June 17, 1958 A. T. HOLMAN ET AL 2,839,273

ROCK DRILLING APPARATUS

Original Filed June 18, 1951 6 Sheets-Sheet 1

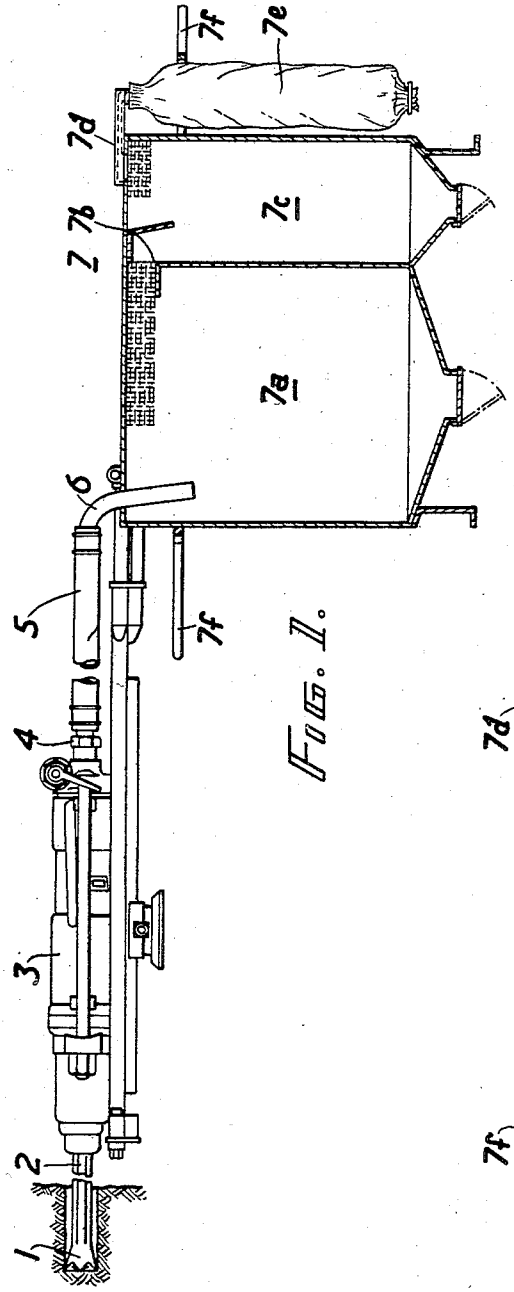


FIG. 1.

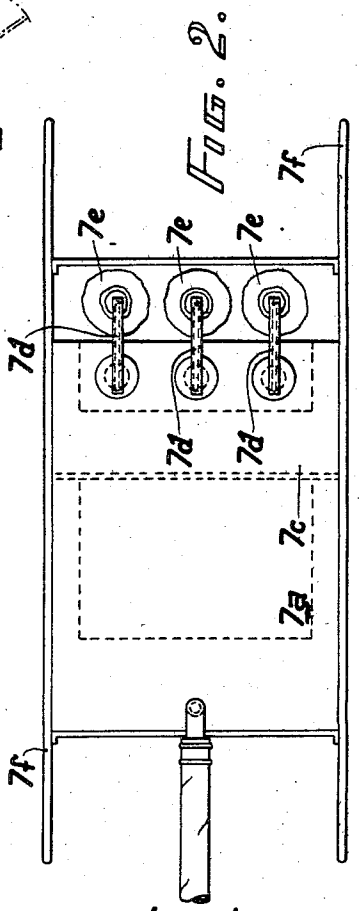


FIG. 2.

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ROCK DRILLING APPARATUS

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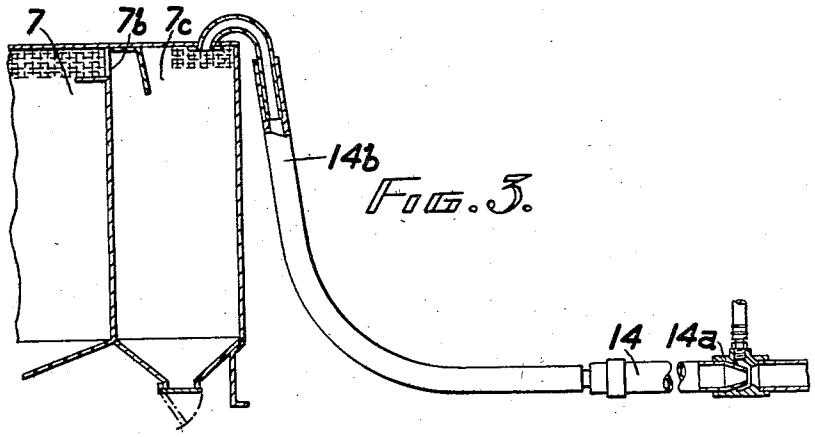


FIG. 5.

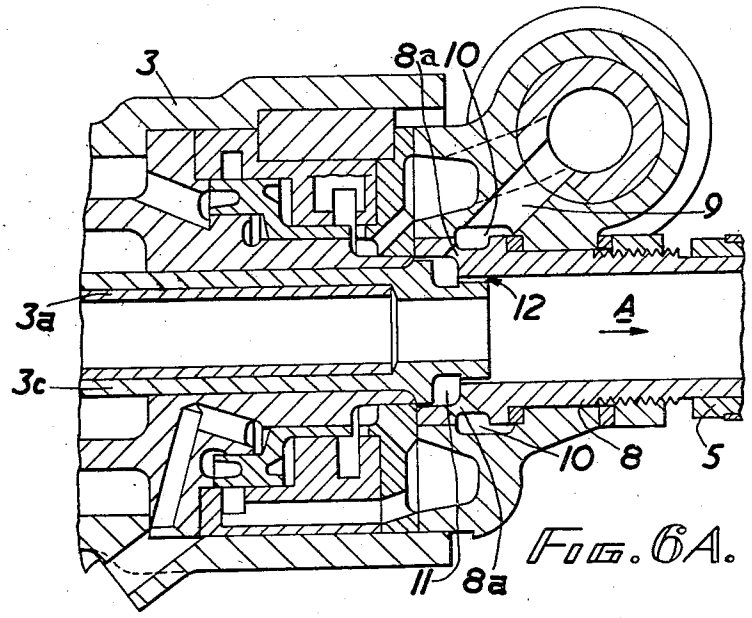


FIG. 6A.

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ROCK DRILLING APPARATUS

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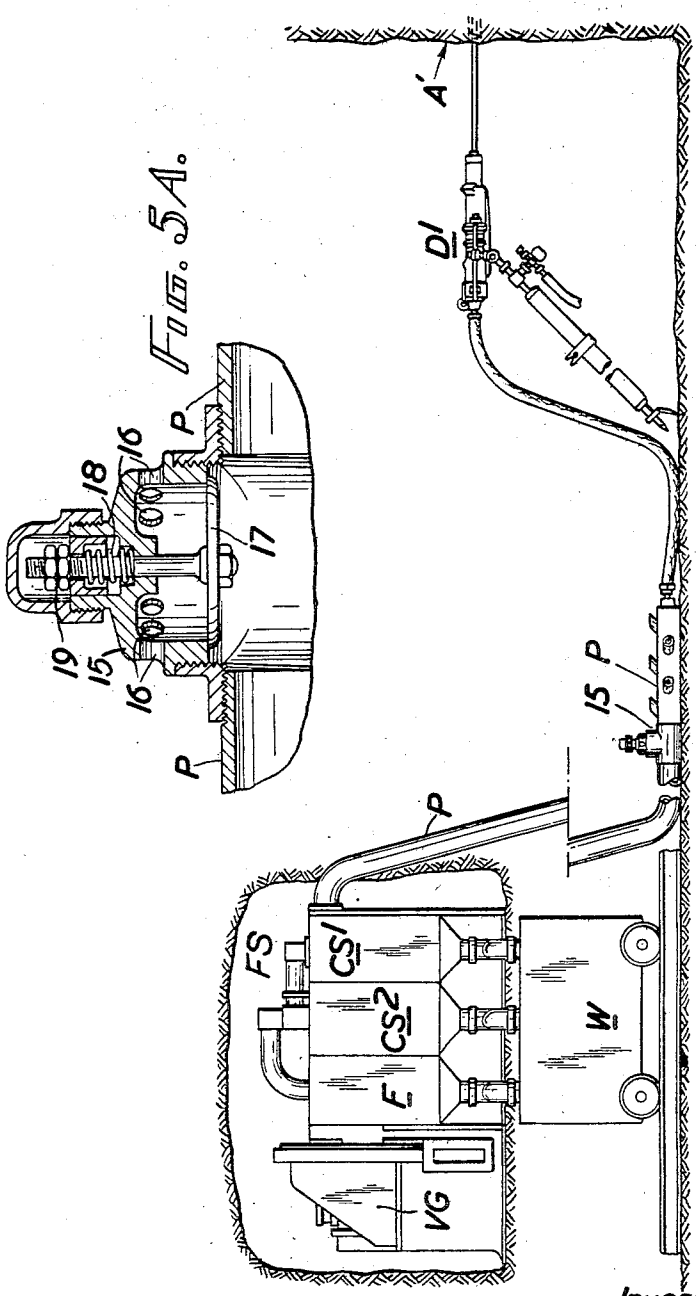


FIG. 5A.

FIG. 4.

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ROCK DRILLING APPARATUS

Original Filed June 18, 1951 6 Sheets-Sheet 4

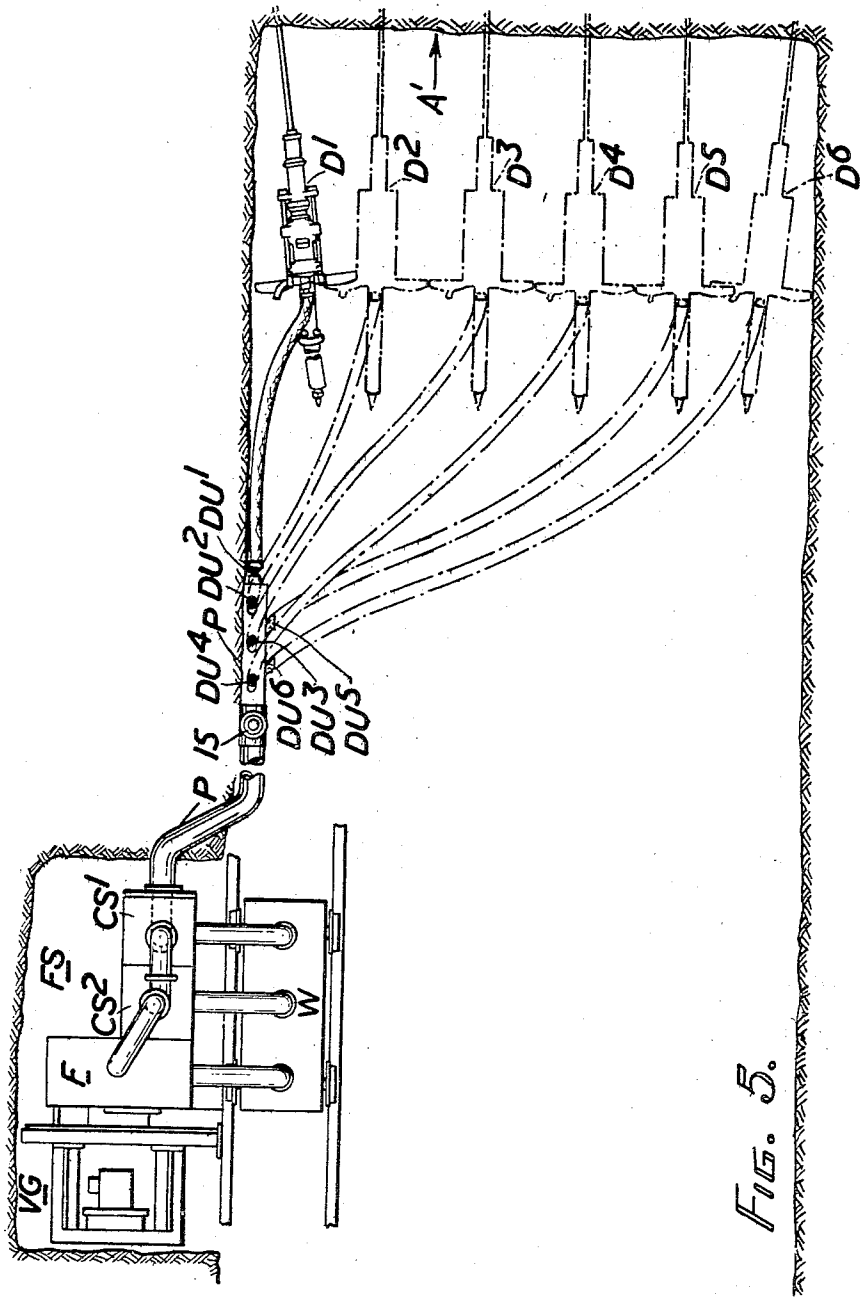


FIG. 5.

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ROCK DRILLING APPARATUS

Original Filed June 18, 1951 6 Sheets-Sheet 5

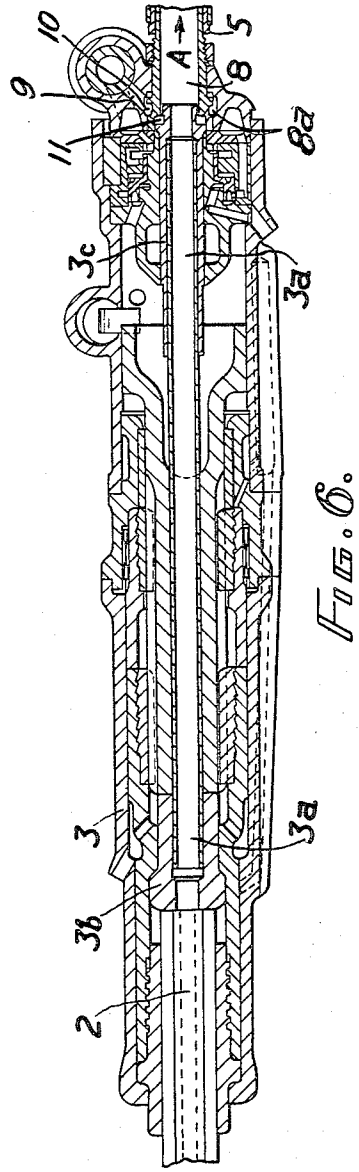


FIG. 6.

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ROCK DRILLING APPARATUS

Original Filed June 18, 1951 6 Sheets-Sheet 6

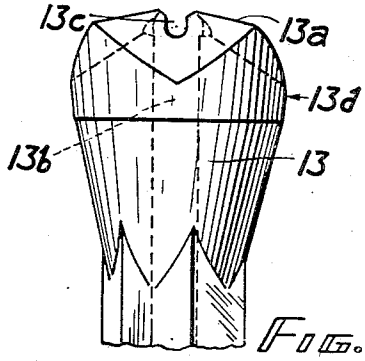


FIG. 7.

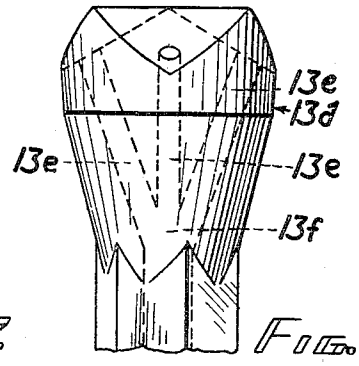


FIG. 9.

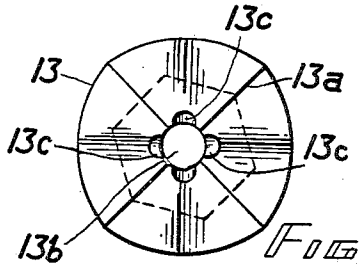


FIG. 8.

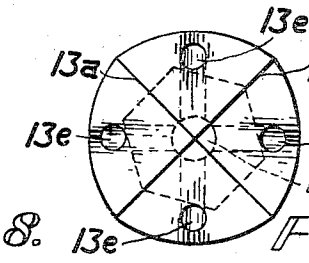


FIG. 10.

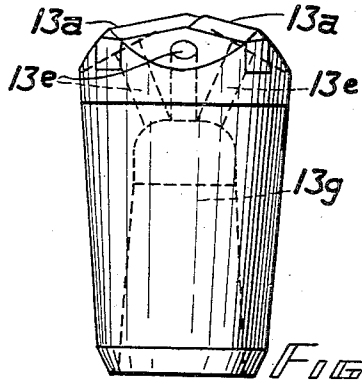


FIG. 11.

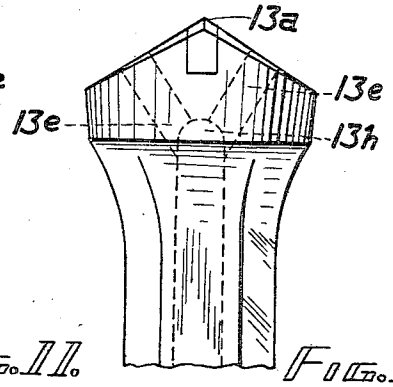


FIG. 13.

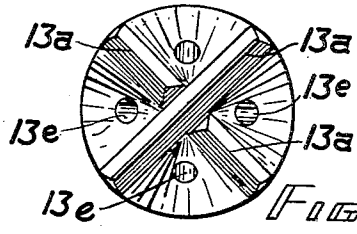


FIG. 12.

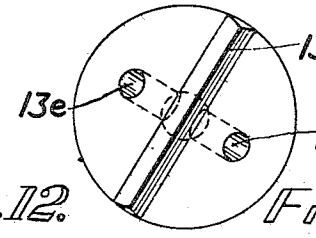


FIG. 14.

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2,839,273

ROCK DRILLING APPARATUS

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Continuation of application Serial No. 232,172, June 18, 1951. This application May 20, 1955, Serial No. 509,996

4 Claims. (Cl. 255—50)

This invention relates to rock drilling apparatus of that type where the particles and dust produced by the drilling operation are removed from the point of drilling under vacuum.

This application is a continuing application of our co-pending application, Serial No. 232,172 filed June 18, 1951, for Rock Drilling Apparatus, now abandoned.

It is generally agreed that one of the most important problems still facing the mining industry is the prevention of the occupational diseases such as silicosis, pneumonoconiosis and phthisis due to, or encouraged by, the breathing in of dust laden air. The dangers have no doubt been ameliorated by the introduction of wet drilling which in some countries is compulsory but medical experience and opinion goes to show that this is not a complete solution since some of the most dangerous dust even when damped down by water does get into the air in the working place and moreover, in wet drilling it is possible for the drills to be operated dry if the water system has gone out of action. Furthermore wet drilling is not always practicable in deep mines owing to the effect of the water on the humidity of the atmosphere and some other cases water has an adverse effect on the surrounding strata.

It is believed that the only complete solution of the problem is to be found in an air eduction dry drilling system whereby the dust, created by the drilling operation is instantly removed from the positions of drilling as it is created, the ideal arrangement being such that any failure of the eduction system renders the drill inoperative. Many proposals having for their object the removal or trapping of dust at the drilling positions have been proposed, the more usual suggestion being to connect the outlet pipe carrying the dust laden air from each drill to a porous filter bag located adjacent the drill. This arrangement is not wholly satisfactory in that the filter bag is liable to become punctured or develop leaks with the result that the dust accumulated in the bag will be released into the atmosphere where the operators are working. In this connection it is to be remembered that as beforementioned the most dangerous dust forms an almost invisible cloud so that its leakage may not be readily perceptible and may go on unnoticed.

The object of the present invention is to provide a dry drilling system in which the disadvantages hitherto obtaining are overcome and in its broadest aspect the invention consists of a dry drilling equipment for mines wherein the dust created at the drill bits is withdrawn directly therefrom through the drill steel and the drill to a filtering unit under vacuum.

The invention also comprises modifications of the drills for use in the system, convenient means for creating the necessary vacuum and a special construction of the drill bits such as will ensure close contact with the walls of the holes being drilled so that adequate suction effect will be maintained during the drilling operation and an adequate area of eduction passages leading into a hollow

drill steel and thence through the drill itself to a discharge point at the back of the drill.

The invention will be better understood from the following description read in conjunction with the accompanying drawings of specific forms the equipment according to the invention may take.

In these drawings:

Fig. 1 is a diagrammatic elevation of a system suitable for use with a single drill.

Fig. 2 is a diagrammatic plan of a dust collecting and filtering unit for such a system.

Fig. 3 is a view similar to Fig. 1 illustrating a modification of the arrangement.

Fig. 4 is a diagrammatic elevation and Fig. 5 a plan of an equipment designed for enabling the dust discharges from a number of drills to be carried through a common pipe line to a common dust separating and filtering system. Fig. 5A is an enlarged sectional view of an important detail.

Fig. 6 is a longitudinal section through a special form of drill for use in the system and Fig. 6A is an enlarged view of the back end of the drill.

Fig. 7 is an elevation and Fig. 8 a plan of one form of drill bit for use in the system.

Figs. 9 and 10, 11 and 12, 13 and 14 are similar views showing other specific forms the bits may take.

Referring first to Fig. 1 let it be assumed that there is an unobstructed passage from an opening or openings in the drill bit 1 through the hollow drill steel 2, through an aligned passage through the drill 3 up to the coupling 4 to which the hose pipe 5 is connected at one end, its other end being coupled to the pipe 6. This pipe 6 constitutes the inlet into a filter unit 7. It is also to be assumed for the purpose of this preliminary explanation that the whole of the aligned passages leading from the bit 1 to the connection and the filter unit are at a negative pressure, i. e. under a partial vacuum.

Thus, as the drill bit in the normal operation of the drill creates dust at the bit this dust is sucked through a hole or holes in the bit, through the hollow drill steel and hence through the drill and the hose into the first stage 7*a* of the filter unit. The dust laden air from which the larger dust particles are separated in this first stage filter, passes through the opening 7*b* into the second stage 7*c* of the filter unit and the very fine dust still remaining in the air passes through the ducts 7*d* to the removable filter bags 7*e* This filter unit as a whole which may include one or more cyclone dust separators in each stage of separation is provided with handles 7*f* by means of which it can be transported to a convenient position for connection of the inlet pipe 6 to the hose pipe 5 and can from time to time be disconnected from the hose pipe and carried away and its contents dumped at any convenient place.

To enable the foregoing operations to be performed reference is now made to the construction of the drill 3 shown in Figs. 6 and 6A. This drill is of conventional form except that a central tube 3*a* of large diameter runs from the anvil 3*b* to a sleeve 3*c* disposed centrally of the valve chest to a spigot 8 to which the hose 5 is coupled. Thus this tube 3*a* is supported at at its forward end in the anvil block 3*b* and at its rear end in the sleeve 3*c*. A passage 9 from the compressed air supply of the drill leads to an annular chamber 10 surrounding the end of the coupling spigot 8 and the high pressure air delivered to this annular chamber 10 passes through passages 8*a* in the end of the spigot into an annular chamber 11 formed between the outer end of the sleeve 3*c* and the inner end of the spigot 8 and a clearance 12 is left between the end of the sleeve 3*c* and the spigot 8. Thus, when compressed air is admitted to operate the drill in

normal manner it is also supplied to the annular chamber 11 and thence flows at high velocity through the restricted passage formed by the clearance 12 and an ejector action is thereby set up which creates a strong suction effect in the direction of the arrow A. It should be noted that the incorporation of the vacuum creating ejector in the drill construction itself although manifestly advantageous is not essential to the operation of the system as it is obvious that the same effect could be produced by means of a separate ejector located in the pipe line adjacent the drill and interlinked with the compressed air supply to the drill. It will be observed that with this arrangement of drill the passage of the dust from the drill bit is in a direct straight line so that the dust laden air stream does not have to change direction or be impeded in any way and there are no constricted passages or bottle necks. An important consideration is, of course, to make the fullest possible use of the suction effect created by the ejector action and this necessitates a special construction of drill bit. Examples of such bits are shown in Figs. 7 to 14. The characteristic features of them all is that they have plain substantially cylindrical operative ends without any grooves so that as the drilling proceeds the bit makes a close almost piston-like fit in the hole being drilled which ensures the necessary high factor of suction effect and prevents dust getting back around the drill steel. This close fitting also has the advantage that it causes complete interruption of the drilling operation if the eductor system fails for any reason since on such an occurrence the cuttings and dust build up between the cutting edges of the bit and the rock or coal face so that drilling ceases and cannot be restarted until the defect has been remedied. Another important requirement of the drill bits employed in the system is that they are provided with eduction passages of adequate area so that no substantial obstruction is offered to the dust on its passage to the hollow drill steel. They will, however, be smaller in diameter especially at the entry than the passages through the drill steel, the drill and the succeeding passages which the dust traverses on its way to the filter unit. In Figures 7 and 8 a bit **13** is shown having cutting edges **13***a* and a central large opening **13***b* with lead in channels **13***c*. The outer peripheral surface **13***d* of the bit is substantially cylindrical so that the close almost piston fit before alluded to is attained.

An alternative form of bit is shown in Figures 9 and 10. Here again the peripheral surface of the bit is substantially cylindrical but instead of a single central eduction passage a number of such passages **13***e* are arranged between the cutting edges **13***a* all merging into a central passage **13***f* which, of course, leads into the central passage in the hollow drill steel.

Another arrangement is shown in Figures 11 and 12 where the cutting elements **13***a* are inserted tungsten carbide sections one of which runs completely across a diameter of the bit between smaller ones running at right angles on each side, alternatively four of the smaller inserts may be used. The eduction passages **13***e* run into a central chamber **13***g*.

Yet another alternative is shown by Figures 13 and 14 where eduction passages **13***e* are arranged on either side of the single cutting edge. These eduction passages terminate in a junction **13***h* which connects up to the passage in the drill steel. Although removable bits are preferably employed, it will be understood that they may be integral with the drill steels. Similarly inserted tungsten carbide or other cutting elements may be employed.

The foregoing describes and illustrates the invention in its simplest form. Figure 3 illustrates a modification of the system shown in Fig. 1 and differs from it only in that the filter bags **7***e* are replaced by a pipe line **14** so that the very fine and most dangerous dust is taken away to any desired distance. This may necessitate a boosting of the suction which can be effected by one or more high pressure ejector nozzles such as indicated at **14***a* arranged in the pipe line **14** to which pipe line the filter unit is connected by a hose pipe **14***b*.

The preferred form the invention will take in practice is shown diagrammatically in Figs. 4 and 5 wherein is illustrated a complete installation involving the foregoing general principles suitable for use in a mine by means of which the dust discharge from a number of drills is transferred by a common pipe line to a dust separating and filter unit and a vacuum generator.

Referring to these figures A' designates the rock or coal face being drilled and the symbols **D1** to **D6** designate a number of drills positioned to operate at the face in normal manner. P indicates a main dust discharge pipe line located at a convenient position as to cause no inconvenience to the miners. This pipe line is provided with hose unions **DU1** to **DU6** to which the hose pipes from the drills **D1** to **D6** can be coupled. Valves may be provided so that the connection to each individual drill can be established in and disestablished from the system at will.

This, however, necessitates the provision of the relief valve **15** in the pipe line, designed to operate when the vacuum in the line exceeds a predetermined setting. In operation when all or several drills are in operation and the vacuum drops below the pre-arranged setting due to the dust laden air entering the pipe line, the valve will remain closed and the dust laden air stream will flow freely through the pipe line. Should all the drills be stopped, however, the movement of the column of air in the pipe line would also stop, if this relief valve were not provided, thereby allowing dust to settle on the bottom of the pipe which might ultimately cause choking to occur. This is prevented by the automatic opening of the relief valve in response to the increased vacuum.

A suitable form of relief valve is shown in Fig. 5A. It comprises, in its essentials, a casing open to atmosphere through the holes **16**. A disc or mushroom valve proper **17** normally closes the opening leading into the pipe line P under the influence of the spring **18** the effect of which can be adjusted and set by the adjusting lock nut **19**. On the occurrence of an excessive vacuum the influence of the spring will be overcome and the valve proper **17** will leave its seat and free flow of the dust laden air stream through the pipe line will be maintained as before described.

Dealing specifically with this installation as a whole the dust created at the drill bits is discharged through the drill steels and the drills in the manner before described with relation to Figures 1, 2 and 3 and passes into the common conveyor pipe line P whence it passes to a dust separating and filtering apparatus FS which is in turn connected up to a vacuum generator VG. In the arrangement shown the dust separator and filter is constituted by a cyclone separator, having two stages **CS1** and **CS2**, which extracts the larger dust particles and a filter F, which extracts the very fine particles in the region of 10 microns or less and the vacuum generator VG is constituted by a suction fan but it will be understood that other known devices for effecting the desired object may be employed. Experience has shown that with an installation of this character the dust from the drilling face can be conveyed a considerable distance—as much as 1000 feet for example—away from the drilling position. The separated particles both from the cyclone separator and the filter can from time to time, be discharged into a movable dust collecting wagon W and transported to any desired dumping position. It will be observed that an installation of the foregoing character operates upon the same general principles as the simpler systems described with relation to Figures 1 and 2. That is to say, each of the drills will discharge under the influence of the ejector action produced in each of the drills but the vacuum necessary to carry the dust the considerable distance contemplated is boosted by the suction generator and may be additional compressed air operated ejectors,

such as indicated at 14*a* in Figure 3, applied to the pipe line P.

Where mining conditions permit the separating or filtering stages may be omitted and some or all of the dust may be disposed of by being directed into old working places, as for instance via the outlet pipe from the high pressure ejector nozzle 14A shown in Figure 3.

Particular attention is directed to Fig. 6 wherein our pneumatic drill for the eduction dry drill system explained above is illustrated. The drill comprises a housing having forward and rear end portions. An unobstructed straight passageway extending from the forward end portion of the housing longitudinally rearwardly the full length of the housing is formed by the central tube 3*a*. The central tube 3*a* is positioned within the drill 3 by having the forward end thereof disposed within a longitudinal bore on the anvil 3*b* and the tube 3*a* terminates at its rear portion in a sleeve 3*c*. The passageway of the hollow drill steel 2 is axially aligned with the passageway of the drill 3 and the drill steel passageway is of smaller cross-sectional area than the passageway of the drill and particularly that portion of the tube 3*a* immediately adjacent the sleeve 3*c*.

Also, the opening in the hose pipe 5 is axially aligned with the passageways of the drill 3 and hollow drill steel 2 and the opening of the hose pipe 5 is of larger cross-sectional area than the cross-sectional area of the passageway of the drill 3 and in particular that portion of the drill passageway that is immediately adjacent to the hose opening, i. e. the terminal portion of the drill passageway.

Having thus described and disclosed our invention it will be understood that obvious modifications other than those illustrated in the drawing may be resorted to within the scope and spirit of the invention as defined by the appended claims.

We claim:

1. A drilling and dust eduction system for mines comprising in combination, a drill steel having a longitudinal passage extending therethrough, a drill bit carried by said drill steel and having a plain ungrooved peripheral wall adapted to make a close fit in the hole being drilled, said drill bit having a cutting edge and rearwardly inclined faces in the front containing channels flanking said cutting edge and having an inner longitudinal opening communicating with said channels and aligned with the longitudinal passage in said drill steel, said opening being smaller in cross-sectional area at its entry than the longitudinal passage in the drill steel, a percussive drill carrying said drill steel on the forward portion thereof and containing a longitudinal passage extending therethrough, said drill passage being aligned with and having the rear portion thereof of larger cross-sectional area than the cross-sectional area of the longitudinal passage in said drill steel, a hose coupled to the longitudinal passage in said percussive drill, said hose having a greater internal cross-section than said longitudinal passage, and a vacuum generator and filter unit connected to said hose at a point remote from said percussive drill, whereby dust created by said drill bit passes directly and without change of direction through said drill bit, drill steel and percussive drill to the filter.

2. A drilling and dust eduction system for mines comprising in combination, a drill bit having channels leading from positions located intermediate its cutting edges to an interior opening therein, a drill steel having a longitudinal passage aligned with said opening, said opening being smaller in cross-sectional area at its entry than the longitudinal passage in the drill steel, a percussive drill carrying said drill steel on the forward portion thereof, a passage extending in a straight line completely through said percussive drill, said drill passage being aligned with and having the rear portion thereof of larger cross-sectional area than the cross-sectional area of the longitudinal passage in said drill steel, a dust separator located at a position remote from said percussive drill, a conduit running from said percussive drill to said separator, said conduit having a greater cross-section than said longitudinal passage, and a vacuum generator associated with said dust separator to maintain a partial vacuum throughout the system.

3. A drilling and dust eduction system for mines comprising in combination, a drill bit having channels leading from openings flanking its cutting edges into an opening at its back, a hollow drill steel having a central longitudinal passage aligned with said opening, said opening being smaller in cross-sectional area at its entry than the longitudinal passage in the drill steel, a compressed air operated percussive drill carrying said drill steel on the forward portion thereof, a passage running completely through said percussive drill having the rear portion thereof of larger cross-sectional area than the cross-sectional area of the passage in said drill steel, a hollow coupling spigot at the back end of said percussive drill open to and aligned with the passage therein, said spigot having a greater cross-section than said passage, a remotely positioned vacuum generator and filter unit connected to said spigot, a vacuum creating ejector associated with said percussive drill and operated by the compressed air supplied to the drill whereby dust created at the drill is discharged by ejector action into said spigot and thence by said vacuum generator to the filter.

4. A drilling and dust eduction system for mines comprising in combination, a drill bit having a cutting face and at least one interior opening therein communicating with its cutting face, a drill steel having a longitudinal passage aligned with said opening, said opening being smaller in cross-sectional area at its entry than the longitudinal passage in the drill steel, a percussive drill carrying said drill steel on the forward portion thereof, a passage extending in a straight line completely through said percussive drill aligned with and having the rear portion thereof of larger cross-sectional area than the cross-sectional area of the longitudinal passage in said drill steel, a dust separator located at a position remote from said percussive drill, a conduit running from said percussive drill to said separator, said conduit having a greater cross-section than said longitudinal passage, and a vacuum generator associated with said dust separator to maintain a partial vacuum throughout said system.

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