2 Sheets—Sheet 1.

T. P. SHAFFNER.

Artillery Mining and Blasting.

No. 60,572. Patented Dec. 18, 1866.

Fig. 1.

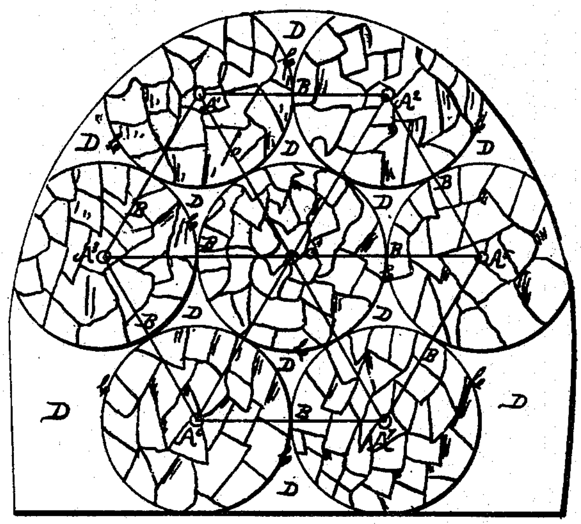
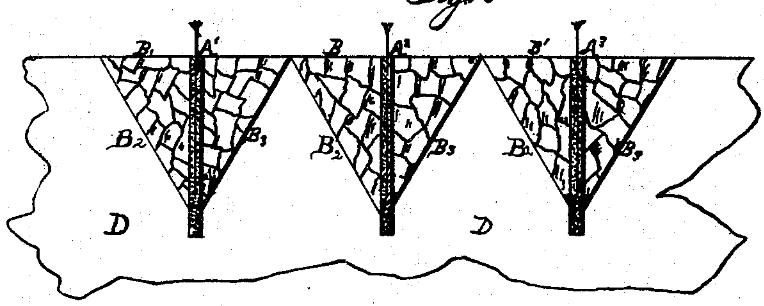


Fig. 2



Witnesses.
W. M. Shaffner
Edw. F. Brown

Inventor.
Tal. P. Shaffner
Inventor,
&
Discoverer

2 Sheets—Sheet 2.

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Fig. 3.

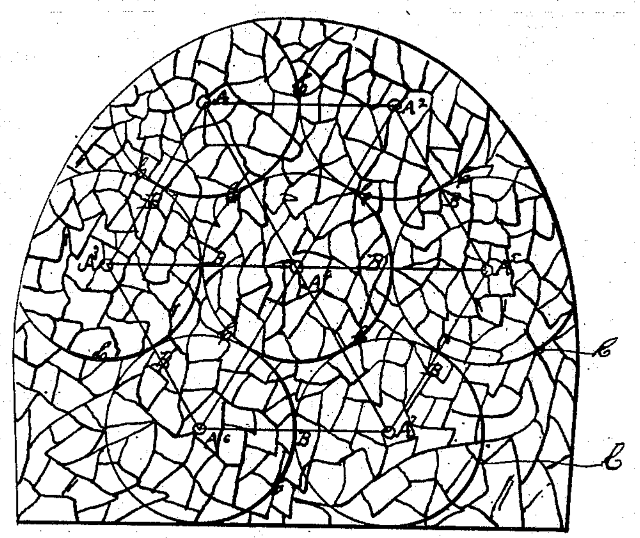
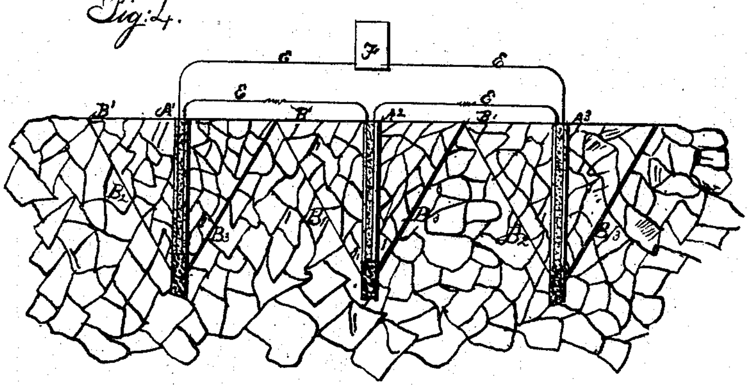


Fig. 4.



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UNITED STATES PATENT OFFICE.

TAL. P. SHAFFNER, OF LOUISVILLE, KENTUCKY.

IMPROVEMENT IN ARTILLERY AND MINING BLASTING.

Specification forming part of Letters Patent No. **60,572**, dated December 18, 1866.

To all whom it may concern:

Be it known that I, TAL. P. SHAFFNER, of Louisville, Jefferson county, State of Kentucky, have discovered or invented a new and Improved Mode of Artillery Mining and Blasting; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The nature of my discovery or invention consists in the arrangements of combustible substances in such angles and relative distances, so that when exploded simultaneously a greater disruption of matter will take place than when each charge is exploded singly, the same being an improvement upon my invention patented No. 51,674, dated December 19, 1865.

To enable others skilled in the art to make and use my invention or discovery, I will proceed to describe the process employed by me.

Practical blasting has for its object the demolition of solid matter, such, for example, as rock, coal, earth, &c.; and that object has been accomplished by drilling holes to a given depth, depending upon the character of the explosive substance to be employed. For centuries gunpowder has been used. Within the past twenty years gun-cotton has been experimentally employed, excepting during the past five years it has been extensively and practically used in Wales, and, to some extent, in Austria, and more recently by myself in the United States. During the past two years I have extensively used nitroleum (commonly called nitro-glycerine) for blasting rock. With these substances I have, from time to time, practiced upon a theory suggested by me some twenty years ago, early after electricity became with me a professional study, namely, that, by combining the angles and positions of the drill-holes in rock, and exploding them simultaneously, a greater disruption of rock will take place than when each blast is exploded separately.

In 1855 I experimented in Finland, Russia, for the purpose of blasting iron-ore, and though my electrical apparatus was imperfect, on account of the fuse, yet I produced favorable results. In 1857 I repeated those experiments in Belgium, and practically attained success. At that time the batteries required for exploding many blasts at the same instant were voltaic, and not practical for mining operations. Since then the magneto apparatuses have been sufficiently perfected to make the application of electricity for blasting purposes practical. I do not confine myself to any one kind of electrical generator, but can employ various kinds of apparatuses.

Having satisfied myself that simultaneous blasting could produce and effect an increased disruption of rock, I next proceeded to determine a formula to be observed when thus blasting, but the effort was surrounded with much difficulty. For example, the hardness of the rock and the quality of the explosive substance had to be relatively considered. Gunpowder has an explosive force of thirteen thousand pounds per cubic inch; gun-cotton, seventy-eight thousand pounds per cubic inch, and nitroleum one hundred and sixty-nine thousand pounds per cubic inch. Powder differs according to quality of manufacture, the gun-cotton according to condition of dryness, but nitroleum does not seem to have any varying conditions of force. Thus stand the relative gases. Another difficulty has retarded the determination of a reliable formula, namely, the different areas occupied by the different explosive substances. Practically applied, two ounces of gun-cotton occupy the same cubic area that three-quarters of a pound of gunpowder require; and nitroleum, of greater power than gun-cotton or gunpowder, as above mentioned, only occupies the space filled by two ounces of gunpowder. The power of nitroleum lies at the bottom of the drill-hole, while that of powder is distributed over about ten lineal inches. Having fully considered these different conditions, and made several thousands of blasts in rock, earth, and water, I have found that the following conditions, as rules, may be observed to attain the greatest success in blasting: The rock may be considered to be very hard, free of seams or slips; the drill-holes to be thirty inches deep, and blasted singly. The cone of disruption will be equal to an equilateral triangle, with its side upon the surface of the rock, bisected by the drill-hole. In hard rock—such, for example, as mica and silex—the quantity of powder that can be put into the drill-hole will not disrupt the rock, but the gas will blow out at the orifice. If the hole be reduced from thirty to twenty inches in depth, the powder may succeed. In holes of the greater depth nitroleum can be successfully employed. Blasting singly is represented by Figures 1 and 2.

Fig. 1 is the heading of a tunnel having at certain angles and distances, each from the other, holes drilled into the rock horizontally. Upon the surface these holes are at the angles of equilateral triangles. A^1, A^2, &c., are the holes, and lines B B the triangular indications. The circular lines C C C represent the circumference of the triangle brought to a circle from the center, where the drill-holes bisect the exterior side. Fig. 2 represents a sectional view of Fig. 1; A^1 A^2, &c., the drill-holes, charged, tamped, and with fuses. B^1 B^2, &c., are the sides of the equilateral triangles. D D is the solid rock. The broken lines within the circles of Fig. 1, and within the triangles of Fig. 2, represent the broken rock after the blasts are discharged separately. The cone of force or of disruption is shown by Fig. 2; and the solid rock remaining is represented by D D D, &c., in each of the figures above described. Fig. 3 represents the heading of a tunnel with drill-holes placed precisely as shown by Fig. 1. Fig. 4 represents a sectional view of Fig. 3, and is like Fig. 2. The blasting of Fig. 3 is supposed to be done by electricity, the whole being discharged simultaneously. Fig. 4 shows the connection of the electric wires.

The simultaneous blasting produces the total disruption of the rock of the whole face of the heading, and, many times, below the bottom of the holes. The gases act conjunctively, and disrupt at least double the quantity of rock than be accomplished by separately discharging the blasts, as represented by Fig. 1 and 2.

When applied to military purpose, for the demolition of earth, rock, or works simultaneous, blasting will prove eminently important. It will require a less number of explosive deposits, and a less number of combinations generally can effect the demolition desired.

Having fully described my discovery or invention, and the mode of the application of the same sufficiently clear to enable one skilled in the art to make and use the same, what I claim, and desire to secure by Letters Patent as my invention or discovery, is—

The combination of blasts to be discharged simultaneously by electricity in such manner as will effect a conjunctive force of the respective charges, thereby increasing the disruption of matter beyond what can be obtained by separately discharging the said blasts.

TAL. P. SHAFFNER.

Witnesses:

W. M. SHAFFNER,

EDM. F. BROWN.