ABSTRACT

A method and a device for dust collecting during air-flushed rock drilling in which a drill stem surrounding shell is located adjacent the rock surface. The shell comprises a drill stem opening through which the drill bit can pass and an air ejector for accomplishing air flow through the annular space left between the drill stem and the shell in said opening, whereby the dust containing flush-air which rushes into the shell from the hole being drilled is prevented from escaping from the shell along the drill stem. The shell is provided with an outlet opening through which dust and air is drained from the shell by means of a suction device.

12 Claims, 5 Drawing Figures
METHOD AND DEVICE FOR DUST COLLECTING AIR-FLOODED ROCK DRILLING

This invention relates to a method and a device for collecting dust at air-flushed rock drilling.

Previous methods for such dust collecting are disadvantageous in being inefficient and demanding an equipment which is difficult to handle. According to those previous methods the equipment has been exposed to a very hard wear during operation. The objects of the present invention are to solve these problems. This is accomplished by the method and the device stated in the claims.

The invention is herebelow described in detail with references to the drawings on which FIG. 1 shows a horizontal elevation of a device according to the invention. FIG. 2 is a longitudinal section along line 2—2 in FIG. 1. FIG. 3 is a vertical section through another embodiment of the invention in which the air ejector is divided into two halves and pivotally mounted on two axles together with a drill stem support. FIG. 4 is a vertical section through still another embodiment of the invention in which an additional air ejector is provided for facilitating the dust collecting and transportation, especially when drilling in formations containing water. FIG. 5 is a vertical section through an ejector adapted for a device according to the invention.

The device shown in FIGS. 1 and 2 comprises a circular housing 1 which is open at its forward rock surface facing end and which is provided with an eccentrically located opening at its opposite end. The opening 2 is adapted for letting the drill stem pass through the housing. In the opening 2 there is arranged an air ejector 3 which comprises a neck ring 4 having a curved inner contour and a narrow annular air slot 5. The opening 2 and the neck ring 4 are so dimensioned as to constitute an air passage 6 between them and the drill stem. The annular air slot 5 is connected to a pressure air source via an inlet conduit 7 and is intended to establish a primary air flow through the neck ring 4. The primary air flow is directed substantially radially inwardly but is linked forwards along the curved neck ring contour by the so called Coanda-effect.

Moreover, the housing 1 is provided with an outlet tube 8 which is substantially tangentially directed in the housing and a conical rubber skirt 9.

The method according to the invention is the following.

The housing 1 is placed at the rock surface and the drill stem 10 is introduced through the neck ring 4 and the housing 1. During drilling, air 12 is flushed down through the drill stem 10 and the drill bit 11 for blowing up of drill dust from the bore hole. Thus, the flush-air comes up to the surface with a considerable velocity containing the drill dust. For preventing the drill dust from escaping into the atmosphere, the housing 1 is placed so that its rubber skirt 9 will be at a distance of a few centimetres above the rock surface. Pressure air is supplied to the air ejector 3 whereby there is obtained a primary air flow 13 through the passage 6. The primary air flow causes a secondary air flow 14, for example of atmospheric air, down through the passage 6. These air flows make together a considerable air flow, the aim of which is to slow down the flushing air 12 coming up through the bore hole.

For transportation of the dust away from the housing, the latter is connected to a suction device (not shown).

This suction device is so dimensioned as to establish an atmospheric air flow 15 into the housing between the rubber skirt 9 and the rock surface whereby the dust is unable to escape into the atmosphere.

By disposing the outlet tube 8 tangentially in the housing and by locating the ejector 3 eccentrically, there is established a rotation of the air and the dust within the housing whereby the dust is prevented from setting at the housing inner walls.

One object of the conical rubber skirt 9 is to catch the most diverging particles coming out through the bore hole. Especially when the device is located at a distance from the rock surface there are lots of such particles. Another object of the rubber skirt 9 is to elastically absorb or compensate for irregularities of the rock surface when the device is located close to the rock surface. The dust collecting device is most efficient when there is a gap left between the skirt 9 and the rock surface because of the fact that the suctional draining of the housing is most efficient when the pressure inside the housing is not too low and when the transported air volume is large. On the other hand, if the device is located against the rock surface, atmospheric air 15 is prevented from entering the housing whereby the pressure inside the housing and the transported air volume decreases.

The method according to the invention has a characteristic that the dust carrying flush-air 12 which leaves the bore hole is slowed down in the housing by means of a counter-directed air stream. This means that the problems with inefficient seals which have to be used in the previous devices are solved. On the contrary, the invention has a further characteristic that an air space 6 has to be present between the drill stem 10 and the housing 1 for enabling accomplishing of a counter-directed air flow. It is also characterized in that the opening 2 in the housing has to be of such a diameter that the drill stem 10, including the drill bit 11, must be able to pass through it. In previous dust collecting devices seals are used which necessitate the housings to be dividable to be able to be put around a drill stem. Such an arrangement is avoided by the present invention.

The method according to the invention is advantageous also by the fact that the housing may be located at a distance from the rock surface without losing any collecting effect. This means that the housing can be mounted on the forward end of a feed bar. It may also be disposed directly against the rock surface if desirable. When it is mounted on a feed bar, the collecting device according to the invention is very well protected from damage because direct contact with the drill stem is avoided. As the drill stem is always wobbling during drilling, damage may very easily occur on the housing if it is located on the rock surface without support. That is a serious problem in conventional dust collecting devices which have to be located directly on the rock surface to work.

The above described type of ejector is advantageous in producing a uniform air flow throughout the periphery and by having its air slot situated at a distance from the hole whereby the edges of the slot are protected from damage during maneuvering of the drill stem.

By the arrangement according to the invention it is possible to pass through the opening in the housing with the drill bit as well as drill stem joints without separating or dividing the housing. It is also possible to use drill stems of different diameters.
In FIG. 3 there is shown a modification of the device according to the invention which is combined with a separable drill stem support 20 and intended for being mounted on a feed bar. The ejector used in this embodiment is adapted for use with a drill stem 10 having a diameter which is relatively small in comparison with the drill bit being used. If the ejector would be of the same type as the above described, the annular clearance between the neck ring 2 and the drill stem 10 would be too large because of the fact that the drill bit would have to pass through the neck ring 2. In order to decrease the annular clearance, this type of ejector is divided into two parts 21 and 22 which are pivotable about two parallel axes 23 and 24. Thus, the two halves of the ejector are pivotable between a closed work position and an open rest position. The two halves 21 and 22 of the ejector are pivotable about the same axes as the drill stem support 20.

In the left part of FIG. 3, the ejector and the drill stem support 20 are shown in their open positions for letting the drill bit through. The right part of FIG. 3 shows the ejector and the drill stem support in their working positions.

In FIG. 4, there is shown still another embodiment of the dust collector according to the invention. This device is provided with two counter-directed air ejectors 30 and 31 each of which comprises an annular air-injecting slot 32 and 33 and a neck ring 34 and 35 of the Coanda-type. This dust collector is intended for use when drilling in formations containing water. The rear ejector 30 has the same purpose as the ejectors of the above described embodiments, namely to prevent dust from escaping backwards along the drill stem 10. The additional ejector 31 is located at the forward end of the housing 1 and is provided for facilitating the collecting of the flush-air which comes out of the hole being drilled together with dust and water.

Another object of the backwardly directed ejector 31 is to increase the pressure within the housing 1 and thereby increase the velocity of the air-dust-water mix through the outlet tube 8. A high velocity is necessary in order to prevent the wet dust from settling in the tube.

This dust collecting device is preferably intended to be mounted on a feed bar and is for that purpose provided with two mounting flanges 36 and 37.

In FIG. 5 there is shown a modified type of an ejector adapted for a dust collector according to the invention. This ejector intends to solve the very special problem concerning the types of ejectors having a narrow slot as air injecting means. The problem is that even very small particles which are brought with the pressure air or which may come from outside, very easily get jammed in the narrow slot, and cause failure to the operation of the ejector.

This type of ejector, shown in FIG. 5, has an elastic part 40 defining the upper edge of the slot. This part 40 comprises a sleeve made of, for instance, a resilient material such as plastic and is prestressed toward a position in which the slot is closed. The magnitude of prestressing and the elasticity of the sleeve 40 is chosen so as to yield for a certain pressure applied on the sleeve inside. In other words, the ejector slot is opened to its proper work size for a proper work pressure. This ejector is advantageous also in that the slot can be cleaned by applying a pressure exceeding the work pressure, whereby the slot is widened. By applying such a pressure, particles that may have gotten jammed in the slot are blown out therefrom. This ejector is self-closing as well as self-cleaning.

The ejector is shown in a closed position in the left part of FIG. 5 and in an opened, pressurized, position to the right in FIG. 5.

The invention is not limited to the disclosed embodiments but can be freely varied within the scope of the claims.

What we claim is:

1. Device for dust collecting during air-flushed rock drilling characterized by the combination of:
   a shell adapted to be located adjacent the rock surface, said shell being open at its forward end and being provided with a drill stem opening at its rear end, the drill stem opening of the shell being dimensioned to form an annular space around a drill stem to be inserted therein, an air ejector provided at the rear end of the shell and including an annular slot through which pressure air is injected in a substantially radial direction, and a neck ring provided with a curved contour for linking the injected air flow forwards, through the annular space, said neck ring having a minimum internal diameter which is smaller than the diameter of said annular slot, said air ejector producing a forwardly directed air flow toward the rock surface through said annular space to aerodynamically retard the flow rate of the dust-containing flush-air rushing out of the hole being drilled, and
   an outlet opening in said shell which is adapted to be connected to a suction device for draining of the air and dust from the shell.

2. Device according to claim 1, characterized in that an additional, backwardly directed air ejector is provided at the forward end of the shell for boosting of the flush-air flow as well as the pressure inside the shell.

3. Device according to claim 1, characterized in that said outlet opening is tangentially directed in the shell in order to cause rotation of the dust containing air within the shell during draining thereof, and that the drill stem opening is eccentrically disposed in the shell for supporting said air rotation.

4. Device according to claim 1, characterized in that the minimum internal diameter of the neck ring is dimensioned to allow passage of the drill bit there-through.

5. Device according to claim 1, characterized in that said shell includes a skirt projecting forwardly and adapted to be located adjacent the rock surface.

6. Device according to claim 5, characterized in that said skirt is flexible.

7. Device according to claim 1, characterized in that the annular slot of said ejector is defined by at least one elastic member which is prestressed toward a position in which the slot is closed.

8. Device according to claim 7, characterized in that said ejector comprises a sleeve of resilient material which surrounds the neck ring and is provided with an internal flange which is prestressed toward the rear end of said neck ring.

9. Device according to claim 8, characterized in that said air ejector comprises means for receiving pressure air internally of said resilient material sleeve for causing said sleeve to yield upon supply of said pressure air to open said slot.

10. Device for dust collecting during air-flushed rock drilling characterized by the combination of:
a shell adapted to be located adjacent the rock surface, said shell being open at its forward end and being provided with a drill stem opening at its rear end, said drill stem opening of the shell being dimensioned so as to allow passage of a drill bit therethrough.

an air ejector provided at the rear end of the shell for producing a forwardly directed air flow through an annular space defined between said drill stem opening and the drill stem, said air ejector including an annular slot through which pressure air is injected in a substantially radial direction, and a neck ring provided with a curved contour for linking the injected air flow forwards, through the annular space, said neck ring having a minimum internal diameter which is smaller than the diameter of said annular slot, and an outlet opening in the shell for connection to a suction device for draining of the air and dust from the shell.

11. Device according to claim 10, characterized in that said air ejector is divided into two halves both of which are movable between a closed, work position and an open, rest position in which latter position the drill bit and any drill stem joints may pass through.

12. Device according to claim 11, characterized in that said air ejector is associated with a drill stem support.

* * * * *