists of a body of slow-burning, light-giving substance, carried in an open-mouthed chamber or cell in the body of the projectile, ignited on the firing of the projectile from a gun, and burning from the open mouth of the cell as the projectile flies. In the said patent I have shown and described the tracer cell as opening preferably to the rear—that is, with its mouth exposed to the flash of the propelling charge. For a tracer composition, I have specified (by way of example) a mixture of magnesium, gunpowder, and an oxidizing agent, bound in a coherent mass with such a binder as shellac. Such a tracer material I have described as capable of being ignited, either directly by the flash of the propelling charge, or indirectly through mechanical means.

Although I have, since the grant of the aforesaid patent, extensively practiced the invention which is described in it, I have heretofore found it impracticable, when dealing with projectiles fired at modern high pressures, to ignite (without exploding) the charge of tracer material directly by the flash of the propelling charge. I have found, in guns fired at modern high pressures, that, if the charge of tracer material be exposed to the flash of firing, it will either be utterly consumed on the instant, or so far destroyed that the tracer cannot be made to burn through a sufficient portion of the trajectory of the projectile to render the tracer certainly useful to any substantial or adequate degree. Accordingly, up to the present time, I have been obliged, in making tracers for use in guns fired at such high pressures as have of late years been commonly employed, to resort to indirect means for effecting ignition of the tracer on the firing of the projectile which carries it. Such necessity is disadvantageous, in that simplicity of structure

and simplicity in function is always to be desired in this art; furthermore, to furnish the mechanical ignition means to which I here refer, is to add appreciably to the cost of the tracer-equipped projectile.

A compound of materials suitable for the tracer charge has been referred to above; and, while my present invention is not limited to the use of any particular composition, I shall for purposes of explanation continue to refer to this particular composition. This composition is a mixture of magnesium, gunpowder, and an oxidizing agent, held together by a suitable binder, such as shellac. The preparation of the composition, as it has heretofore been carried out, has consisted in compounding the ingredients essential for burning with the binder and subjecting the whole to a sufficient amount of pressure to cause the mass to cohere and keep its place in the chamber or cell prepared for it in the body of the projectile.

I have discovered that, if the composition of the ingredients essential for burning and the binder be compressed to a degree far exceeding that required to effect cohesion of the mass, and to a pressure measurably approaching (or even equaling or exceeding) the gaseous pressure produced on the explosion of the propelling charge under which the projectile is to be fired, the charge of tracer material may be exposed for ignition to the flash of the propelling charge, and will not on the firing of the gun be prematurely consumed or destroyed to an injurious degree, even though fired under such high pressure as I have particularly referred to above; and (contrary to what might have been expected) will not under such circumstances resist initial ignition or progressive burning as the projectile flies, but will perform its function in proper and desired manner.

I have found that tracer material so compounded and compressed owes its practical success under the exacting conditions of modern high-pressure service to the substantial exclusion of the gases of discharge from penetration into its body; and that, whereas the tracer composition as it has heretofore been prepared is relatively porous and pervious, when exposed to these high-pressure gases, and consequently is broken down and substantially consumed on the firing of the projectile, the body of tracer material

prepared according to my present invention is dense, and does not permit such destructive penetration, and is not prematurely destroyed.

Accordingly, my invention, in its broadest aspect, consists in compressing the tracer compound to a degree so great as to substantially exclude gas penetration under the exacting conditions above referred to; and, while I have indicated that compression to a degree approximating the pressure generated in the gun on the explosion of the propelling charge will be effective to the end in view, I do not desire to measure the degree of pressure by that figure.

My invention will be embodied, if the material be compressed to a higher degree than has heretofore been supposed necessary or desirable, with the attendant result that the compressed material is resistant to gases which otherwise would permeate and prematurely destroy it.

It will thus be seen that, if it be known beforehand (within reasonable limits) what the degree of pressure will be to which a certain projectile is to be subjected when fired, the manufacturer of the tracer may govern accordingly the degree of compression to which the tracer material is in its preparation subjected, and in so doing adapt his product to the particular service contemplated. While the gas pressure generated on the discharge of a projectile may not be determined in advance with absolute accuracy, it may within workable limits be predetermined.

The invention resides both in the method of production and in the product obtained.

I have spoken above of shellac as a suitable binding material for use in the practice of my invention, and have said that it is requisite that the binding material be plastic at the temperature under which the tracer material is compressed. While I preferably add to the components necessary for combustion another ingredient, such as shellac, rosin, or linseed oil, which (while having no substantial effect upon the proper function of the tracer ingredients with which it is compounded) will serve its own function of holding these ingredients in a coherent mass, the ingredients of the tracer composition itself may include an element or elements effecting under pressure the desired cohesion. The sulfur element of gunpowder, for example (when gunpowder is employed in the tracer composition), becomes plastic at moderately elevated temperature; and, by compressing gunpowder with other ingredients at such temperature, the sulfur element in the gunpowder may if desired be relied on to serve as the binder.

In the accompanying drawings which form part of this specification, Figure 1 is

a view in longitudinal section of a projectile equipped with a tracer, and illustrates my invention in the general aspect hereinabove described. In this drawing, the projectile body is indicated at 1, and the tracer stock (for the tracer cell is preferably formed in a separate piece or member) is indicated at 2, and the tracer material within the cell is indicated at 3. This material 3 is the material which is compressed in the manner and to the degree above indicated, and it will be observed that the mouth 8 of the cell is open rearwardly of the projectile, and is accordingly in a position to be directly exposed to the flash of the propelling charge, when the projectile is fired from a gun.

Figs. 2, 3, 4, and 5 are views in longitudinal section of the tracer stock detached from the projectile, and illustrate (in alternative form) a temporary protective closure for the otherwise open mouth of the tracer cell; Figs. 4 and 5 serve also to illustrate the application to the main body of tracer material, and at the rear thereof, of a supplementary, readily ignitable body of material which serves to insure the ignition of the highly compressed tracer body. I shall describe first this supplemental ignition body.

While I have found the body of tracer material to be ignitable by the flash of the charge, even though highly compressed to resist penetration by the gases generated in high-pressure work, I have reason to think that in the range of permissible and desirable materials, and in the range of pressure which practical conditions may require, difficulty may at times arise, through failure of ignition. I have found it feasible and practical to insure ignition under otherwise unfavorable conditions by forming with or applying to the main body 3 of tracer material a supplementary body of material (3<sup>b</sup> of Fig. 4, 3<sup>c</sup> of Fig. 5) rendered more readily ignitable either by smaller degree of compression, or by being compounded of more inflammable material (such as black powder, magnesium, and niter, compounded in different proportions than those suited for tracer material, having a relatively larger black powder content), or both, and arranged at the rear of the main tracer body, and in a position directly exposed to the flash of discharge.

The means shown in Fig. 2 for protecting the body of tracer material within its cell from injury consist of a disk 4, temporarily closing the mouth of the chamber. As shown in the figure, this disk is preferably of somewhat greater diameter than the bore of the cell, is countersunk in the mouth of the cell, and may conveniently be secured in place with adequate firmness by crimping the lip of the orifice over the rear edge of

the disk, as is indicated at 5. This disk 4 is perforate, and the hole through it is closed by a plug 6, of material destructible or removable by the flash or pressure of the propelling charge—lead, for example, or other relatively soft material, such as wax. The flash of discharge will penetrate through the plugged perforation in disk 4 and gain access to the body of tracer material to ignite it. When the discharged projectile leaves the gun, the disk 4 will be removed from its temporary security in the mouth of the cell by the pressure of gas in front of it, and thereafter the tracer will burn from the open mouth.

The alternative form of closure illustrated in Fig. 3 contemplates protection of the means employed from injurious effects of the air. If the plate 4 be used as it is shown in Fig. 2, it will preferably be formed of non-corrosive metal, such as brass. The sea air, to which such articles are very commonly exposed, will corrode and injure this part of the structure, if it be in any substantial degree corrosive. Non-corrosive materials are however relatively expensive, and in Fig. 3 I have shown that a disk 4<sup>a</sup> made of cheaper but corrosive material, may be protected from the air by a cover-plate 7 of non-corrosive material such, for example, as brass. If such a cover-plate be employed, it will be of relatively light weight, readily penetrable (where unsupported) by the flash of discharge. The perforation in the plate 4<sup>a</sup> will not be plugged, and the flash of discharge will pierce the cover plate 7 and gain access through the perforation to the body of tracer material.

In Fig. 4, the disk 4<sup>b</sup> (preferably of brass), instead of being relatively heavy and perforate, is relatively light and imperforate, and the flash of discharge gains access to the tracer by piercing the imperforate disk.

In Fig. 5, the protecting disk becomes a membrane 4<sup>c</sup>, of such thin material as tin foil or shellacked paper, which the flash of discharge will even more readily pierce. It will be observed that in Fig. 5 the closure is not countersunk in the mouth of the tracer cell (as in Figs. 2, 3, and 4) but the closure, being of flexible material, is shaped to conform to and be secured to the unenlarged bore of the cell.

It will be observed, on reference to Figs. 2, 3, and 4, than an air space is left within the tracer chamber, and between the rear face of the compressed tracer compound and the forward face of the temporary protecting disk. I have found the presence of such a space desirable; for, when present, the action of the flash of discharge in penetrating the temporary protecting covering and getting access to the tracer compound itself is facilitated. If, for certainty of

ignition or otherwise, the body of tracer material (otherwise impervious), be, at its posterior end, of diminished density, and so penetrable by the gases of discharge, the air space between closure and tracer body may without detriment be eliminated. This feature is indicated in Fig. 5, wherein the supplemental body 3<sup>c</sup> (whether of uniform composition with the main body 3 or of a composition more readily ignitable) will be understood to be less dense than the main body 3, and previous to high-pressure gases. The closure 4<sup>c</sup> may then, as the figure shows, bear directly upon the posterior face of the tracer charge.

A further structural detail will readily be understood, without further illustration. If the closure be formed of inflammable material, such as collodion, the closure may be laid directly against the posterior face of the tracer charge, even though the tracer charge be highly compressed throughout. If such a material as collodion be used as a closure, it will preferably be protected externally by a coating of easily fusible weather-proof material, such as wax, or shellac varnish.

I claim herein as my invention:

1. The herein described method of preparing a body of tracer material for service in projectiles fired at high pressure, which consists in compounding and compressing the tracer ingredients to a degree of pressure in excess of that required to afford cohesion and to a degree rendering such body resistant to immediate destruction when the projectile furnished with it is fired at its intended service pressure.

2. The herein described method of preparing a body of tracer material for service in projectiles fired at high pressure, which consists in compounding the tracer ingredients, and compressing such compound to a degree of pressure in excess of that required to afford cohesion, and sufficient to render the mass impervious to gas penetration when exposed to the high gas pressure incident to its intended service.

3. The method herein described of preparing a tracer charge for a projectile fired under predetermined conditions of gas pressure, which consists in compressing one portion of the body of the charge to the degree in excess of that required to give cohesion and arranging contiguous to such highly compressed portion another portion less highly compressed.

4. A body of tracer material adapted for service within a projectile fired under conditions of high pressure, such body of tracer material compounded and compressed to a degree in excess of the pressure required to give cohesion, and to the point of resistance to penetration by the gases of explosion, substantially as described.

5. A tracer charge for a projectile fired under predetermined conditions of gas pressure, one portion of the said charge compressed to the exclusion of gas penetration under the conditions of discharge and another and contiguous portion of said charge penetrable by the gases of discharge, substantially as described.

6. A tracer charge for a projectile fired under predetermined conditions of gas pressure, one portion of the said charge composed of tracer material and compressed to the exclusion of gas penetration under the conditions of discharge, and another and contiguous portion of said charge composed or more readily ignitable material, substantially as described.

7. A projectile having a cell open at its rear end, in combination with a combustible non-explosive or pyrotechnic compound arranged in said cell and compressed to a degree in excess of that necessary to afford cohesion and to the exclusion of gas penetration, substantially as described.

8. The combination of a projectile, a rearwardly opening tracer cell formed therein, a body of tracer material within said cell compressed to the exclusion of gas penetration under the conditions of discharge, and a closure for said tracer cell penetrable by the flash of the propelling charge, substantially as described.

9. The combination of a projectile, a rearwardly opening tracer cell formed therein,

a body of tracer material within said cell compressed to the exclusion of gas penetration under the conditions of discharge, and a closure for said tracer cell penetrable by the flash of the propelling charge, and removable by the combustion of the tracer material within its cell as the projectile flies, substantially as described.

10. The combination of a projectile, a tracer cell formed therein and opening rearwardly, a body of tracer material within said cell, impervious by compression to penetration by the gases of explosion, a closure for said cell rearward, said closure being penetrable by the flash of the propelling charge, and said closure being spaced at an interval from the body of tracer material within the cell, substantially as described.

11. The combination of a projectile provided with a rearwardly opening tracer cell, a body of tracer material within said cell and compressed to the prevention of penetration of gases of explosion, a perforate plate closing the said tracer cell, and a closure for the perforation in said plate, said closure removable by the flash of the propelling charge, substantially as described.

In testimony whereof I have hereunto set my hand.

JOHN B. SEMPLE.

Witnesses:

ALICE A. TRILL,  
PAUL N. CRITCHLOW.