Aug. 24, 1943. R. B. AITCHISON ET AL 2,327,483

APPARATUS FOR ROCK PIERCING AND SIMILAR OPERATIONS

Filed June 13, 1940 2 Sheets-Sheet 1

Fig. 1.

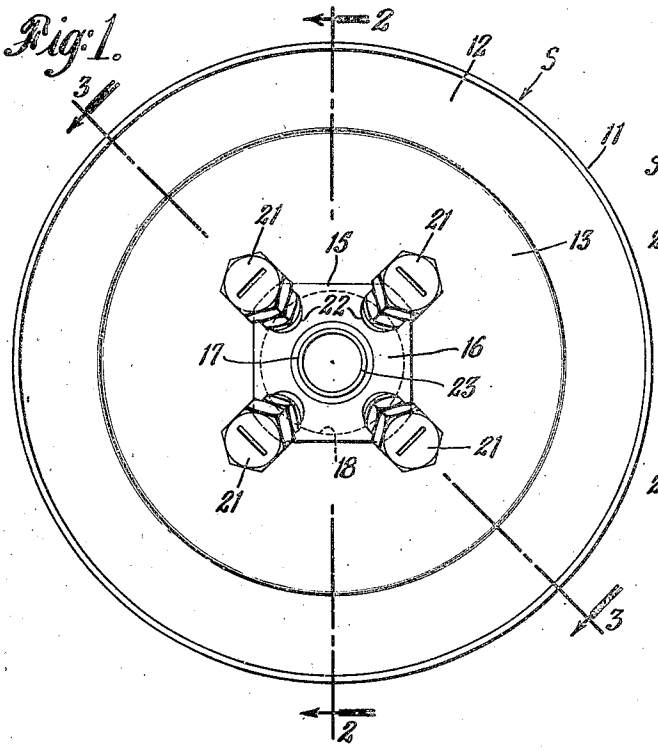
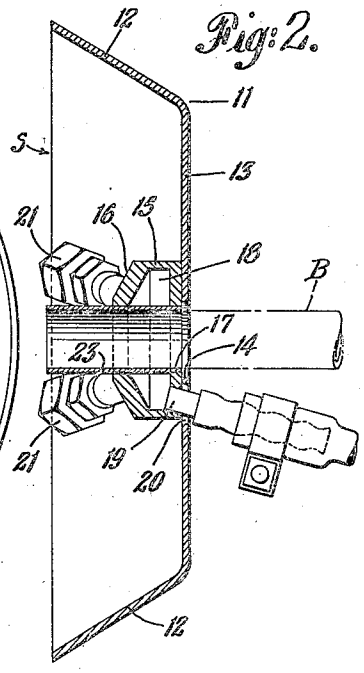


Fig. 2.



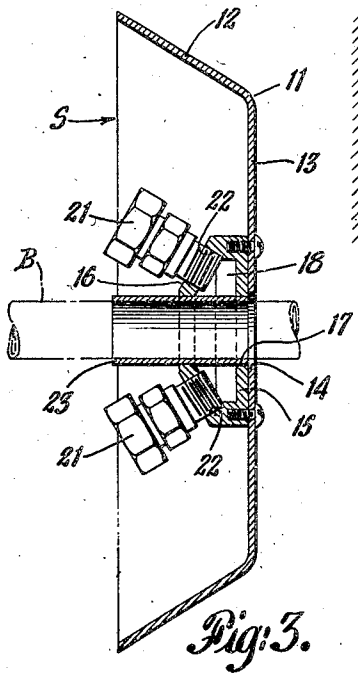
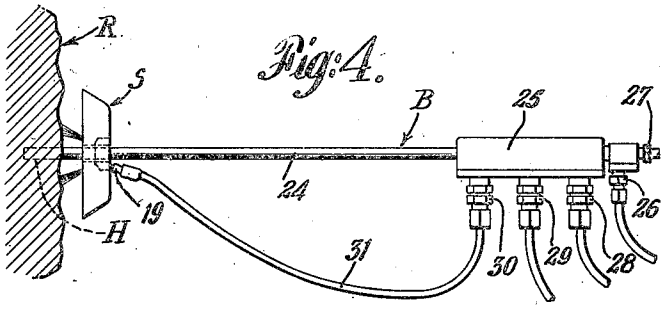


Fig. 3.

Fig. 4.



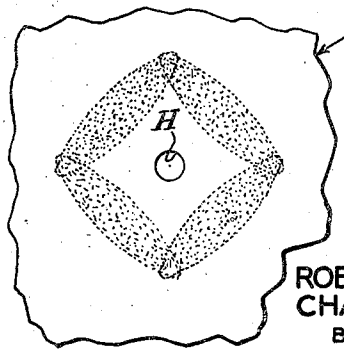


Fig. 5.

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Fig. 6.

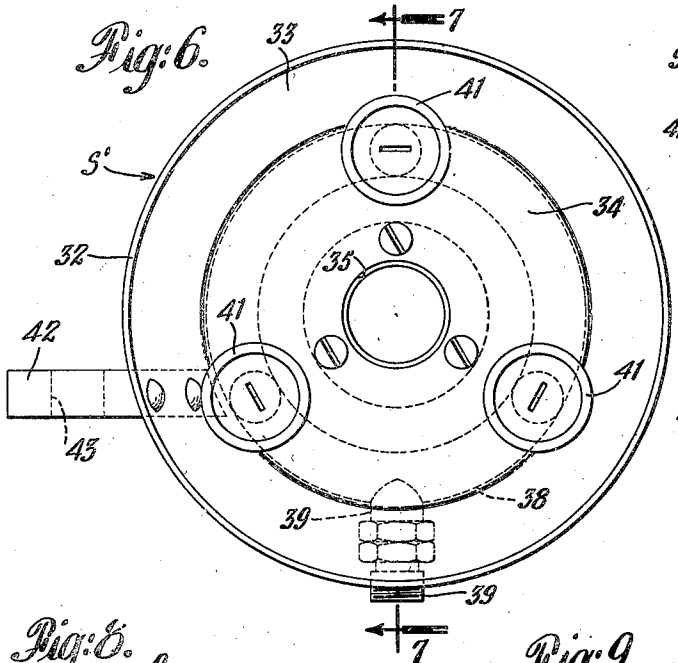


Fig. 7.

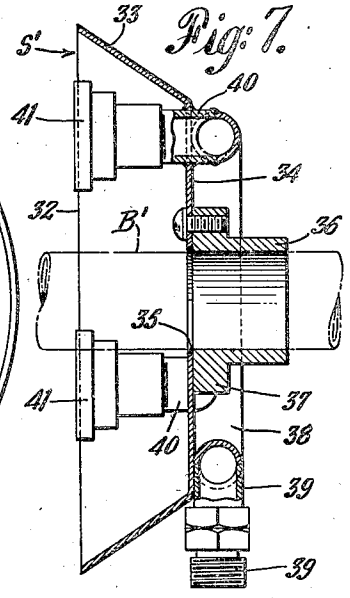


Fig. 8.

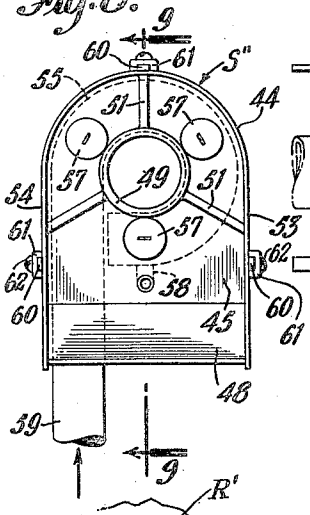


Fig. 9.

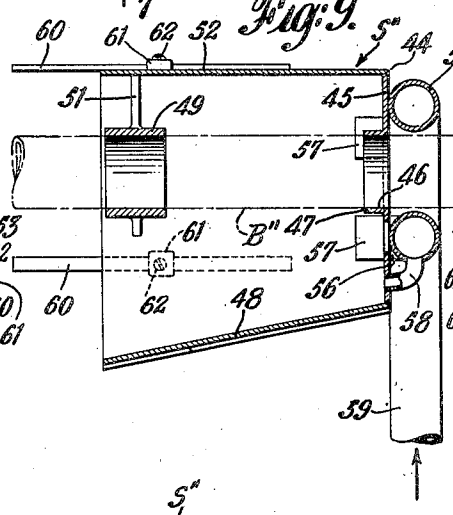
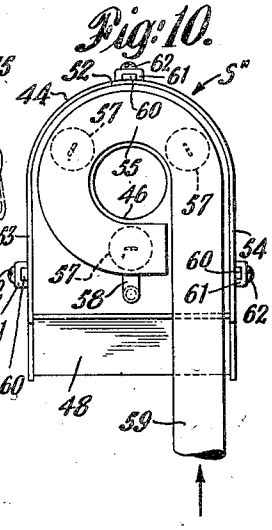


Fig. 10.



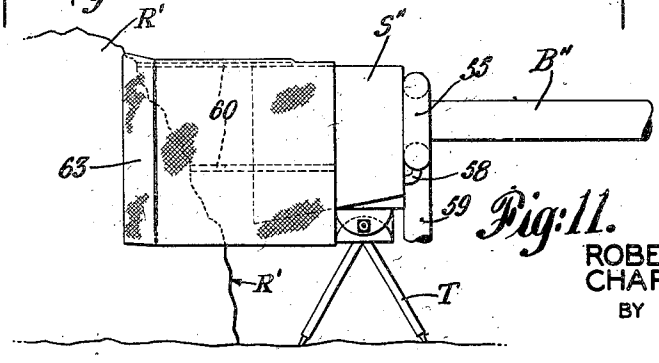


Fig. 11.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR ROCK PIERCING AND SIMILAR OPERATIONS

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Application June 13, 1940, Serial No. 340,276

17 Claims. (Cl. 255—49)

This invention relates to apparatus for piercing or cutting rock and the like whereby the dust hazard usually present in such operations may be eliminated, and whereby an operator or other persons near the scene of operation may be protected from injury by relatively large particles of rock or the like which may be ejected from the hole or cut with considerable force. More particularly, the invention relates to liquid-spray shields which, when combined with a rock piercing or cutting instrumentality, may be operated to lay the dust discharged from a hole or cut, as well as to arrest flying particles of material before they have proceeded from the mouth of the hole any great distance.

The apparatus of the present invention is particularly applicable to rock piercing by thermal processes, such as the spalling process described in application Serial No. 268,634, filed April 18, 1939, by R. B. Aitchison, C. W. Swartout, and V. C. Williams. Suitable thermal piercing instrumentalities for rock piercing are described and claimed in Patent No. 2,286,191 issued June 16, 1942 to R. B. Aitchison, C. J. Burch, and C. W. Swartout, and Patent No. 2,286,192 issued on the same day to R. B. Aitchison, G. H. Smith, and C. W. Swartout.

In the spalling process of thermal rock piercing described in application Serial No. 268,634, an oxy-acetylene flame is applied to the surface of a rock, causing the rock to spall and disintegrate locally to form a hole, with the concurrent production of dust and relatively larger particles which blow out of the hole and away from the rock surface. As spalling progresses and the hole becomes deeper an auxiliary medium, such as high-pressure air or water streams, often is required for ejecting the dust and larger particles of rock from the hole. When the auxiliary ejection medium is a gas, such as compressed air, the hazard from dust and flying particles is present throughout the piercing operation. When the ejection medium is a liquid, such as water, the dust and larger particles of rock are so dampened prior to leaving the mouth of the hole that the hazard is eliminated. At the start of such a thermal rock piercing operation, and before the hole has been deepened sufficiently to require the use of an auxiliary ejection fluid, it is always necessary to lay the dust and shield the operator from flying particles by extraneous means. This extraneous protection also is needed throughout the piercing operation when no auxiliary ejection medium is used as the depth of the hole increases, or when the ejection medium is a gas; but extraneous protection ordinarily may be dispensed with when a liquid debris-ejection medium is employed, which dampens the debris before discharge from the mouth of the hole.

It has been proposed to lay the dust from mechanical rock drilling operations by directing water sprays toward the surface of the rock and into the mouth of the hole. Water sprays directed in this manner are, however, of little value for thermal rock piercing because, if water is permitted to enter into the hole from the outside, the effectiveness of the flames may be impaired seriously and the efficient ejection of debris from the hole may be prevented. Furthermore, prior devices provide no protection to the operator or other persons in the vicinity against the larger size rock particles which may fly from the mouth of the hole being pierced thermally.

The principal object of the present invention, therefore, is to provide apparatus for piercing or cutting rock and the like whereby the hazards from rock dust and flying particles of rock may be eliminated. Other objects are the provision of such apparatus whereby thermal rock piercing may be carried out without interference with the piercing operation itself; the provision of such apparatus which will effectively lay dust and stop flying particles when piercing a hole in a rock surface which is irregular in shape or inclined from the vertical; and the provision of various forms of shields which shall be effective and dependable to lay dust and stop flying particles, yet simple and sturdy in construction and inexpensive to manufacture.

The above and other objects, and the novel features of the invention, will become apparent from the following description taken with the accompanying drawings, in which:

Fig. 1 is a front elevational view of one type of shield according to the invention;

Fig. 2 is a cross-sectional view, partly in elevation, taken along the line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view, partly in elevation, taken along the line 3—3 of Fig. 1;

Fig. 4 is a view of the shield of Figs. 1, 2, and 3 assembled with a thermal rock piercing instrumentality, shown in position for piercing a hole in a rock;

Fig. 5 is a view looking toward the mouth of the hole in a rock, showing the approximate pattern produced by the liquid sprays from the shield of

Figs. 1 to 3, inclusive, on the rock surface adjacent to the mouth of the hole;

Fig. 6 is a front elevational view of another type of shield according to the invention;

Fig. 7 is a cross-sectional view, partly in elevation, taken along the line 7—7 of Fig. 6;

Fig. 8 is a front elevational view of another type of shield according to the invention;

Fig. 9 is a cross-sectional view, partly in elevation, taken along the line 9—9 of Fig. 8;

Fig. 10 is a rear elevational view of the shield of Fig. 8; and

Fig. 11 is a side elevational view showing the shield of Figs. 8, 9, and 10 assembled with a rock piercing instrumentality, shown in position for piercing a hole in a rock having an irregularly-shaped and inclined face.

Generally, apparatus for piercing holes in rock or the like, according to the invention, comprises a hollow dish-shaped shield which is mounted upon a piercing or cutting instrumentality or device, such as a tubular piercing blowpipe, for sliding movement relatively to the instrumentality so that the shield may at all times be maintained adjacent to the mouth of the hole or cut being produced without interrupting the progress of the instrumentality. Several liquid-spray nozzles, which are associated with the shield, are adapted to discharge sprays of liquid against the rock face surrounding the hole in such a manner that the individual sprays from the nozzles overlap adjacent to the hole to thoroughly moisten the dust and larger particles and prevent their escape to the surrounding atmosphere. Suitable auxiliary supports may be provided, if desired, to at least partially relieve the piercing instrumentality of the weight of the shield.

More particularly, the preferred type of shield S of the invention, as shown in Figs. 1, 2, and 3, comprises a dish-shaped shield-member 11, formed of sheet steel, having a frusto-conical wall 12 which is open at its front large-diameter end and at its small-diameter end is provided with a rear wall 13 having a substantially centrally arranged aperture 14. A generally square tubular nozzle-block or header 15, having chamfered corners and an annular beveled front face 16, is removably secured to the rear wall 13 within the shield member 11 with its rear face flush with the inner surface of the rear wall, by means of bolts, in such a position that the bore 17 of the block registers with the aperture 14, which has a slightly greater diameter than the bore 17. A continuous annular recess or groove 18 in the inner peripheral surface of the nozzle block 15, having a slanting front surface parallel to the bevel 16, forms a distributing chamber with which communicates a hose-connection inlet nipple 19 secured in a bore in the rear wall of the block and projecting rearwardly at an angle through an eccentrically arranged aperture 20 in the rear wall 13.

Four flat-spray liquid spray nozzles 21, of standard construction, are threaded into corresponding equi-spaced internally threaded bores 22 in the beveled front wall 16 of the nozzle block 15, and are arranged with their axes diverging from each other, and from the axis of the nozzle-block. Each nozzle 21 terminates approximately at the front edge of the shield member 11.

A tubular sleeve 23, which is fitted within the bore 17 of the nozzle block 15 and secured to the block as by silver soldering, covers and seals the annular groove 18 and projects forward from the block slightly beyond the front edge of the shield-member 11. The sleeve 23 and the aperture 14 are adapted to permit the insertion of a tubular piercing instrumentality, such as the blowpipe B, through the shield S, and to permit sliding movement of the shield relatively to the piercing instrumentality.

Fig. 4 shows the shield of Figs. 1, 2, and 3, mounted upon a thermal rock piercing blowpipe B, with the shield and blowpipe properly arranged for piercing a hole H in a large rock R. As shown, the blowpipe B comprises a long tubular member 24 which is adapted to be advanced into the hole H progressively as the depth of the hole increases, and a rear body 25 having inlet connections 26, 27, 28, and 29 for oxygen, acetylene, compressed air, and cooling water, respectively, which are connected by flexible tubes to suitable sources of supply. As shown in the aforementioned Patent 2,286,191, the blowpipe is adapted to conduct the water therethrough in heat exchange relation thereto for cooling the blowpipe. An outlet connection 30 for the cooling water is connected by a flexible conduit or tube 31 to the inlet nipple 19 of the shield S. The tubular portion 24 which extends rearwardly from the front end of the blowpipe, passes through the sleeve of the shield S, and the shield therefore can be moved back and forth upon the blowpipe, as desired, to the proper position. Usually the best results are obtained by maintaining the forward edge of the shield S about three inches from the face of the rock. The cooling water which is discharged from the blowpipe B is conducted through the tube 31 to the shield S, and sprayed from the nozzles 21 against the face of the rock adjacent to and surrounding the hole H in flat finely-dispersed sprays, the axes of which increase in distance from each other and from the axis of the nozzle block 15 as the distance from the nozzles increases. The slit-like orifice of each nozzle is so arranged with respect to the orifices of the other nozzles that the adjacent ends of the sprays issuing from adjacent nozzles overlap each other to produce a closed geometric pattern on the rock face approximately like the sides of a square, such as shown approximately in Fig. 5, thus preventing the escape of any dust from the vicinity of the hole. Any relatively large particles of rock which may be ejected from the hole at a high velocity are caught by the shield-member S, the side wall 12 of which prevents lateral dispersion, and fall harmlessly down from its open forward end.

A modified form of shield S' according to the present invention is shown in Figs. 6 and 7. In this embodiment of the invention, a circular dish-shaped sheet steel shield-member 32 has a frusto-conical side wall 33 which is open at its large-diameter forward end, and has a rear wall 34 at its small-diameter end provided with a substantially centrally arranged aperture 35, as in the modification of Figs. 1, 2, and 3. A tubular sleeve 36, having a bore of slightly smaller diameter than the aperture 35, is removably secured to the outside of the shield-member 32, with its bore in registry with the aperture 35, by means of a flange 37 at one end bolted to the rear wall 34. An annular tubular header 38, which also is secured to the outside of the rear wall 34, as by fusion welding, has an inlet nipple 39 secured thereto, as by welding, which is adapted to be connected to a liquid supply conduit. Three equi-spaced pipe nipples 40 are welded to

the tubular header 38 in communication with the interior of the header, and extend into the interior of the shield-member 32 through apertures in the rear wall 34 close to its edges. Spray nozzles 41, of standard construction, are arranged with their axes parallel and are threaded to the pipe nipples 40 within the shield-member 32. The nozzles 41 terminate approximately at the front edge of the shield-member 32. A bracket 42, which is secured to the side wall 33 of the shield-member 32, is adapted to engage a supporting member if desired, such as a tripod, for example, by means of the bore 43 extending through the bracket.

The shield of Figs. 6 and 7 functions similarly to the shield of Figs. 1, 2, and 3 when slidably mounted on a blowpipe B', which extends through the sleeve 36 and the aperture 35. As the spray nozzles 41 are arranged with parallel axes, however, and as the spray slots of the three nozzles are arranged on the sides of a triangle, the spray pattern produced on the face of a rock during a piercing operation is generally triangular in shape and closer to the mouth of the hole than that produced by the previously described modification. In a third embodiment of the apparatus of the invention, as shown in Figs. 8, 9, and 10, the shield S'' comprises a cup-shaped shield-member 44 having an open forward end, side walls, and a rear end wall 45 provided with an aperture 46 surrounded by an inwardly turned flange or sleeve 47. The bottom side wall 48 slopes downwardly from the end wall 45 to the forward edge of the shield-member 44, so that any sludge which may accumulate in the shield will flow downwardly and be discharged from its forward end. A second tubular sleeve 49 is arranged within the shield-member 44 intermediate the rear wall 45 and the front edge of the shield member, and adjacent to the latter, in axial alignment with the aperture 46. The sleeve 49 is supported by means of a spider comprising three supporting rods 51 secured to the sleeve and to the arched top side wall 52 and the vertical side walls 53 and 54, respectively, of the shield. A generally circular dead-ended header tube 55, having three short equi-spaced perpendicular branch tubes 56 communicating with the interior of the header, is arranged outside of the shield-member 44 with the ends of the branch tubes abutting against the outside surface of the rear wall 45 and registering with eccentrically-arranged apertures in the rear wall. Three shouldered spray nozzles 57, arranged with parallel axes within the shield-member 44, extend through the last-mentioned eccentrically-arranged apertures and are threaded into the branch tubes 56 with their shoulders abutting against the inside surface of the rear wall 45, thus securing the header tube 55 to the shield-member 44. As in the modification of Figs. 6 and 7, the slots of the nozzles 57 are arranged as the sides of a triangle, and a generally triangular spray pattern will be formed on the face of a rock or the like. A small tube 58, which is secured at one end to the header 55 adjacent to the closed end of the latter and is arranged with its other end within an aperture in the rear wall 45 near the bottom of the wall, is adapted to discharge a stream of liquid, such as water, upon the sloping bottom side wall 48 so that the liquid will flow down the wall and wash accumulated sludge from the forward end of the shield. A suitable liquid, such as water, is supplied to the header tube 55 through an inlet tube 59, which is shown integral with the header tube.

When piercing holes in rock having irregularly-shaped and sloping surfaces, it sometimes is impossible to place the forward edge of the shield itself close enough to the rock face to wholly prevent the escape of dust and larger particles to the atmosphere. To correct such a condition, therefore, three adjustable horizontal curtain-supporting extension rods 60 are journalled for sliding movement in suitable sleeve members 61 secured to the outside of the top side wall 52 and the vertical side walls 53 and 54 respectively, of the shield-member 44, the construction and arrangement being such that the extension members may be individually adjusted to extend variable distances forwardly of the open front end of the shield. Each sleeve 61 is provided with a set screw 62 for setting the rods 60 in adjusted position.

As shown in Fig. 11, when the apparatus of Figs. 8, 9, and 10 is to be used for piercing holes in an irregularly-shaped rock having a sloping surface, the shield S'' is mounted for sliding movement on the blowpipe B'', which extends through the aperture 46 and the sleeve 49. The shield also may be supported by a tripod T, if desired, which is pivotally secured to the shield S'' in any suitable manner. The extension rods 60 are adjusted individually in the sleeves 61 so that their forward ends contact the surface of the rock to adapt the apparatus thereto; and a flexible sheet 63 of canvas or similar material is supported by the extension rods 60 and the side walls of the shield-member 44. Thus a curtain is formed which substantially encloses the mouth of the hole and the adjacent rock surface on three sides so that the escape of dust and small flying fragments to the outside atmosphere will be prevented.

Although the shields of the invention have been described particularly in connection with thermal rock piercing blowpipes, it is evident that they may be used with other types of rock piercing or cutting equipment without departing from the principles of the invention.

What is claimed is:

1. Apparatus for piercing holes in rock and the like comprising, in combination, a piercing instrumentality; a shield mounted on said piercing instrumentality, said shield being adapted to be positioned adjacent to the rock or the like to be pierced; extension members adjustably secured to said shield; a curtain supported by said extension members; and means for discharging a spray of liquid against the surface of such rock or the like adjacent to such hole.

2. Apparatus for rock piercing comprising, in combination, a shield member open at one end and having side walls and a rear wall, said rear wall having an aperture for the passage of a rock piercing device; a tubular nozzle block secured within said shield member, said block having a bore aligned with said aperture for the passage of a rock piercing device; said nozzle block having a distributing chamber; spray nozzles secured to said nozzle block in communication with said chamber; and means providing an inlet to said chamber.

3. The combination defined in claim 2 wherein said spray nozzles are constructed and arranged to discharge sprays of liquid from the open end of said shield member in such directions that the axes thereof increase in distance from the longi-

tudinal axis of said nozzle block as the distance from said nozzles increases.

4. In combination, a shield member open at one end and having side walls, and a rear wall at its opposite end, said rear wall having an aperture; a tubular nozzle block secured to said rear wall within said shield member and aligned with said aperture, the inner peripheral surface of said nozzle block having a continuous recess; a sleeve fitted within said nozzle block and covering said recess, thereby forming a continuous chamber; a plurality of spray nozzles secured to said nozzle block in communication with said chamber, said nozzles being substantially equi-spaced around said sleeve, and said nozzles being constructed and arranged to discharge generally flat sprays of liquid from said shield in such directions that the axes thereof increase in distance from each other and from the longitudinal axis of said sleeve as the distance from said nozzles increases, such sprays overlapping one another externally of said shield; and means providing an inlet to said chamber.

5. In combination, a shield member open at one end and having side walls, and a rear wall at its opposite end, said rear wall having an aperture; a sleeve aligned with said aperture and secured to the outside of said wall; a header secured to the outside of said wall; a plurality of spray nozzles in said shield member communicating with said header; and means providing an inlet to said header.

6. The combination defined in claim 5, also including means whereby said shield member may be attached to a supporting member.

7. In combination, a shield member open at one end and having side walls, and a rear wall at its opposite end, said rear wall having an approximately centrally arranged aperture; a sleeve aligned with said aperture and secured to the outside of said wall; an annular header secured to the outside of said wall surrounding said aperture; means providing an inlet to said header; a plurality of substantially equi-spaced nipples secured to said header and extending into said shield member; and a spray nozzle secured to each of said nipples.

8. In combination, a shield member comprising side walls and a rear end wall, said shield member being open at its front end; said rear wall having an aperture for the passage of a rock piercing device; means for discharging a spray of liquid from said shield member through the open end thereof; and means for flowing a stream of liquid over the bottom side wall of said shield member.

9. In combination, a shield member comprising side walls and a rear end wall, said shield member being open at its front end; said rear wall having an aperture for the passage of a rock piercing device; means for discharging a spray of liquid from said shield member through the open end thereof; and extension members adjustably secured to said shield member and adapted to project beyond the open end thereof.

10. The combination defined in claim 9, also including a curtain supported by said extension members.

11. In combination, a shield member comprising side walls and a rear end wall, said shield member being open at its front end; said rear wall having an aperture providing a sleeve; means for discharging a spray of liquid from said shield member through the open end thereof; a second sleeve intermediate said rear wall and the open end of said shield aligned with such aperture; and means for supporting said second sleeve.

12. In combination, a shield member comprising side walls and a rear end wall, said shield member being open at its front end; said rear wall having an aperture providing a sleeve; a tubular sleeve intermediate said rear wall and the open end of said shield aligned with such aperture; means for supporting said tubular sleeve; a generally circular header secured to said shield member around such aperture; inlet means associated with said header; a plurality of substantially equi-spaced spray nozzles communicating with said header and adapted to discharge a liquid spray from said shield member through the open end thereof; and a nozzle communicating with said header and arranged to discharge a stream of liquid within said shield member upon the bottom side wall thereof.

13. Appartus for piercing holes in rock or the like comprising, in combination, a hollow dish shaped shield adapted to be positioned close to the surface of a rock or the like to be pierced for arresting flying particles of rock, said shield having a side wall, a rear wall, and an open front end; a sleeve associated with said shield; a long piercing blowpipe having a front end, and a long tubular portion extending rearwardly from said front end, said tubular portion passing through said sleeve and said shield and being freely slidable therein, said sleeve fitting said tubular portion closely to prevent the escape of particles of rock and the like; means for spraying liquid through the open front end of said shield from a plurality of points within said shield spaced laterally from said sleeve, said means being so constructed and arranged that said sprays of liquid will impinge upon the surface of such rock or the like surrounding the mouth of a hole being pierced and in spaced relation thereto; and means for supplying liquid to said last-named means.

14. In combination, a shield member open at one end and having side walls, and a rear wall at its opposite end, said rear wall having an aperture; a tubular nozzle block secured to said rear wall within said shield member and aligned with said aperture, the inner peripheral surface of said nozzle block having a continuous recess; a sleeve fitted within said nozzle block and covering said recess, thereby forming a continuous chamber; means in communication with said chamber for discharging liquid spray from said shield through said open end; and means providing an inlet to said chamber.

15. Apparatus for piercing holes in rock and the like comprising, in combination, a tubular blowpipe having an inlet and an outlet for water, said blowpipe being adapted to conduct such water therethrough in heat-exchange relation thereto, for cooling the blowpipe before discharge of such water from said blowpipe through said outlet; a shield slidably mounted on said blowpipe, said shield having side and rear walls and an open front end; spray nozzles associated with said shield and arranged to discharge overlapping sprays of water against the surface of such rock surrounding the mouth of such hole, for laying dust discharged from such hole during a piercing operation; and flexible conduit means establishing communication between said nozzles and said outlet for supplying to said nozzles the water discharged from said outlet.

16. Apparatus for piercing a hole in rock or

the like comprising, in combination, a tubular blowpipe having inlet means and outlet means for a liquid, said blowpipe being adapted to conduct such liquid therethrough in heat-exchange relation thereto for cooling the blowpipe before discharge from said blowpipe through said outlet means; a shield slidably mounted on said blowpipe and adapted to be positioned adjacent to the mouth of such hole; liquid discharge means associated with said shield for discharging a spray of liquid against the surface of such rock or the like adjacent to the mouth of such hole, for laying dust discharged from such hole during a piercing operation; and conduit means for conducting liquid from said outlet means to said liquid discharge means.

17. Rock piercing apparatus comprising, in combination, a shield having side walls, and a rear end wall provided with an aperture for the passage of a rock piercing device, said shield being open at its front end; and a plurality of extension members slidably mounted on said shield, the construction and arrangement being such that said extension members may be individually adjusted to extend variable distances forwardly of the open front end of said shield, thereby adapting said apparatus to a mass of rock having an irregular shape.

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