

March 4, 1969

BO GUNNAR NORDGREN
METHOD IN ROCK BLASTING OPERATIONS FOR
MARKING OUT DRILL HOLE PATTERNS
Filed Sept. 7, 1966

3,431,049

Fig. 1

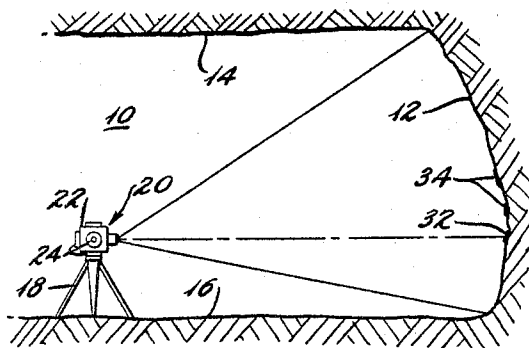


Fig. 2

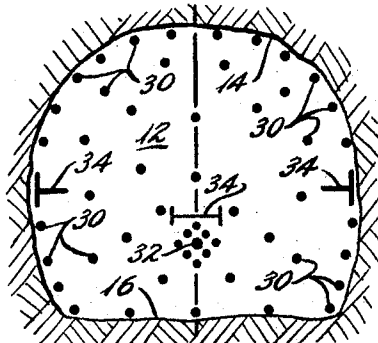


Fig. 3

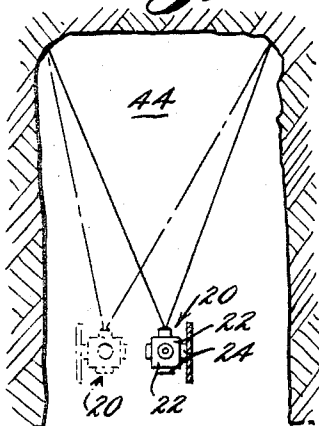


Fig. 4

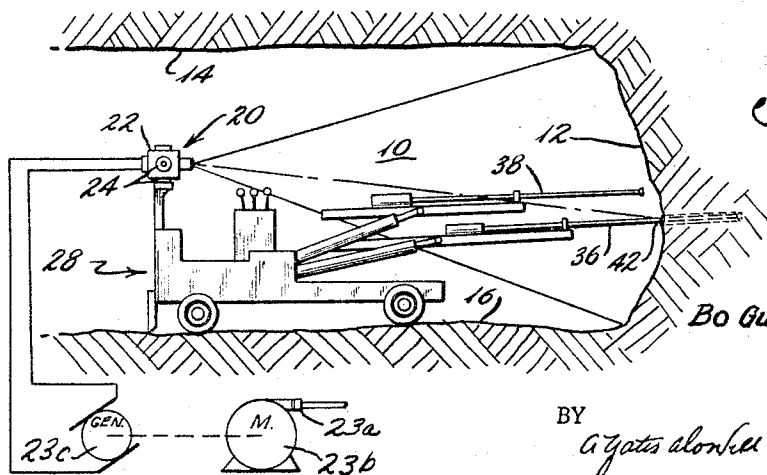
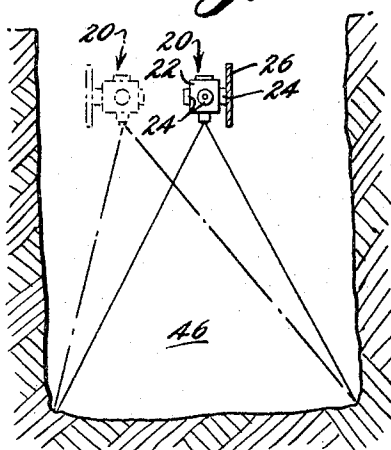


Fig. 5

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3,431,049 METHOD IN ROCK BLASTING OPERATIONS FOR MARKING OUT DRILL HOLE PATTERNS

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Filed Sept. 7, 1966, Ser. No. 577,652

Claims priority, application Sweden, Sept. 9, 1965,
11,759/65

U.S. Cl. 353—121
Int. Cl. G03b 21/12

4 Claims

ABSTRACT OF THE DISCLOSURE

A method of making holes for explosives for use in the blasting of rock faces in tunnels. The method includes the steps of preparing a projector slide in which the hole positions are located on a reduced scale corresponding to the ratio of the sizes of the rock face and the slide and are adjusted for the particular profile of the rock face, optically projecting an image of the slide onto the rock face, and drilling holes for explosives at the positions indicated by the image.

This invention relates to a method in rock blasting operations for marking out drill hole patterns and to an apparatus for carrying out said method.

When constructing tunnels, drifting mines, sinking shafts or drifting raises it is generally necessary that the positions of the drill holes be marked out on the face of the rock itself. Hitherto this has been effected by means of measuring rules, tape measures or mechanical devices which are either detached or connected to the frame-work of a drill unit or the like.

The use of such auxiliary equipment has very often meant that time consumed in marking out the holes has been highly disproportionate and has sometimes caused delay in the working cycle planned for the blasting operations. Deficiencies in accuracy of the known methods have also caused uneven outlining of the contours of a tunnel for instance—or have caused the outlines to be completely wrong—either resulting in more rock being taken out and carried away than would have been the case if the tunnel had been marked out as intended, or too little rock being removed so that the outlines of the tunnel were too narrow to permit the passage of machines or other pieces of equipment, intended for use in said tunnel. Besides demanding high costs and much time, subsequent blasting of the erroneously marked out profiles has resulted in tunnel walls or drifts of less strength and reliability, owing to the unevenness of the rock surface.

One main object of the invention is to avoid the aforementioned drawbacks by applying a completely new method of marking out drill hole patterns for blasting charges, and to thereby improve the conditions for an even and strong rock surface.

Another object of the invention is to provide a method for marking out the drill hole pattern whereby the amount of so-called "surplus" rock (that is the rock that lies outside the profile of the intended tunnel or drift) taken out is greatly reduced.

According to one main feature of the invention a diagram or lay-out of the positions of the drill hole pattern is marked out in a light transmitting manner on a slide of a material otherwise opaque to light such as an exposed photographic film or glass sheet or cut out of a metal slide and projected against the face of the rock in which the charges are to be placed. In this connection the diagram on the glass, metal or film slide is drawn or cut out in a reduced scale corresponding to the ratio of the size of the rock face over which the drill hole pattern is de-

sired to extend and the size of the slide and the surface to be projected; a scale and one or more positioning points also being marked on the slide, whereas conversely, an enlarged scale and one or more corresponding measured positioning points are marked out on the face of the rock, projection of the diagram on to said face being effected by means of a projector positioned at a distance from the rock face, adjusted relative to the scale and set so that the positioning point or points projected from the slide coincide with the positioning point or points marked out on the face of the rock, and the projecting scale coinciding with the scale marked out on said rock face. The drill hole positions projected from the slide onto the face of the rock in the form of points of light are then suitably permanently marked out by painting said positions onto the surface of the rock, or the light spots representing the positions can be used directly as guides for drilling the holes intended for the blasting charge.

The projection of a plan or diagram onto a work piece from a small film slide or the like whilst enlarging the dimensions of the work piece in accordance with optical laws is already known, e.g. in shipbuilding. In this connection, however, the plans are projected onto a flat or at least an even surface. The end-wall met with in tunneling or drifting operations, as well as when sinking shafts, etc., often presents, however, a very uneven and dark and dirty surface, where variations in depth reach from between 1 and 1.5 meters. Furthermore, in such drifting operations the roof of the tunnel in front of the end wall is generally lower than it is further away. It is therefore very surprising that by means of the method according to the invention the positions of the drill holes can be fixed on the rock face or the end wall much more accurately than is the case when applying previous diagrams for drill hole patterns. Corrections governed by the special contours of the end wall of the drift, particularly where there is a difference between the intended roof of the tunnel and the height of the roof of the tunnel at the end wall of the drift, can be made without difficulty, when marking out the diagram.

Further objects and advantages of the invention will become apparent from the following description, considered in connection with the accompanying drawings which form part of this specification and of which:

FIG. 1 shows diagrammatically an application of the method of the invention in a horizontal drift or tunnel.

FIG. 2 shows the end wall in the tunnel of FIG. 1 on which certain measurements have been made for the purpose of carrying out the method.

FIG. 3 shows diagrammatically an application of the method in a raise and FIG. 4 shows an application of the method when sinking a shaft.

FIG 5 shows finally a modification of the method according to FIGS. 1–2 with a projector, used in carrying out the method, mounted on a drill unit.

Referring now particularly to FIG. 1, a tunnel is indicated generally with the reference numeral 10, an end wall of said tunnel with reference numeral 12, a roof thereof with 14 and a floor with 16. Standing on the floor 16 is a projector 20 mounted on a frame 18. The projector includes in a manner known per se a light source, a slide holder, a lens, preferably having an adjustable focal length, and connected to preferably a cube-shaped casing 22 of resilient, protective material, such as rubber, plastic or similar dust and moisture tight pliable sheet material. A plurality of the sides of the casing 22, preferably all except that from which the image is projected, are provided with attachment devices 24. In this way the apparatus may be adjusted to project in any desired direction in horizontal or vertical planes, both upwards and downwards. In addition to the frame 18 it is also conceivable to secure

the projector in suspension points, as indicated diagrammatically in FIGS. 3 and 4, at 26 or on a firm support on the floor 16 of the tunnel or also on a drill unit 28 as shown in FIG. 5. The means necessary for operating the projector are suitably mounted outside the casing 22 and include at least one operating means for adjusting the sharpness of the image and if the lens has an adjustable focal length, a sensitive, operating means for this purpose should also be included. The projector is also suitably provided with means for adjusting the elevation of the projector in the plane in which the projector has been set when the apparatus was secured. These means, which are known per se, and thus need no further description in the present application, are also suitably operated by knobs or the like located outside the casing 22. The casing 22 may also be provided with connecting means 23a for a supply of compressed air, as a driving means for an air operated motor 23b driving an electrical generator 23c to power the light source. In overseas countries for instance compressed air may be the only source of energy at disposal.

The diagram of the drill hole pattern is now projected by means of the just described projector onto the end wall 12. As can be seen from FIGS. 1 and 2 the projector 20 is positioned at a distance from the end wall 12 of the drift, adjusted with respect to the said scale and possibly also the type of lens used. The light source of the apparatus is connected to a current source, while remaining illumination in the tunnel is subdued. The image emitted from the projector becomes visible on the end wall 12, in the form of dots of light 30. Positioned on the slide is a positioning point which corresponds to a positioning point 32 measured beforehand on the end wall. Further, the end wall has been provided with a scale, in the present case a horizontal one, or width gauge 34 corresponded by a scale, reduced in the correct ratio, on the slide. The positioning point 32 and the scale 34 are preferably manufactured from scotchlight or self-illuminating tape or in reflecting paint. The projected image is adapted to the scale or width gauge marked out on the end wall and is focused by adjusting either the distance or the focal length of the lens of the projector, which thus should preferably be a zoom lens. The image is positioned in the correct plane by causing the positioning points on the image to coincide with the positioning points 32 on the end wall 12. The visible spots of light on the end wall 12 now give exactly the positions of the drill holes in the required blasting pattern, as marked out on the diagram on the slide. The positions of these bore holes in the blasting pattern can then be painted on the end wall as indications for drilling the holes in the said pattern. However, it is also possible, as shown in FIG. 5, to drill the holes direct in the positions disclosed by the light spots. In FIG. 5 the moveable drill unit 28 supports a plurality of drills which are indicated by reference numerals 36 and 38, respectively. A beam of light 40 emitted from the projector 20 creates an illuminated point 42 on the end wall and the drill 36 is indicated at this point.

Adaption of the method according to the invention in a raise 44 is shown in FIG. 3 which also shows how far the projector 20 can be moved from the vertical center plane of the raise without jeopardizing the accuracy of the operation. In the present case, as also in the embodiment according to FIG. 4, which is concerned with the

sinking of a shaft 46, the projector 20 is mounted at the, diagrammatically indicated, position 26.

While several more or less specific embodiments of the invention have been shown and described it is to be understood that this is for purpose of illustration only and that the invention is not to be limited thereby but its scope is to be determined by the appended claims.

What I claim is:

1. In the method of blasting passages through rock faces which extend in any desired direction which includes the steps of marking drill hole patterns on an uneven rock face, drilling holes at the points indicated by said patterns, placing an explosive material within the said holes, and exploding the said material to remove the rock, the improvement which comprises the steps of

marking the positions of holes to be drilled onto a slide at points whose position is adjusted for the particular profile of the rock face to be blasted and on a reduced scale which corresponds to the ratio between the size of the rock face over which the drill hole pattern is intended to extend and the size of the slide, projecting the image from the slide onto the face of the rock, and

drilling the holes for explosive at the positions indicated by the image.

2. The method of claim 1 including placing on the slide images of at least three non-linear positioning points, marking on the rock face corresponding positioning points,

projecting an image of the slide on the rock face, and adjusting the projector so that the projected images of the positioning points on the slide are superimposed on the corresponding points marked on the rock face.

3. The method of claim 1 including the step of painting the rock face at the points indicated by the images of the drill holes prior to the drilling operation.

4. The method of claim 1 including the step of adjusting the pattern of drilling hole images on the slide to correspond with the irregularities of the rock face so that the hole images projected on the rock face will be located at points adjusted for a non-planar rock face profile.

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U.S. Cl. X.R.

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