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[54] **SEAL ARRANGEMENT FOR AN ELECTRO-PNEUMATIC ROCK DRILL**

[75] Inventors: **Josef Unterschweiger,** Feldkirch-Nofels, Austria; **Peter Schmück,** Mauren Fuerstentum, Liechtenstein

[73] Assignee: **Hilti-Aktiengesellschaft,** Fuerstentum, Liechtenstein

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[51] **Int. Cl.** **B25d 11/00**

[58] **Field of Search** 173/109, 116, 117

[56] **References Cited**

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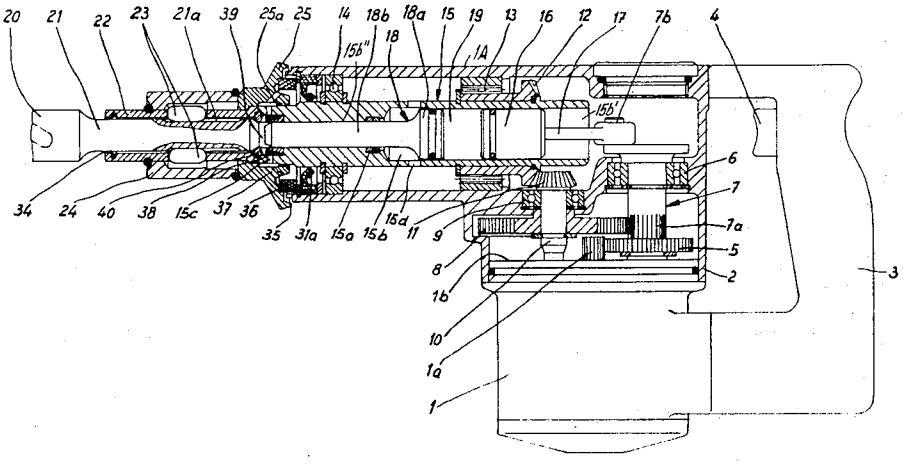
Primary Examiner—James A. Leppink
Attorney—Toren & McGeady

[57] **ABSTRACT**

In an electro-pneumatic rock drill an axially extending bore is formed within a cylinder contained within a housing and the bore has a forward part which has a smaller diameter than its rearward part. A piston is reciprocably mounted in the rearward part and is spaced from the rearward end of a percussion piston which extends into the forward part of the bore. In operation, the piston transmits its reciprocating movement through the medium of an air cushion to the percussion piston which in turn drives a tool held in a holder adjacent the forward end of the bore. A seal is provided in the forward part of the bore to prevent any passage of air rearwardly through the bore along the percussion piston. Further, a space is provided at the forward end of the percussion piston when it is in its rearward position, into which filtered air is drawn and expelled forwardly through the tool holder when the percussion piston transmits its energy to the tool so that dust-laden air cannot enter into the bore within the rock drill.

6 Claims, 3 Drawing Figures



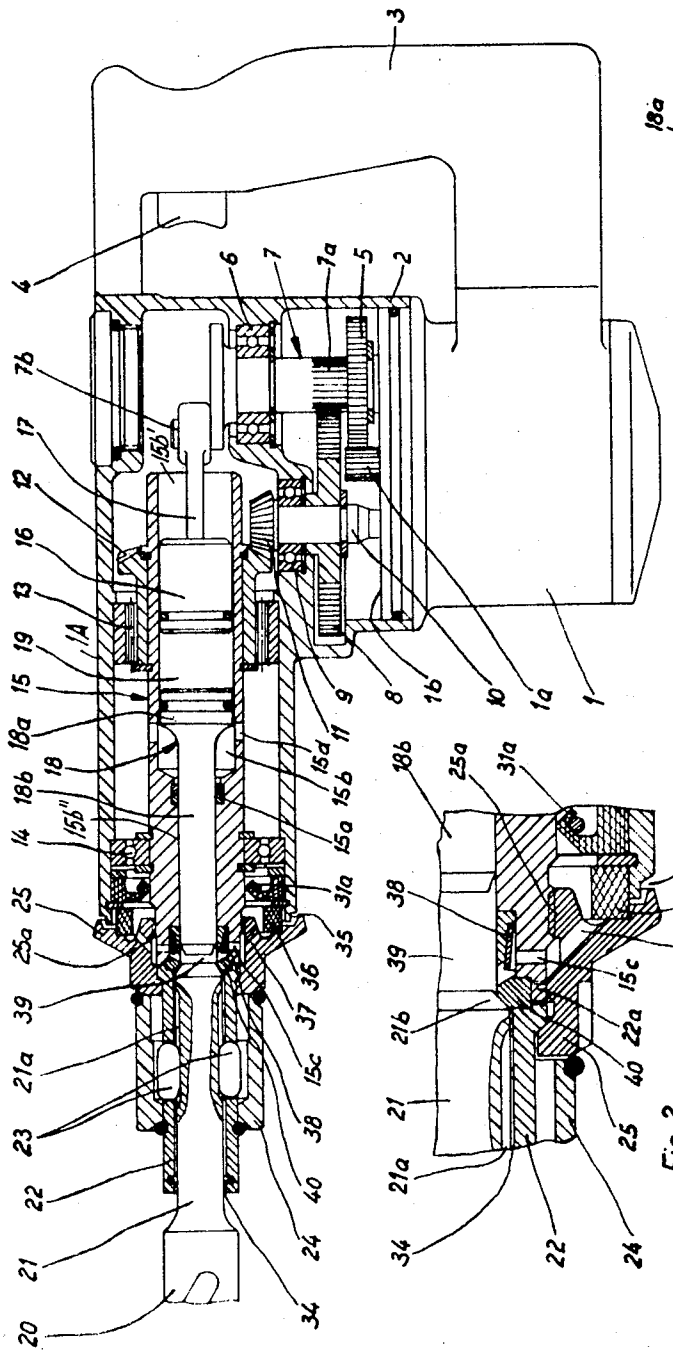


Fig. 1

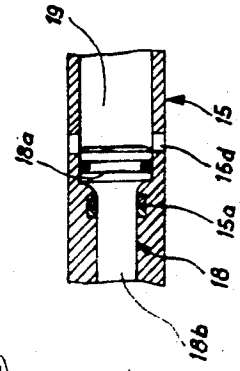


Fig. 3

Fig. 2

INVENTORS
JOSEF UNTERSCHWEIGER
PETER SCHMUCK
BY:
Toren & McGeady
ATTORNEYS

SEAL ARRANGEMENT FOR AN ELECTRO-PNEUMATIC ROCK DRILL

SUMMARY OF THE INVENTION

The present invention is directed to an electro-pneumatic rock drill construction and, more particularly, it is concerned with means for sealing the interior of the rock drill so that it can be operated without any problems being caused by dust-laden air entering its interior. In this invention, the rock drill includes a percussion piston sealed within a bore so that it can be driven through the medium of an air cushion by a reciprocating piston spaced from the percussion piston. The energy transmitted to the percussion piston is, in turn, directed against a tool positioned within a holdeR, such as a rock drilling tool.

Rock drills of the type mentioned above are exposed to rock dust-laden air which can have a very deleteRious effect an the useful lifetime and the safe operation of the drill. One of the articular problems experienced in such apparatus is the provision of a seal in the vicinity of the tool holder for preventing dust-laden air from entering through the holder into the interior of the drill.

Rock drills of this type are known in which the tool holder has a bore which opens directly into the bore through the cylinder in which the percussion piston is positioned. In such an arrangement, with every return stroke of the percussion piston the dust-laden air from about the drill is drawn into the tool holder and in turn into the interior of the drill. Furthermore, foreign bodies adhering to the tool shank present an additional source of fouling for the pistons within the rock drill.

To avoid damage to the interior of a rock drill caused by dust-laden air entering its cylinder, it has been known to use an additional impact transmission member arranged for axial displacement in the cylinder relative to a packing. In this arrangement, the impact energy is transmitted from the impact transmission member to the percussion piston and, in turn, to the tool, and the interior of the cylinder is closed against the entry of dust and the like which would cause it to become fouled. However, the advantage of the seal provided by thiS arrangement is offset by the disadvantage of the loss of impact energy, since an additional impact transmission area is required and, as is known, at each impact transmission point about 20 percent of the impact energy is lost, that is it is transformed into heat.

Therefore, the primary object of the present invention is to provide a sealed percussion piston for a rock drill which avoids the above-listed disadvantages.

In accordance with the present invention, the sealed arrangement is afforded by providing an axially extending bore through a cylinder within the rock drill with the bore having a larger diameter section in its rear part as compared to a smaller diameter section in its forward part. A reciprocating piston is positioned within the rear part of the bore and is separated from the rear end of a percussion piston by an air space which provides an air cushion during the operation of the rock drill. A piston shank is provided on the percussion piston which extends forwardly into the forward part of the bore and has a diameter similar to that of the forward part of the bore and a seal member is provided in the bore which seals the bore when the percussion piston is reciprocated within the cylinder.

In this arrangement, the interior of the cylinder, that is the rearward part of its bore is sealed off from the entry of any dust-laden air regardless of the position of the percussion piston within the bore. Further, the energy is transmitted from the reciprocating piston through the percussion piston to the tool at the forward end of the rock drill without any additional energy loss.

Preferably, the seal is provided within the reduced diameter portion of the bore by means of an annular packing fixed in relationship to the cylinder which prevents the penetration of any foreign bodies from passing along the shank into the rearward part of the cylinder bore. Further, the seal provided about the percussion cylinder serves to maintain the air cushion within the rearward part of the bore between the rear end of the percussion piston and the adjacent face of the reciprocating piston.

The bore through the cylinder has a rearward section with a larger diameter than its forward section. The head of the percussion piston is guided within the rearward section of the bore while its shank extending toward the forward end of the drill extends through the forward section of the bore so that the percussion piston is guided in both sections of the bore and especially good sliding properties are provided.

Another characteristic of the invention is the arrangement of the rock drill housing adjacent the impact zone between the percussion piston and the tool within the tool holder. Apertures are provided through the housing in communication with the impact zone so that, due to the suction effected by the return stroke of the percussion piston, external air is drawn into the impact zone. Valves are provided in the path of the external air which close the passage into the impact zone during the forward or drive stroke of the percussion piston. As a result, a positive pressure relative to the atmosphere about the rock drill is provided and the external air drawn into the impact zone is expelled during the forward stroke of the percussion piston and directs the air through the clearance between the tool shank and the tool holder toward the forward end of the rock drill. Due to the positive displacement of the air from the impact zone outwardly any passage or rock dust-laden air into the impact zone is prevented. Furthermore, the passage of air from the impact zone avoids any excessive heating of the impact transmission surfaces which would be disadvantageous to the operation of the drill.

To assure that rock dust or other foreign bodies are not drawn into the impact zone through the aperture provided in the housing, filters are located in the path of the air being drawn into the impact zone so that any deleterious material can be removed.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawing and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a side view, partly in section, through a rock drill or similar device incorporating a percussion piston, in accordance with the present invention;

FIG. 2 is an enlarged detail of a portion of the rock drill shown in FIG. 1; and

FIG. 3 is another detail of a portion of the rock drill shown in FIG. 1 with the percussion piston in a different position.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1, a rock drill or drill hammer is illustrated and is formed of a motor 1 secured to a drill housing 1A through the medium of a gear box 2. Further, a handle 3 including a pressure switch 4 is secured to the motor and to the rearward end of the housing 1A.

By means of a pinion 1*a*, the rotary movement of the motor is transmitted through a gear 5 to crank shaft 7 supported at its upper end within a bearing 6. Above the gear 5, teeth 7*a* are provided on the crank shaft 7 which intermesh with another gear 8 located within the gear box 2. Gear 8 is mounted on a tapered pinion shaft 10 supported within a bearing 9 at its upper end and is supported at its lower end on the upper part 1*b* of the motor housing. The upper end of the pinion shaft 10 contains a bevel gear 11 which is interconnected with a matching bevel gear 12. The rotary movement from the motor is transmitted through the pinion shaft 10 and its bevel gear 11 to the matching bevel gear 12 which, in turn, rotates a cylinder 15 rotatably mounted within the housing 1A by bearings 13 and 14.

Extending axially through the rotatable cylinder 15 is a bore 15*b* having a rearward section 15*b'* which has a larger diameter than its forward section 15*b''*. Secured to the upper end of the rotating crank shaft 7 by a crank pin 7*b*, is a connecting rod 17 which extends forwardly into the rearward section 15*b'* of the cylinder bore. At its opposite end from the crank shaft 7, the connecting rod 17 is secured to a piston 16 which it reciprocates within the rearward section of the bore. Within the bore 15*b* of the cylinder 15 and spaced forwardly of the piston 16, is a percussion piston 18 which is separated from the forward end of the piston 16 by means of an air cushion within the space 19. As the piston 16 is reciprocated, the percussion piston 18 is similarly moved back and forth through the bore in the cylinder through the medium of the air cushion in the space 19 which separates the two pistons. The percussion piston 18 has a piston head 18*a* at its rearward end located within the rearward section 15*b'* of the bore and a shank 18*b* extends forwardly from the piston head through the forward section 15*b''* to the forward end of the cylinder 15. The kinetic energy of the percussion piston 18 is transmitted through the forward end of its shank 18*b* to the end of a tool 20 supported by its shank 21 within a tool holder 22.

Within the forward section of the bore 15*b''* an annular seal member 15*a* is secured in a stationary position within the cylinder so that it effects a seal against the sliding surface of the shank 18*b* of the percussion piston 18.

The shank 21 of the tool 20 is retained in the tool holder 22 by retaining members 23 which engage within axially extending grooves 21*a* in the surface of the shank 21. For locking the tool within the holder, a sleeve 24 surrounds a portion of the tool holder 22 and by rotating the sleeve in a known manner the members 23 can be displaced from engagement with the grooves 21*a* in the shank 21 and the tool can be removed from its holder. The tool holder is secured to the forward end of the rotating cylinder 15 by means of a cap nut 25 which fits over the end of the tool holder and has a thread 25*a* which engages a similar thread on the cylinder. For transmitting the rotational movement of the cylinder 15 to the tool holder 22 and to the tool which it engages, a radially extending tooth system 22*a* is provided on the rearward end of the holder which engages the cylinder 15.

As can be noted in FIG. 1, in its rearward position the piston head 18*a* of the percussion piston 18 is spaced rearwardly from the back end of the forward section 15*b''* of the bore 15*b*. When the percussion piston is displaced forwardly through the bore, the air in front of its piston head 18*a* escapes through apertures 15*d* formed in the front end of the rearward section 15*b'* of the bore 15. When the percussion piston executes it return stroke within the bore, air is again sucked back into the bore in front of the piston head through the apertures 15*d*. With the percussion piston in its rearward position ready to be driven forwardly against the tool 20 the apertures 15*d* are located forwardly of the piston head 18*a*, that is on the shank side of the piston, as shown in FIG. 1. When the piston 18 is driven forwardly, into the position shown in FIG. 3, the apertures 15*d* are then located rearwardly of the piston head 18*a* and communicate with the space 19 forming the air cushion between the piston 16 and the piston head 18*a*. With the space 19 opened through the apertures 15*d* the air cushion is no longer operative and the percussion piston 18 cannot be reciprocated within the cylinder until the percussion piston is returned rearwardly through the bore 15*b* by the tool shank 21 so that the apertures 15*d* no longer communicate with the space 19.

In FIG. 2 the forward end of the cylinder 15 and the rearward end of the tool holder 22 are shown on an enlarged scale. As the percussion piston 18 executes its rearward stroke through the bore 15*b* air is drawn through an annular gap 35 between the housing 1A and the cap nut 25, through a filter 36, into a channel 37 and then through a passage 15*c* in the forward end of the cylinder into an impact transmission zone 39 located at the forward end of the cylinder 15 between the shank 18*b* of the percussion piston and the shank 21 of the tool 20. At the entrance from the passage 15*c* into the bore 15*b*, an elastic ring 38 is provided which forms a valve arrangement for the passage of air into the impact transmission zone 39. While air is being drawn into the impact transmission zone 39, a packing 31*a* seals the zone off from the interior of the housing 1A and the gear box 2. Similarly, the forward end of the impact transmission zone is sealed off by the bevel 21*b* on the rearward end of the tool shank 21 which rests against an abutment ring 40 located at the rearward end of the tool holder 22. When the percussion piston 18 is driven forwardly, the valve arrangement provided by the elastic ring 38 closes off the entry from the passages 15*c* into the impact transmission zone, so that the air previously drawn in is compressed. During impact the tool shank is driven forwardly with the engagement between its bevel 21*b* and the abutment ring being broken so that the air contained within the impact transmission zone 39 flows forwardly through the annular space 34 between the shank 21 and the interior surface of tool holder 22. The positive displacement of the air forwardly through the annular space 34 prevents any flow of dust-laden air into the zone 39 and any dirt or other matter positioned on the tool shank within the holder 22 is also blown out through the forward end of the drill. Moreover, the flow of air outwardly through

the holder 22 provides a cooling effect on the tool shank 21.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. An electro-pneumatic rock drill and the like, comprising a housing, an axially elongated cylinder rotatably mounted within said housing, said cylinder having an axially extending bore therethrough which has a forward part and a rearward part, a piston positioned within the rearward part of the bore in said cylinder, means for reciprocating said piston within the rearward part of the bore, a percussion piston located within and being axially slidably displaceable through said bore and being positioned therein spaced relationship from said piston, said housing arranged to support a tool at the forward end of said bore to which the energy transmitted to said piston across the air space within said bore from said reciprocating piston is supplied, the forward part of said bore having a smaller diameter size than the rearward part, the rearward section of said percussion piston being located within and having a diameter similar to the diameter of the rearward part of said bore and the forward section of said percussion piston being located within and having a diameter similar to the diameter of the forward part of said bore, and seal means positioned within the forward part of said bore and being disposed in sealing engagement with aid percussion piston so that the rearward part of said bore is sealed against the passage of matter along the percussion piston within the forward part of said bore, wherein the improvement comprises means cooperating with said housing at the forward end of said cylinder for positioning a tool relative to the forward end of said percussion piston and for limiting the extent to which the tool extends rearwardly relative to the forward end of said bore within said cylinder, said percussion piston having a rearwardly displaced position spaced from said means and forming in combination therewith a space at the forward end of said bore, and means including a passage for admitting air into the space and for sealing said space against the admission of air during the forward stroke of said percussion piston and for preventing the air from venting through said passage so that due to the forward stroke of said percussion piston the air flow forwardly from said space over the tool and prevents any flow of dust-laden air and the like in the opposite direction over the tool into said space.

2. An electro-pneumatic rock drill, as set forth in claim 1, characterized in that said means for positioning a tool for limiting its rearward movement comprises a tool holder having a bore therethrough, attachment means for securing said tool holder to said rotatable cylinder with its bore in axial alignment with the bore in said cylinder, and an abutment ring at the rearward end of said holder and extending radially inwardly in the bore therethrough for limiting the extent to which a tool can be displaced rearwardly toward said percussion piston mounted in said cylinder.

3. An electro-pneumatic rock drill, as set forth in claim 1, characterized in that said means for admitting air includes an air filter disposed in said passage for the incoming air for removing dust and other deleterious matter.

4. An electro-pneumatic rock drill, as set forth in claim 1, wherein said means for reciprocating said piston comprises a crank shaft driven by said motor, a connecting rod secured at one end to said crank shaft and at its other end to the rearward face of said piston within the rearward part of said bore for reciprocating said piston within said bore in spaced relationship to said percussion piston.

5. An electro-pneumatic rock drill, as set forth in claim 1, wherein said cylinder having an aperture therethrough communicating between the space within said housing and said rearward section of said bore, the aperture being spaced rearwardly from the junction between the forward section and the rearward section of said bore so that the aperture is positioned forwardly of the percussion piston head when the percussion piston is in its rearward position within said cylinder and the aperture communicates with the space located between said percussion piston head and said reciprocating piston when said percussion piston is driven forwardly within said cylinder.

6. An electro-pneumatic rock drill, as set forth in claim 1, characterized in that said means for sealing said space during the forward stroke of said compression piston comprises a resilient ring-shaped member located within said passage for the air entering the space at the forward end of said bore and being arranged so that it seals the passage when said percussion piston is driven forwardly through said cylinder.

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