(No Model.)

J. L. L. KNOX.

METHOD OF BLASTING ROCKS.

No. 342,366. Patented May 25, 1886.

Fig. 1.

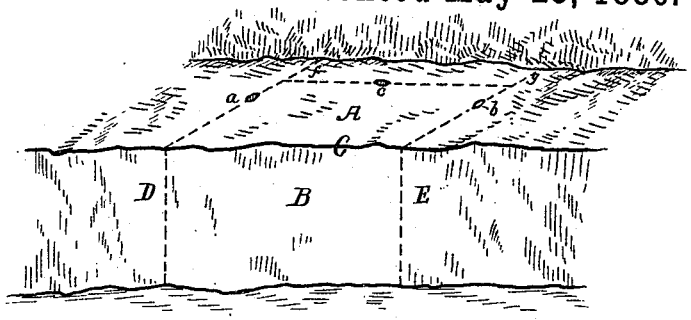


Fig. 2.

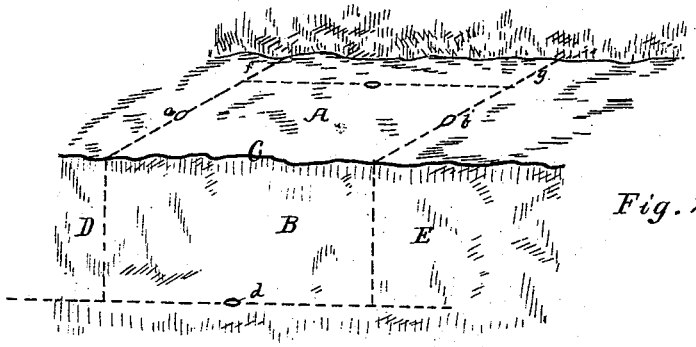


Fig. 3.

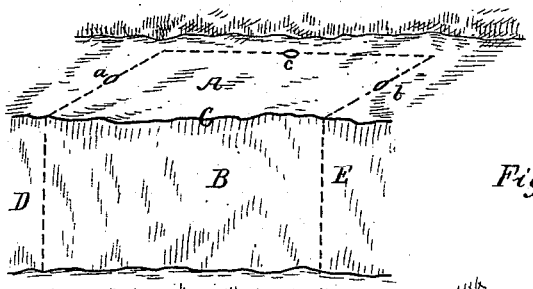
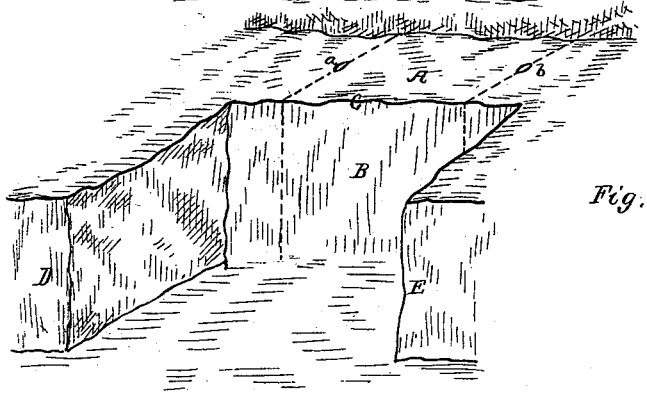


Fig. 4.



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UNITED STATES PATENT OFFICE.

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METHOD OF BLASTING ROCK.

SPECIFICATION forming part of Letters Patent No. 342,366, dated May 25, 1886.

Application filed November 24, 1885. Serial No. 183,884. (No model.)

To all whom it may concern:

Be it known that I, JOHN L. L. KNOX, a citizen of the United States, and a resident of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Methods of Blasting Rock, of which the following is a full, clear, and exact description.

This invention relates more particularly to a method of blasting designed to be practiced in the opening of quarries having certain peculiar characteristics.

The object of the invention is to form open ends in quarries having any one of the following characteristics: First, where there is a solid ledge of rock extending indefinitely in two directions from the spot to be opened; second, where the aforesaid ledge is of too great depth to be worked in a single bench, and is massive or without open lines of stratification; third, where in either of the above cases it is necessary that the vertical cuts shall not extend beyond the outlines of the block detached; fourth, where there is a "hang" of rock extending indefinitely in two directions.

The invention consists in blasting the rock in predetermined straight lines, and in charging with reference to the character of the rock, in such manner as to take advantage of its elasticity.

In the drawings, Figure 1 represents a solid ledge of rock having indefinite longitudinal extension and not too great depth to be worked in a single bench; Fig. 2, a like ledge of massive rock having too great depth to be worked in a single bench; Fig. 3, a ledge similar to the last, but with the blast arranged to open the rock without extending the vertical cuts beyond the outlines of the block to be removed. Fig. 4 represents a hang of rock.

Similar letters of reference indicate corresponding parts throughout the different views.

In the opening of quarries having any of the before-mentioned characteristics one of two courses is now pursued—viz., either the rock is channeled with a channeling-machine and the ends thus formed worked from, or a blast-hole is sunk to a considerable depth, a large amount of powder placed therein, and the charge tamped and fired. In the first case the work is slow, costly machinery is required, and a large number of laborers necessary. In the second case an irregular hole results, an immense amount of stone is rendered worthless, and the surrounding rock is damaged by rents to a greater or less extent. By my method the expense of the blast is less than in either case, the rock is split into rectangular-sided blocks from the beginning, and absolutely no waste incurred, the time required for opening the quarry greatly lessened, and all the labor necessary performed by three men.

In the practice of my invention I form the blast-holes first in the ordinary manner. I then ream out oppositely-located longitudinal grooves in the sides of said hole, care being taken that the apices of these grooves are in alignment with each other and with the cut to be made. The holes are then charged, reference being had to the character and elasticity of the rock.

I wish it to be understood that the form of the hole and the method of making it are no part of this invention, which consists in charging the holes with reference to the particular rock and grouping the holes in a manner to produce a specified result.

I will now proceed to describe the arrangement and relative position of the holes and the order of discharging the blasts in quarries having the characteristics heretofore specified.

In Fig. 1 is shown a ledge having indefinite longitudinal extension, and not too great depth to be worked in a single bench. A is the top and B the face of the ledge, and C is the block to be removed. I first insert in the top of the ledge a hole, *a*, whose grooves are so placed that a line joining their apices will form a slightly-acute angle with the face B on the side next the block C. This hole is then charged, tamped, and fired. The result will be a cut in the direction of the dotted lines extending downwardly through the rock, forwardly to the face B, and rearwardly to a distance varying with circumstances. Immediately upon the charge being fired the sides of the cleft come together, and the crack is imperceptible. The elasticity of the rock is always sufficient to allow the cut to be made, even when said cut fails to reach the face of

the rock. I next make a second hole, *b*, at some distance from the first and form its grooves so that a line joining their apices will form an acute angle with the face of the rock on the side next the block C. This hole is then charged, tamped, and fired, resulting in a cut in the direction of the dotted lines. Finally I make a third hole, *c*, midway between the cuts first made and form its grooves so that a line joining their apices will be parallel with the face B of the ledge. This hole is then charged and fired, resulting in a cut in the direction of the dotted lines, said cut joining the two former cuts at obtuse angles. We now have a block, C, separated from the main body of the rock, widest at the front, and gradually narrowing toward the rear. This block may be divided or worked out in any well-known manner. The bench is then worked out from the two ends D E, the vertical cuts being then all made at right angles to the face. Thus all blocks after the first three are perfectly rectangular.

In Fig. 2 is shown a ledge of rock similar in all respect to that in Fig. 1, except that the rock is of too great depth to be worked in a single bench. In this case it becomes necessary to form a false bed before the block C can be cut out. I therefore first sink a horizontal hole, *d*, in the face B of the rock at such distance from the top as I may desire the bed. I form the grooves in such manner as that a line joining their apices may be parallel with the top of the ledge. This hole is then charged and fired, resulting in a cut parallel with the top of the ledge of a length in either direction proportioned to the charge. The block C is then cut out in the manner already described, and the ends D E worked to the extremities of the false bed. A shot similar to the first is then made to continue the false bed, and so on until the end of the ledge is reached, if desired. Sometimes it is necessary to avoid the back cuts, *f g*, in forming the block C. In such case (see Fig. 3) the holes *a b* are placed equidistant from the front and back line of said block, the hole *c* equidistant from both sides, and the side holes and back hole equidistant from the back corners of the block. The three holes are then charged, tamped, and simultaneously fired by means of electricity. The cuts thus produced simultaneously reach the points of intersection, intercept each other, and the gases escape or are condensed before the cuts can be prolonged. Thus a block is disengaged from the body of the ledge without splitting or marring the surrounding rock.

In Fig. 4 is shown a hang of rock, in which it is desired to work. I first bore a hole midway between the two sides of the neck, and make the grooves therein so that a line joining their apices will extend (with a slight diagonal deflection) transversely across the hang. This hole is then charged and fired, and a cut is made which extends entirely across the hang. A second hole is then inserted near the first, whose grooves are so formed as that a line joining their apices has a slight diagonal deflection in the direction opposite to the first. This hole is then charged, tamped, and fired, and the result is that a wedge-shaped block is disengaged from the surrounding mass. This may be worked out in any desirable manner, and there remains two ends from which to work.

It will be seen that the success of all the hereinbefore-described shots is dependent entirely upon the elasticity of the rock. By making the force of the powder expend itself in right lines, and employing comparatively small charges, cuts are made in the solid face of the rock which need not necessarily extend to the surface in either direction. The rock simply opens momentarily and then closes. By combining these "blind" cuts with ordinary open cuts—*i. e.*, where the rock is free on two or more sides—I am enabled to open and work any imaginable character of quarry without the loss of any material, without throwing fragments, and thereby endangering lives, and with scarcely perceptible noise. The charges required are necessarily dependent, *cæteris paribus*, on the elasticity of the particular rock, and must be properly proportioned thereto. Such a charge as might work in one rock with the greatest success in another might have little or no effect, and in a third might overdo the work required of it and shatter the rock. This matter can only be settled by actual experiment in each quarry, the character of stone differing endlessly.

I am aware that in breaking up blocks of ice grooves are made to mark the desired planes of cleavage; but

What I claim as new, and desire to protect by Letters Patent, is—

The described method of blasting rocks, which consists in making a series of blast-holes in the line of desired cleavage, connecting such holes by a groove in the surface of the rock, to define the cleavage, and then charging and exploding, substantially as set forth.

JNO. L. L. KNOX.

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