

[54] **CONSTRAINED LAYER DAMPER AND NOISE SUPPRESSOR FOR A ROCK DRILL STEEL**

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[58] Field of Search **181/33 A, 36 A, 36 R; 30/168; 81/52.3, 52.35; 125/36, 40; 175/327, 414; 299/79**

[56] **References Cited**

UNITED STATES PATENTS

2,685,274	8/1954	Liddicoat.....	181/33 A
2,997,024	8/1961	McLean.....	181/33 A

3,263,770	8/1966	Alm	181/36 R
3,662,855	5/1972	Adams et al.....	181/36 A
3,783,970	1/1974	Danielson	181/36 A

FOREIGN PATENTS OR APPLICATIONS

332,914	7/1930	Great Britain.....	181/33 A
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Primary Examiner—Richard B. Wilkinson

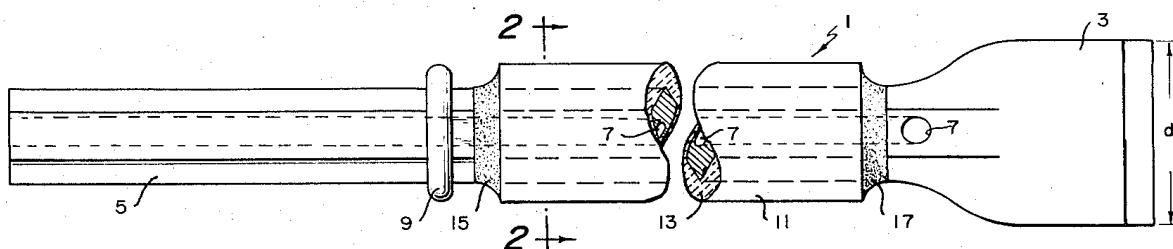
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[57] **ABSTRACT**

A constrained layer damper and noise suppressor which is made an integral part of a rock drill steel shaft. Rearward of the drill bit a viscoelastic layer constituting a damping medium is bonded around the drill steel for a major portion of its length. Coextensive with the outer diameter of this medium a smooth thin walled rigid abrasive resistant tube is bonded. Usually the diameter of the constraint tube is less than the major diameter of the drill bit so the entire invention can penetrate a drilled hole.

5 Claims, 3 Drawing Figures



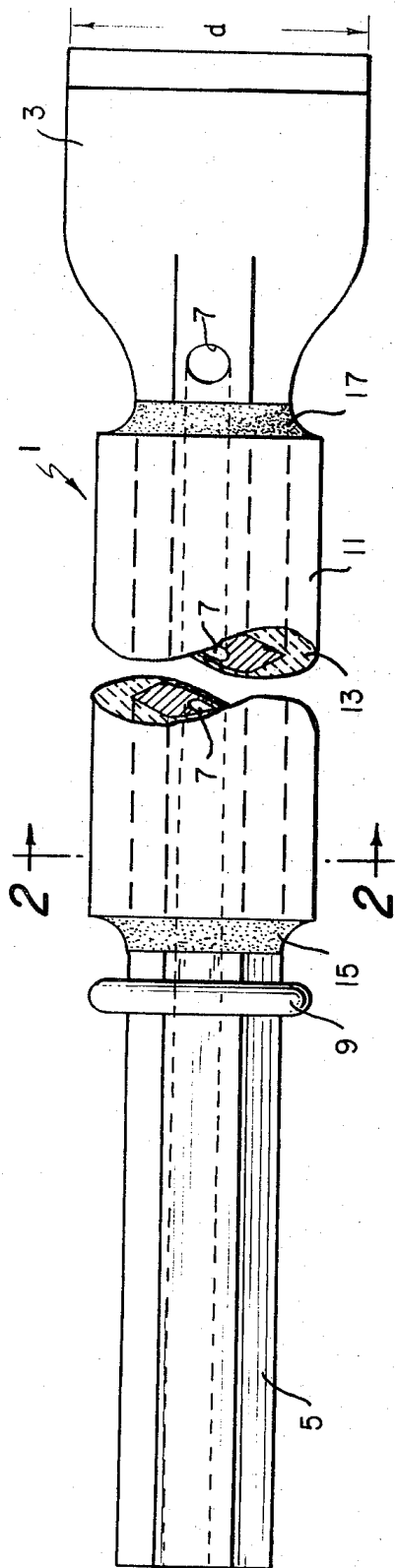


FIG. 1.

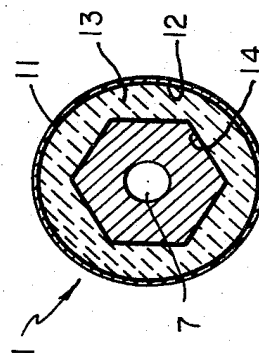


FIG. 2.

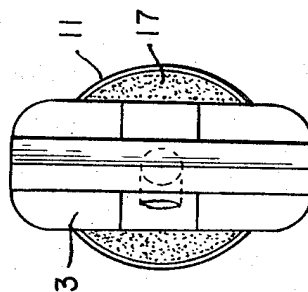


FIG. 3.

CONSTRAINED LAYER DAMPER AND NOISE SUPPRESSOR FOR A ROCK DRILL STEEL

BACKGROUND OF THE INVENTION

This invention relates to an integral constraint layer damper and noise suppressor for a rock drill. More specifically, it relates to such a device in which all components are bonded to the drill steel to form an integral part to reduce resonant vibrations of the drill steel.

In the rock drilling art various devices have been used to reduce the noise associated therewith. When a pneumatic percussion type of drill is involved much of the prior emphasis has been on muffling the air exhaust to reduce the noise level. One example of such a muffler is shown in U.S. Pat. No. 3,225,861 to J. W. Reynolds. However, because of the new stringent requirements for occupational noise level reduction now being imposed by federal law and state law, it now is necessary to not only reduce the noise due to the exhaust but also the noise caused by vibrations set up by the drill itself. The Adams et al U.S. Pat. No. 3,662,855 discloses one way of reducing the noise vibrations of a drill shaft by clamping a rubber collar on the drill steel shaft.

Our invention is an improvement over the prior art which seeks to reduce the noise of a vibrating drill steel shaft. It does this by combining in a single unit integral with the drill steel a damping medium and a rigid outer constraint tube. Compliance with the noise standards can thus be achieved to a greater degree than was heretofore possible at the same time there is little reduction in the practical use of the drill by added weight or obstructions.

SUMMARY

Our invention consists of a smooth rigid, constraint tube which is bonded to and coextensive with the outer surface of a damping medium made of a viscoelastic material. This medium is in turn directly bonded to the drill steel shaft rearward of the drill bit along its longitudinal extent. To allow the tube to enter into a drilled hole its diameter can be made smaller than the major drill bit diameter.

The primary object of this invention is an improved constraint layer damper and noise suppressor for a rock drill steel shaft.

FIG. 1 shows a side view of a drill with our invention.

FIG. 2 is a cross-sectional view along lines 2—2 of FIG. 1.

FIG. 3 is a front view looking from the drill bit end towards the shank.

The elongated drill steel shaft 1 of FIG. 1 has a rear shank portion 5 and a frontal section which is integral with or screwed onto, or otherwise rigidly fixed to a front drill bit 3. Normally, the shank end is held loosely in a chuck attached to the front head of an air cylinder (not shown). A moving piston in the cylinder rapidly strikes the shank end of the drill steel to cause the front drill bit to hammer rock when held thereon. This type of drill hammering action, called a percussion drill, creates a great deal of noise as it impacts at a rate of 20 to 50 blows per second against the rock. To create a round hole the chisel shaped bit 3 is rotated by a mechanism like a rifle bar and nut combined with a ratchet and pawl (not shown). The drill steel shaft 1 is gener-

ally hexagonal in cross-section as best shown in FIG. 2. A hole 7 may also run along its longitudinal center line to allow water and air to be sent to the front end of the bit to wash drillings and dust from the drilled hole. A small exit orifice on the bit (FIG. 1) near where the front of the drill steel and bit join allows the water or air to accomplish this purpose. A collar 9 normally encircles the drill steel to maintain proper depth of the shank in the drill.

Our invention essentially consists of a constraint tube 11 that is bonded to a damping medium 13 along its outer surface. The number 12 of FIG. 2 indicates this bond. The medium is in turn bonded around the drill steel substantially its entire length rearward of the drill bit 3. This second bond 14 is also best shown in FIG. 2. In FIG. 1, the tube and medium extend substantially the entire length of the drill steel shaft from the rear end of the drill bit, where it joins the drill steel to the collar 9 that begins the smaller shank portion 5. Two small exposed end segments 15 and 17 of the medium are not covered by the tube to allow freer movement of tube when subjected to the vibratory action of the drill. Normally, the drill steel from the bit to collar is about 2 to 4 feet in length and is almost completely covered by the tube and its underlying damping medium. Drills having such drill steel portions as large as 10 or even 12 feet are known. However, whatever the length our invention can accomplish the same desired result.

The outside constraint tube 11 has a smooth outer surface and a diameter slightly less than the distance d (FIG. 1) of the drill bit. In this way the tube transmits little vibration to the ambient air and can fit into the drilled hole formed by the bit its entire length and not interfere with the depth of rock penetration. Desirably the tube is of a thin walled, hard, rigid and elastic construction which is abrasive resistant. Many materials can fulfill these desired features. Our preferred embodiment uses a round cold drawn tube made of seamless carbon steel with a 1 3/8 inch outer diameter and a 0.049 inch wall thickness. Other sizes, materials, and dimensions are, of course, possible. Whatever the size or material (whether metal, plastic or an alloy), the tube should also be light in weight with the mentioned characteristics of smoothness, rigidity, elasticity, abrasive resistant, and thin walled construction. For example, nonferrous materials would tend to resonate at different frequencies from the drill steel and might therefore act as better vibration dampers. Also these nonferrous metals usually have a higher damping capacity and are as a result more effective. The bonding characteristics of the tube material relative to the medium 13 is also another factor to be considered in selecting a material.

The constrained layer damping medium 13 is usually a viscoelastic material which is bonded to both the tube 11 at bonding layer 12 and drill steel 1 at bonding layer 14. It extends from just short of the collar 9, starting at exposed edge 15, and fills the cavity between the inner diameter of tube 11 and drill steel 1 to where it terminates just short of the drill bit 3 at its other exposed end 17. By viscoelastic material we mean an elastic material that eventually returns from its distorted shape after the distorting force is removed. In returning, however, it is unlike a truly elastic material which returns rapidly because of a time delay built into the material. Our preferred material for this is a material sold under the

trade name of "Flexane 85" by Devcon Corporation of Danvers, Massachusetts. Another way of describing this material used for the medium is to say it is a polymer, like butyl rubber.

Several methods may be utilized to apply the constraint tube to the damping layer medium. They consist of a liquid filling method, an injection filling method, and a swaging method. In the liquid filling method, the constraint tube is first cut to its desired length and the shank of the drill steel shaft is waxed so the polymer of the medium will not adhere to it. A closure plate is next fixed on one end of the tube by welding or inserting a plug. When in a vertical position, the tube is filled by the medium (polymer and catalyst in its liquid state. After a period of time the catalyst acts to aid the hardening of the liquid. Before this happens the drill shaft with its center hole 7 plugged is centered and lowered into the liquid until it rests on the bottom closure plate. After hardening the tube is cut to the desired size and the polymer is removed from the shank portion of the shaft. Injection filling is accomplished by first cutting the tube to its desired length and then providing one or more holes in the tube. Next, the medium is forced under pressure through fittings into these holes. The combination is then forced over the drill rod and in its liquid state until the annular space between the rod and tube is completely filled. After hardening takes place the fittings are removed from the holes. The third method, the swaging method, consists of taking a constraint tube slightly larger in diameter than the final desired size. Butyl rubber such as that used in tire retreading, is applied as a layer to the surface of the drill steel and held in place by a wire or cord. The tube is then slipped over the rubber and reduced in diameter by cold swaging until it is very tight. Heat is applied to this combination in a furnace to vulcanize the rubber to bond it to both the drill steel and tube.

It should be apparent that our invention has some very desirable advantages and characteristics over the prior art. First, because it is bonded to the drill steel shank; it is more effective than a loose cover to dampen the ringing of the steel; it reduces the fatigue resistance of the drill steel; and it cannot be removed by a capricious operator as it is an integral part of the drill steel. Also, our construction allows the invention to go down the drill hole with the drill and at the same time does not interfere with the operator's visibility. Additionally, and perhaps most important, our invention allows com-

pliance with the noise standards established by federal and state laws like the Occupational Safety and Health Act (Walsh-Healey Act) by reducing ambient air vibrations to an acceptable dB (decibel) level. It does this by quelling the resonance vibration and resonance amplification in the drill steel itself.

Our invention should not be limited in its scope or spirit to the specific materials or type of pneumatic rock drill mentioned in the preferred embodiment. Application for its damping principles can be found in other types of drilling operations using vibrating drill shafts whether in the mining, manufacturing, or construction industry. The important thing is not what powers the drill or what it is used for. The important thing is that there is a vibrating drill shaft which has its resonance vibration dampened. In any event, none of the specific disclosed embodiments or disclosed uses should be used to limit the scope and extent of this invention which is to be measured only by the spirit of the claims which follow.

We claim:

1. A combined constrained layer damper and noise suppressor for a rock drill steel shaft comprising:
an elongated drill steel shaft;
a drill bit rigidly fixed at the front end of said shaft;

a viscoelastic layer damping medium bonded around said steel shaft rearward of the drill bit and extending substantially along its entire length; and
a smooth, rigid constraint tube bonded to the outer surface of said medium and coextensive therewith along substantially its entire length, said tube having a wall thickness much less than said medium and less than one tenth its outer diameter.

2. The apparatus of claim 1 wherein said tube is made of a thin walled abrasive resistant metal material.

3. The apparatus of claim 1 wherein said drill bit has a cross section surface dimension such that it is greater in diameter than the cross sectional diameter of said constraint tube.

4. The apparatus of claim 1 wherein there are exposed areas of the damping medium at either end of the constraint tube.

5. The apparatus of claim 2 wherein said viscoelastic layer comprises a butyl rubber composition and said metal tube is made of carbon steel.

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