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Danielson

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[54] **SOUND ATTENUATING DEVICE FOR A WORK STEEL OR THE LIKE**

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[52] **U.S. Cl.** ..... **181/33 A,** 181/36 A

[51] **Int. Cl.** **E04b 1/99**

[58] **Field of Search** ..... 181/33 A, 36 R, 36 A, 181/36 B; 173/139; 279/19.5, 19.6, 19.7

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[57] **ABSTRACT**

A sound attenuating device for a work steel or other tool subject to impact blows during the operation thereof is disclosed, wherein a metal sleeve encircles a portion of the body of the steel and a quantity of elastomeric material is provided in the clearance between the sleeve and steel so as to fill such clearance and engage both the exterior of the steel and the interior of the sleeve.

12 Claims, 10 Drawing Figures

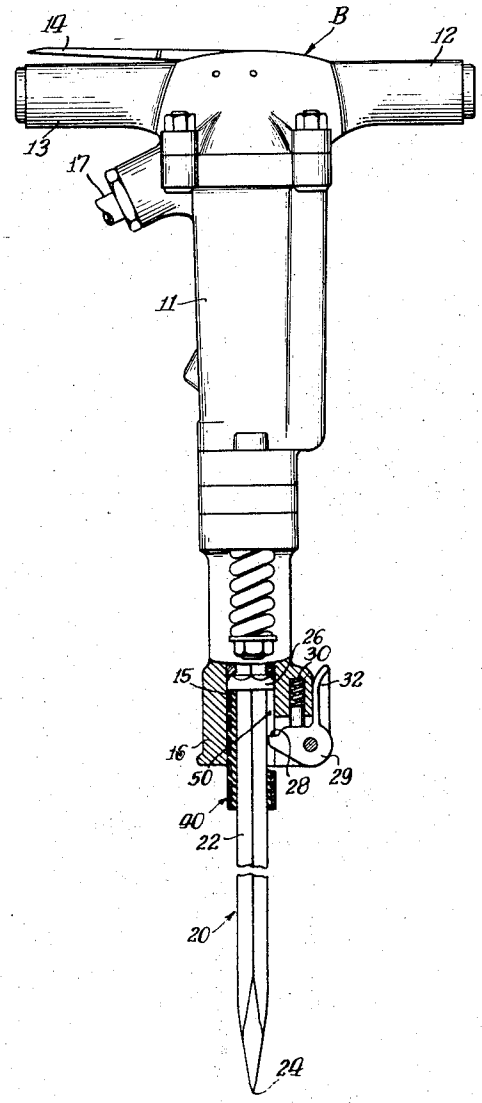


Fig. 1.

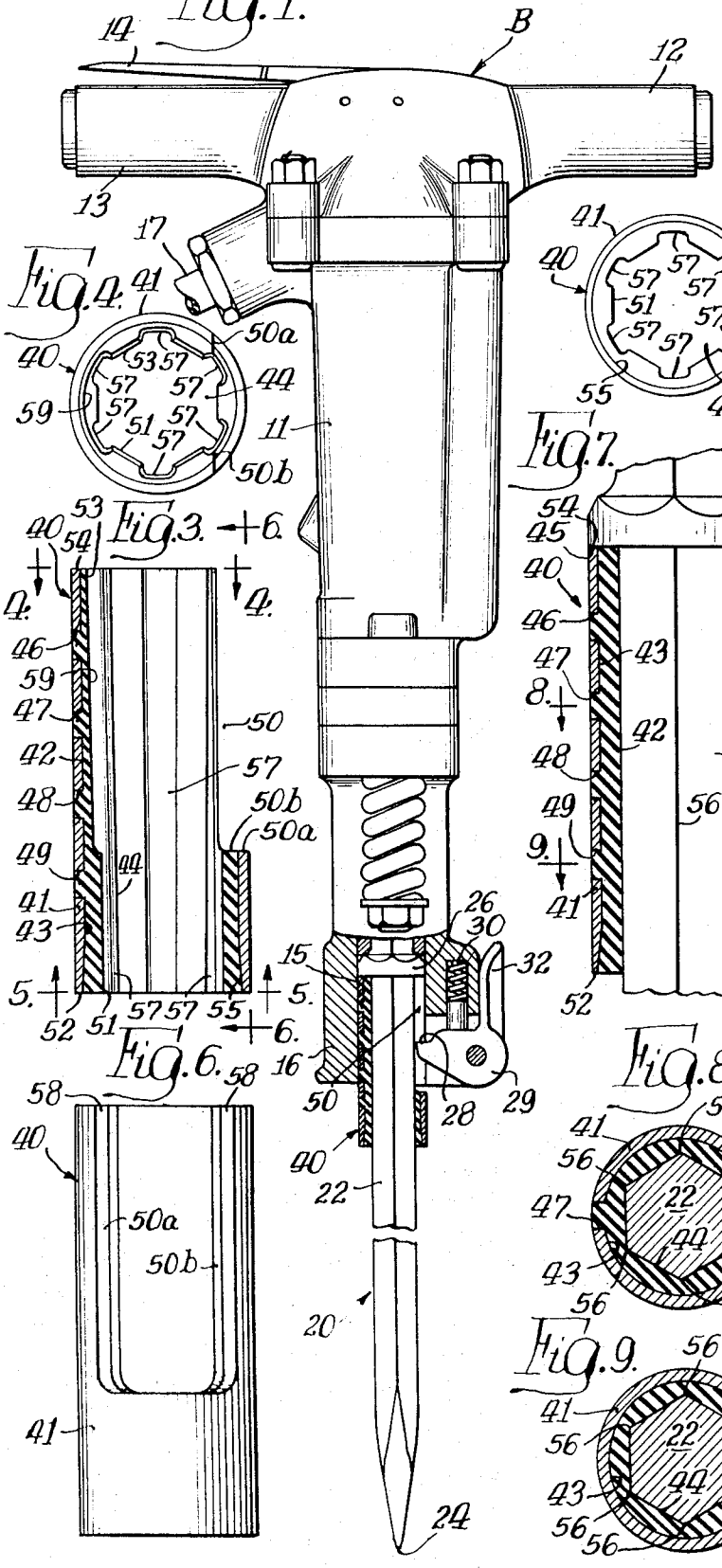


Fig. 2.

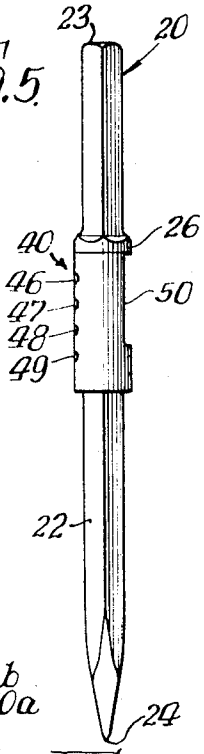


Fig. 4.

Fig. 5.

Fig. 3.

Fig. 7.

Fig. 10.

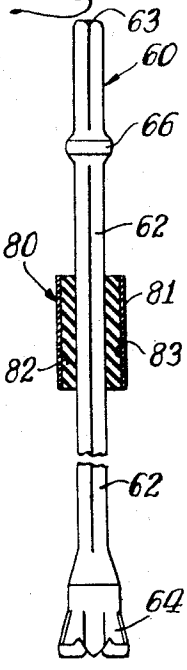


Fig. 6.

Fig. 8.

Fig. 9.

SOUND ATTENUATING DEVICE FOR A WORK STEEL OR THE LIKE

This invention relates to sound attenuating devices and more particularly relates to a sound attenuating device for a work steel or the like.

Paving breakers and other types of devices employing a reciprocating piston to transmit blows to one end of a working element or steel, as they are sometimes referred to, have long been objected to because of the sound levels generated when such devices are in operation. Efforts have heretofore been made to reduce the sound level generated by air exhausting from the cylinder of such devices. And also efforts have been made to reduce the sound generated by the impacts of the piston or tappet of such devices on the work steel However, the devices heretofore advanced have not proved entirely satisfactory for various reasons such as inadequate sound attenuating capability, complexity of construction, and premature failure.

Accordingly, it is a general object of the present invention to provide a sound attenuating device for a work steel or other device of the type adapted to receive blows from an associated impacting device.

A more particular object is to provide a novel sound attenuating device of the foregoing character, which may be removed from the work steel to facilitate the performance of periodic maintenance operations on the steel and then remounted on the same or another steel.

A further object is to provide a novel sound attenuating device of the character described, which is simple in construction, economical to manufacture and effective in operation.

Other objects and advantages of the invention will become apparent from the following detailed description and accompanying sheet of drawings, wherein:

FIG. 1 is a front elevational view, with some parts in section, of a paving breaker having a work steel mounted therein, the latter incorporating a sound attenuating device embodying the features of the present invention;

FIG. 2 is an elevational view, on a reduced scale, of the work steel and sound attenuating device employed in the paving breaker illustrated in FIG. 1;

FIG. 3 is a somewhat enlarged longitudinal sectional view of the sound attenuating device utilized on the work steel shown in FIGS. 1 and 2, and showing the device as it would appear prior to being mounted on the steel;

FIGS. 4 and 5 are end elevational views of the device shown in FIG. 3 and taken on the lines 4—4 and 5—5, respectively, of FIG. 3;

FIG. 6 is a side elevational view, taken on the line 6—6 of FIG. 3;

FIG. 7 is a somewhat enlarged longitudinal sectional view through the sound attenuating device and a portion of the work steel illustrated in FIG. 2;

FIGS. 8 and 9 are cross sectional views taken along the lines 8—8 and 9—9, respectively, of FIG. 7; and

FIG. 10 is a broken elevational view, with a portion thereof in section, of another work steel having another sound attenuating device embodying the features of the invention mounted thereon.

In FIG. 1, an impacting device, in the present instance a pneumatically operated paving breaker, is illustrated and indicated generally at B. The paving breaker B includes an elongated housing 11 having a pair of transversely extending handles 12 and 13 at the upper end thereof, and a throttle lever 14 is pivotally mounted on the upper end of the housing for controlling the operation of the device. A piston (not shown) is reciprocably mounted in a cylinder in the housing 11 for movement toward and away from a reciprocably mounted tappet (also not shown) in the housing 11, the tappet being adapted to engage and impart impact blows to the upper or impact receiving end of a work steel or other implement mounted in an axially extending opening 15 in the lower end, indicated at 16, of the device. Control structure (also not shown) is provided in the housing 11 for effecting continuous reciprocation of the piston in its cylinder as long as the throttle lever 14 is held closed by an operator, and working fluid, such as air under pressure, is supplied to the housing 11 through a pipe 17. A work steel in the form of a moil point 20, for example, is shown mounted in the lower end 16 of the housing 11, the moil point having a sound attenuating device 40 mounted thereon and embodying the features of the present invention.

As best seen in FIG. 2, the moil point 20 includes an elongated metal body 22, hexagonal in cross section and having an upper or impact receiving end 23 and a lower, pointed, working end 24. Retaining structure in the form of a collar 26 is provided on the body 22 intermediate the ends thereof and formed integrally therewith, as by forging. The collar 26 provides a shoulder 27 on the body, which is adapted to be engaged by latching structure carried on the lower end 16 of the housing 11. Such latching structure, in the present instance, comprises one end 28 (FIG. 1) of an L-shaped lever 29 that is pivotally secured to the lower end of the housing. The lever 29 is releasably biased to latching position by spring means 30. The end 28 of the lever 29 thus serves to retain the steel 20 in the lower end 16 of the housing 11 and may be pivoted to a position permitting withdrawal of the steel from the housing by manipulation of a handle portion 32 of the lever.

Referring now to FIGS. 3–6, inclusive, it will be seen that the sound attenuating device 40 comprises a tubular member in the form of a cylindrical, metal sleeve 41 having an inside diameter that is somewhat greater than the outside diameter of the body 22 so as to provide a clearance therebetween when the sleeve is mounted on the body. A sound attenuating material liner 42, preferably an elastomeric such as natural gum rubber, is secured to the inner surface, indicated at 43, of the sleeve 41. The wall thickness of the elastomeric material liner is sufficient to completely fill the clearance between the inner surface 43 of the sleeve 41 and the adjacent outer surface of the body 22 so that substantially complete area contact is obtained between these parts when the device 40 is mounted on the steel. Since the body 22 of the steel 20 is, in the present instance, hexagonal in cross section, the cross-sectional shape of the axially extending opening, indicated at 44, through the elastomeric material is also preferably generally hexagonal.

While the elastomeric material 42 may be applied to the interior of the metal sleeve 41 in various ways, it is preferably injected into the interior of the sleeve through at least one and preferably four axially spaced openings 46–49, inclusive, in the sidewall of the sleeve 41 while the sleeve and an associated core pin (not shown) are in a mold. To this end, a suitable vulcanizing primer is applied to the inner surface 43 of the

sleeve and the sleeve and a core pin (not shown), which extends through the sleeve, are then mounted in the mold. The core pin has a radially enlarged portion which prevents elastomeric material from flowing into and filling a removed or cutout portion, the margin of which is indicated at **50***a* in FIGS. **2–4**, inclusive, and **6–8**, inclusive, of the sleeve and into the area underlying the removed portion of the sleeve when elastomeric material is injected through the openings **46–49**. The margin of the elastomeric material **42** adjacent to the removed portion of the sleeve **41** is indicated at **50***b* in FIGS. **3, 4, 6–8**, inclusive. In this regard, the openings **46–49** are preferably arranged diametrically opposite from the removed portion of the sleeve to provide flow paths of substantially equal length for the elastomeric material flowing into the space between the core pin and sleeve during the molding operation. Thus, the possibility of the formation of splits in the elastomeric material or separation thereof from the sleeve, is minimized. The removed portion of the sleeve **41** and the absence of elastomeric material in the area thereunder provides a "window", indicated generally at **50**, in the side wall of the device **40** which permits the retaining end **28** of the latching lever **29** to engage the shoulder **27** of the collar **26** on the steel when the latter is mounted in the impacting device B.

When natural gum rubber is utilized as the material for the liner **42**, the molding and vulcanizing thereof is preferably done at a temperature and pressure, and a curing time thereof in the mold is utilized, such that the rubber in the completed device will have a durometer of about 70 plus or minus 5 and a maximum compression set of about 11 percent. Compression set is a measure of the ability of a material to return to its original shape or volume after being compressed. It is usually expressed as the percent change in shape or volume that the material undergoes after compression, with respect to the shape or volume of the material as originally formed. By way of example, a molding temperature of about 320° Fahrenheit and a curing time of about 18 minutes have been found to provide the aforementioned properties in the rubber. After molding and curing, the core pin is removed from the device **40** and the latter is then ready for mounting on a steel, the elastomeric material liner **42** being permanently bonded to the inner surface **43** of the sleeve **41**.

In order to provide for the releasable securement of the device **40** to the body **22** of the steel and to improve attenuation of sounds generated by the impacts on the upper end **23** of the steel, at least a portion of the opening **44** through the liner **42** is smaller in cross section than the cross section of the body **22**. Thus, when the device **40** is mounted on the body **20** of the steel, the liner **42** is compressed and the device **40** is frictionally retained on the body **22** and will not shift thereon during normal usage. In this regard, in order to facilitate mounting of the device **40** on the body **22**, which is preferably done by pressing the device onto the body, and to improve retention of the device on the body, the opening **44** is preferably tapered. Such taper preferably extends in a direction such that the smaller end, indicated at **51** in FIGS. **3** and **5**, of the opening **44** is located at one end, in this instance, the lower end **52** of the sleeve **41** and the larger end, indicated at **53** in FIGS. **3** and **4**, of the opening is located at the other or upper end, indicated at **54**, of the sleeve **41**.

Shifting of the device **40** on the body **22** toward the working end **24** of the steel **20** when the steel is in use is further resisted by providing an annular, radially outwardly diverging or flaring portion **55** (FIGS. **3** and **7**) on the inner surface of the sleeve **41**. Thus, when the steel **20** is in use and the device **40** is subjected to inertia or other forces tending to cause movement thereof toward the working end **24** of the steel, the elastomeric material underlying the diverging inner surface portion **55** will be compressed an additional amount as a result of the wedging or clamping action exerted by the diverging surface portion **55** on the underlying elastomeric material. Such compression progressively increases with axial movement of the sleeve **41** toward the working end **24** of the body **22** so that the frictional force in the vicinity of the lower end **52** of the sleeve increases in proportion to the amount of movement of the sleeve **41** toward the working end of the body. Consequently, in normal use, the device **40** will not shift on the body **22** to any significant extent.

As previously mentioned, the sound attenuating device **40** is preferably mounted on the body of a work steel, such as the body **22** of the steel **20**, by pressing the device onto the body. When mounted thereon, the difference in size between the body **22** and opening **44** in the device **40** causes the elastomeric material **42** to be compressed so that the device **40** is frictionally retained on the body. Such compression serves to enhance the sound attenuating characteristics of the device **40** and is preferably about **25** percent. However, since the body **22** is hexagonal, rather than circular, in cross section the body has at least one and specifically six axially extending corner edges **56** adjacent to which the compression of the elastomeric liner **42** could exceed **25** percent. To prevent this, at least one and preferably a plurality of circumferentially spaced, axially extending compression relief grooves **57** are provided in the inner surface of the wall of the liner **42**. The grooves **57** are preferably in substantial radial alignment with the corner edges **56**, and the depth and overall length of the grooves **57** is such as to limit the maximum compression of the rubber of the liner **42** to about 25 percent. However, under some circumstances, the compression of the liner **42** could reach values of up to 40 percent.

Since the sound attenuating device **40** is provided with the window **50** in the side wall thereof to accommodate the retaining end **28** of the latching lever **29** of the associated impacting device B, the reaction force of the elastomeric material of the liner **42** on the opposite side of the body **22** from the window **50** would tend to exert an outward side thrust force on the sleeve **41**. Such side thrust force could cause the device **40** to skew on the body **22** with the result that the upper edges, indicated at **58** in FIG. **6** of the margin **50***a* of the removed portion of the sleeve **41** might diverge so that complete area contact between the inner surface of the liner **42** and the outer surface of the body **22** might not be obtained. Consequently, a substantial loss in the sound attenuating capability of the device **40** might occur. In addition, skewing of the device on the body could cause the upper edge, opposite from the window **50** and indicated at **45** in FIG. **7**, to move outwardly of the periphery of the retainer collar **26** and possibly interfere with the mounting of the steel in the impacting device **10**.

To prevent any of the foregoing from occurring, a recess or cavity, indicated at 59 in FIG. 4, is provided in the material of the liner 42 on the opposite side of the sleeve 41 from the window 50 thereof and having an area substantially equal to the area of the removed portion 50. Consequently, the liner 42 cannot exert any unbalanced side thrust force on the sleeve 41 and the axis of the device 40 will, therefore, at all times remain coincident with that of the body of the steel.

While the sound attenuating device 40 has been heretofore described as being removable from the work steel on which it is mounted, it also is contemplated that the device 40 could be permanently mounted on the steel. In such a construction, a suitable vulcanizing primer would be applied both to the exterior of the body 22 of the steel and to the interior of the sleeve 41. The steel with the sleeve 41 thereon would then be placed in a mold, and a quantity of elastomeric material 42, such as natural gum rubber, would then be injected through the openings 46–49 in the sidewall of the sleeve into the clearance between the body and the sleeve. The elastomeric material 42 would then be vulcanized so as to become permanently bonded both to the inner surface 43 of the sleeve 41 and the outer surface of the body 22. After a suitable curing time the steel, with the sound attenuating device permanently bonded thereto, would then be removed from the mold and the assembly would then be ready for use. In this construction, the elastomeric material 42 would also compressively engage the body 22 of the steel as a result of the vulcanizing step so that the sound attenuating characteristics of the device would be enhanced.

In use, the sound attenuating device 40 is mounted on a work steel, such as the moil point 20, by aligning the larger end 53 of the opening 44 in the elastomeric material 42 with the working end 24 of the steel and then pressing the device 40 onto the body 22 until the upper end 53 of the sleeve 41 engages the lower shoulder 27 of the collar 26. Since the cross section of the opening 44 is smaller than that of the body 22, the device 40 is frictionally retained in position on the steel. In this regard, while the frictional force holding the sound attenuating device 40 on the steel is sufficient to prevent the device from shifting thereon under normal conditions of use, the device 40 can and should be periodically removed from the steel when it becomes necessary to repoint the steel or to perform some other maintenance operation. When the device 40 is remounted, it is desirable to do so with the device in a different rotated position on the body of the steel in order to equalize the wear on the shoulder 27 from the end 28 of the latch lever 29.

For maximum attenuation, the device 40 is preferably positioned on the steel at the point of maximum amplitude of the standing wave generated by the blows on the upper or impact receiving end 23 of the steel. For the moil point 20 illustrated in FIG. 2, the device 40 is preferably positioned on the body 22 of the steel so that the upper end 54 of the sleeve 41 is engaged with or closely adjacent to the shoulder 27 of the collar 26. In other words, the point of maximum amplitude of the standing wave for the moil point 20 is located somewhat below the collar 26. However, if the sound attenuating device 40 were to be used on a steel or other impact type implement having different physical characteristics than the moil point 20, the device 40 might be located in a different position thereon than the position thereof illustrated in FIG. 2.

In FIG. 10, another work steel, in this instance a rock drill 60, is illustrated, and another sound attenuating device 80 embodying the features of the present invention is shown mounted on the elongated shank or body 62 of the drill 60. Only a portion of the drill shank 62 is illustrated in FIG. 10. The drill 60 is conventional to the extent that it includes an upper end 63 that is adapted to receive blows from an associated impact device (not shown) when the drill is mounted therein. A replaceable cutting bit 64 is provided on the lower end of the body 62, and retaining structure in the form of a collar 66 is provided on the body 62 adjacent to the upper end 63 thereof and formed integrally therewith, as by forging. The collar 66 provides an abutment or shoulder which coacts with latching structure (also not shown) in the impacting device to retain the drill engaged therewith.

The sound attenuating device 80 is similar to the device 40 of the previous embodiment in that the device 80 likewise comprises a tubular member in the form of a cylindrical metal sleeve 81 having an inside diameter somewhat greater than the outside diameter of the body 62 so as to provide a clearance therebetween. The sleeve 81 differs from the previous embodiment, however, in that it is of thinner gauge material than the sleeve 41. The reason for this is that the metal sleeve 81 does not come into contact with the associated impacting device when the drill 60 is mounted therein and is therefore not subject to wear from the impacting device.

The sound attenuating device 80 is also similar to the device 40 in that a quantity of sound attenuating material 82, preferably an elastomeric such as natural gum rubber, is provided in the clearance between the inner surface, indicated at 83, of the sleeve 81 and the outer surface of the drill body 62 when the device 80 is mounted on the drill 60.

The device 80 differs from the device 40 in that the elastomeric material 82 is bonded both to the inner surface 83 of the sleeve 81 and the outer surface of the drill body 62 so that the device 80 is permanently secured to the drill. To this end, the sleeve 81 of the device 80 is concentrically supported on the drill body 62, and then elastomeric material, such as natural gum rubber, is poured into or otherwise added to the clearance between the sleeve 81 and the body 62 while in a flowable state. Thereafter, the rubber is vulcanized and then allowed to cure to a resilient state. The device 80 is then ready for use. After vulcanizing and curing, the elastomeric material 82 compressively engages the drill body 62 so that the sound attenuating characteristics of the device 80 are enhanced, as in the previous embodiment. Since the sound attenuating device 80 is located below collar 66 and does not contact the latching structure of the associated impacting device, no "window" is provided in the sidewall of the sleeve 81.

As in the previous embodiment, the sound attenuating device 80 is preferably secured to the body 62 of the drill 60 so as to be located at the point of maximum amplitude of the standing wave generated by impacts imparted to the upper or impact receiving end 63 of the drill.

While only two embodiments of the invention have been herein illustrated and described, it will be understood that modifications and variations thereof may be

effected without departing from the concepts of the invention as exemplified in the appended claims.

I claim:

1. A sound attenuating device adapted to be removably mounted on a work steel or the like having an elongated body having a working end and an impact receiving end, said device comprising a tubular member adapted to encircle said body, one end of said tubular member being disposed toward the working end of said body and the other end of said tubular member being disposed toward the impact receiving end of said body when said device is mounted thereon, and an elastomeric material liner secured to the inner surface of said tubular member, the inner surface of said liner defining an opening through said device of generally the same cross sectional shape as the cross sectional shape of said body so that said liner is in substantially complete area contact with said body when said device is mounted thereon, at least a portion of said opening being of smaller cross section than the cross section of said body so that said liner compressively engages said body when mounted thereon, said opening tapering inwardly the full length of said tubular member from said other end of said tubular member toward said one end of said tubular member, whereby the taper of said opening facilitates mounting of said device on said body and the compression of the elastomeric material of said liner serves to releasably retain said device on said body.

2. The sound attenuating device of claim 1, further characterized in that at least a portion diverges radially outwardly toward said one end of said tubular member, said diverging inner surface portion causing elastomeric material underlying said radially outwardly diverging wall surface to be additionally compressed by an amount proportional to the extent of axial movement of said tubular member toward the working end of said steel, whereby axial movement of said tubular member toward said working end of said steel is resisted.

3. The sound attenuating device of claim 1, further characterized in that and the inner surface of the opening in said elastomeric material is provided with at least one compression relief groove into which the elastomeric material may deform, said groove limiting the compression of said elastomeric material to a predetermined value when said device is mounted on said body.

4. The sound attenuating device of claim 3, further characterized in that said groove is sized so that the compression of said elastomeric material does not exceed about 25 percent.

5. The sound attenuating device of claim 3, further characterized in that said body is non-circular in cross section and has at least one corner edge extending lengthwise thereof, and said compression relief groove is located in said elastomeric material so as to be in substantial radial alignment with said corner edge of said body.

6. The sound attenuating device of claim 5, further characterized in that said body is provided with a plurality of said corner edges, and the inner surface of said elastomeric material is provided with a plurality of said relief grooves corresponding to the number of said edges.

7. The sound attenuating device of claim 1, further characterized in that said elastomeric material comprises natural gum rubber.

8. A sound attenuating device for a work steel or the like having an elongated body, said body having a working end and an impact receiving end and retaining structure intermediate said ends, said retaining structure being adapted to be engaged by latching structure carried by an associated impacting device, said device comprising a tubular member adapted to encircle said body and to be positioned thereon closely adjacent to said retaining structure, and an elastomeric material liner on the inner surface of said tubular member and adapted to compressively engage said body when said device is mounted thereon, a portion of said tubular member and said elastomeric material being removed to permit the latching structure of said associated impacting device to engage said retaining structure and thereby releasably retain said steel in said impacting device.

9. The sound attenuating device of claim 8, further characterized in that said tubular member has at least one opening in the side wall thereof to facilitate injection of said elastomeric material into said clearance, and said opening is provided in said tubular member in diametrically spaced relation with respect to the removed portion thereof.

10. The sound attenuating device of claim 9, further characterized in that a plurality of axially spaced openings are provided in said side wall of said tubular member.

11. The sound attenuating device of claim 8, further characterized in that a recess is provided in the inner surface of said elastomeric material opposite from the removed portion of said tubular member, said recess preventing said elastomeric material on the side of said tubular member opposite from the removed portion thereof from exerting an outward thrust force on said side of said tubular member and skewing thereof on said body.

12. The sound attenuating device of claim 11, further characterized in that the area of said recess is substantially equal to the area of the removed portion of said elastomeric material.

* * * * *

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,783,970 Dated January 8, 1974

Inventor(x) IRVIN R. DANIELSON

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 7, line 31, after "portion" should appear --of the inner surface of the wall of said tubular member--.

Signed and sealed this 3rd day of September 1974.

(SEAL)
Attest;

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

PO-1050
(5/69)

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