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SONIC TOOL WITH MEANS FOR REDUCING NOISE LEVEL

Filed Feb. 19, 1968

FIG. 1

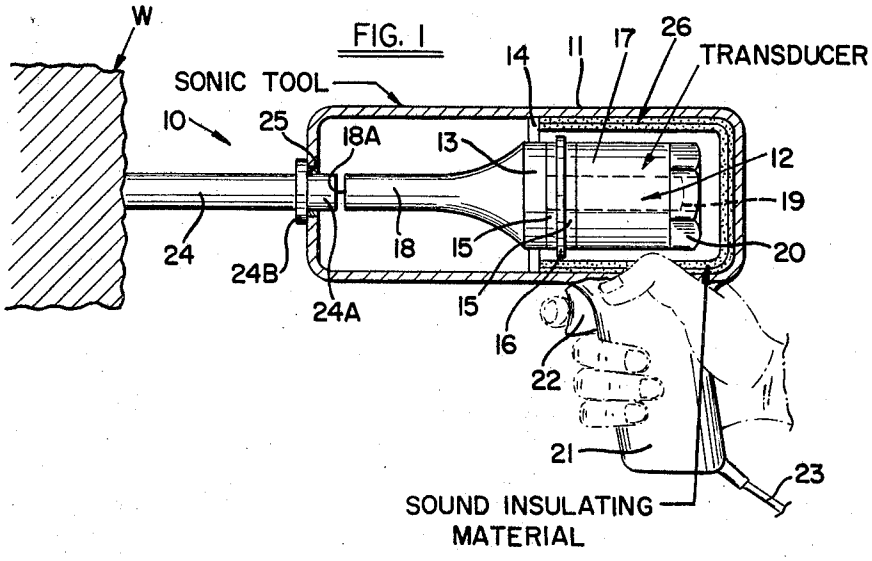


FIG. 2

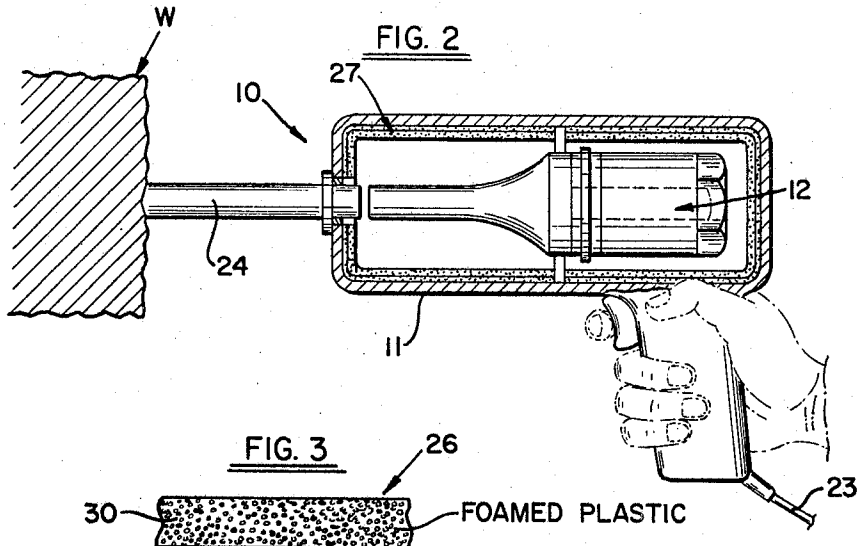
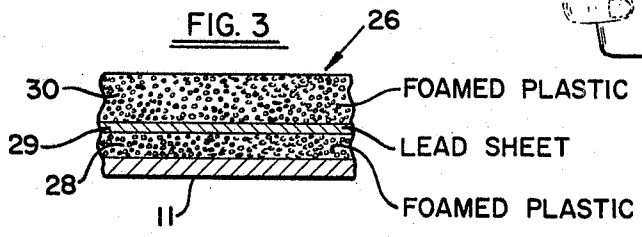


FIG. 3



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SONIC TOOL WITH MEANS FOR REDUCING NOISE LEVEL

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U.S. Cl. 173—117 9 Claims

ABSTRACT OF THE DISCLOSURE

A sonic tool houses a resonant transducer which is adapted for delivering energy to a work-engaging tool element. The transducer exhibits cyclic elastic deformations within the sonic acoustical range. A layer of sound insulating material is provided within the housing for substantially reducing the ambient noise level externally of the sonic tool.

OBJECTS OF THE DISCLOSURE

It is an object of the present invention to substantially reduce the ambient noise level externally of a sonic tool for improved safety and comfort for the operator.

It is another object to provide a layer of sound insulating material arranged against the inner surfaces of the housing for a sonic tool.

It is yet another object to provide a layer of sound insulating material for substantially enclosing the piezoelectric transducer of a sonic tool.

It is a further object to incorporate, within a sonic tool, a layer of sound insulation comprising two layers of foamed plastic with a lead sheet therebetween.

These and other objects of the present invention will become apparent from a reading of the following specification taken in conjunction with the enclosed drawings.

DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side elevation of a portable sonic hand tool, with certain parts broken away and sectioned, illustrating one embodiment of the present invention;

FIGURE 2 is a second embodiment, wherein the layer of sound insulating material is joined to the inner surface of the walled housing substantially throughout the sonic tool; and

FIGURE 3 is an enlargement of a portion of FIGURE 2, showing a preferred form of sound insulating material.

DETAILED DESCRIPTION

With reference to FIGURE 1, there is illustrated a portable sonic (or ultrasonic) hand tool **10** having a generally longitudinal housing **11** within which a resonant means comprising a transducer assembly **12** is disposed. Any type of transducer assembly or means may be employed, but preferably the transducer assembly **12** is of the piezoelectric type and exhibits cyclic elastic deformations within the sonic acoustical range, such as 10,000 cycles per second, during the operation of the tool. Moreover, the construction and theory of operation of the transducer assembly **12** form no part of the present invention, but rather are described more specifically in the McMaster et al. Patent No. 3,368,085, entitled "Sonic Transducer," issued on Feb. 6, 1968.

With this in mind, the transducer assembly **12** comprises an intermediate substantially acoustically-nodal portion **13** secured to the housing as at **14**, a pair of piezoelectric transducer crystals or elements **15**, a contact ring or element **16** between the transducer elements, a spacer portion **17**, a mechanical impedance-transforming horn portion **18** formed integrally with the nodal portion and extending forwardly therefrom, a central bolt portion **19** formed integrally with the nodal portion and extending rearwardly therefrom, the transducer elements and the contact element being piloted on the bolt and electrically insulated therefrom, and nut means **20** engaging the central bolt for retaining the overall assembly and for applying the desired degree of axial compressive bias upon the transducer elements. This compressive clamping of the transducer elements is habitually resorted to in the prior art and is illustrated in the now-expired patents to Heising, No. 2,044,000, and to Burkhardt, No. 2,368,609.

The portable sonic tool **10** further includes a pistol-grip handle **21** adapted to be grasped by the operator for applying the tool to the work W. In lieu of the pistol-grip configuration, any suitable handle means may be provided, or else the tool housing itself could be grasped by the operator. A trigger **22** is provided for controlling the energization of the tool from a line cord **23**, and it will be noted that the electrical connections, being conventional, have been omitted for ease of illustration.

A tool element **24** is provided, which tool element may comprise a masonry-drilling bit, a wood-gouging tool, a scraping blade, or any suitable type of work-engaging element; and preferably, the tool element **24** is loosely (or removably) mounted within a bearing sleeve **25** (or its equivalent) on the housing. The tool element **24** includes a first portion **24A** extending within the tool housing, confronting the end face **18A** of the horn portion **18** of the transducer assembly, and adapted to receive a series of vibratory-type impacts therefrom during the operation of the tool. The tool element further includes a collar portion **24B** which is in abutting engagement with the forward face of the tool housing. Moreover, the impact-receiving portion **24A** is axially positioned with respect to the impact-delivering horn portion **18** of the transducer assembly by a predetermined amount. This amount, in one embodiment, comprises only a few thousandths of an inch; while in another embodiment, the surfaces are just touching each other.

With this arrangement, the forward thrust or bias is exerted by the operator on the handle **21**, through the housing **11** to the collar **24B** on the tool element **24**, and through the tool element directly to the work. Thus, any variations or excesses or operator bias are in a sense neutralized; hence are precluded from overloading the transducer and otherwise interfering with the transducer output or efficiency. The construction of the sonic tool **10** and its method of operation are described in detail in the copending Riley et al. application, Ser. No. 705,045, filed February 13, 1968, entitled "Portable Sonic Hand Tool with Means for Reducing the Effects of Operator Bias Upon Transducer Output and Efficiency," and assigned to the assignee of the present invention.

With further reference to FIGURE 1, a layer **26** of sound insulating material is joined (as by a suitable adhesive) to the inner surface of the walled housing **11**, from the intermediate nodal portion **13** of the transducer assembly **12** to the rearward extremity of the tool.

In the embodiment of FIGURE 2, a similar layer **27** of sound insulating material is joined to the inner surface of the walled housing substantially throughout the sonic tool.

The preferred material, with which the improved results have been obtained, is shown in enlarged cross-section in FIGURE 3. The layer (**26** or **27**) comprises a first layer **28** of foamed plastic against the inner surface of the housing wall, a relatively-thin lead sheet **29** against the other side of the first plastic layer **28**, and a second layer **30** of foamed plastic on the other side of the lead sheet. Preferably, the second plastic layer **30** is somewhat thicker than the first layer **28**.

Thus the layer (**26** or **27**) substantially encloses the

transducer, especially the piezoelectric transducing elements **15**, and has been found in practice to substantially reduce the ambient noise level externally of the sonic tool, thereby materially improving the safety, comfort and convenience to the operator of the sonic tool as well as others in the vicinity. In laboratory testing of an embodiment similar to that of FIGURE 2, approximately a 20 decibel reduction in sound (or noise) energy level was obtained.

Obviously, many modifications may be made without departing from the basic spirit of the present invention; and accordingly, within the scope of the appended claims, the invention may be practiced other than has been specifically described herein.

I claim:

1. In a sonic tool having a walled housing, a work-engaging tool element adjacent said housing, a transducer of the piezoelectric type within said housing, said transducer having an intermediate, substantially nodal portion mounted to the housing and further having an impedance-transforming horn portion forwardly of said nodal portion for delivering vibratory energy to said tool element, said transducer exhibiting cyclic elastic deformations within the sonic acoustical range, and sound insulating material mounted within said housing for substantially reducing the ambient noise level externally of said tool, said material comprising a layer of sound-damping material of high density and low stiffness suspended between two layers of sound-absorbent material having low density and low stiffness.

2. The sonic tool of claim **1**, wherein the sound insulating material comprises a layer joined to the inner surface of the walled housing from the intermediate nodal portion of the transducer to the rearward extremity of the tool.

3. The sonic tool of claim **1**, wherein the sound insulating material comprises a layer joined to the inner surface of the walled housing substantially throughout the sonic tool.

4. The sonic tool of claim **1** wherein said sound-damping layer comprises lead and wherein said sound absorbent material comprises plastic.

5. In a sonic tool having a housing, a work-engaging tool element adjacent to the housing, a transducer within the housing for delivering vibratory energy within the sonic acoustical range to the tool element, and a layer of sound insulating material within the housing for substantially reducing the ambient noise level externally of the sonic tool, thereby improving operator safety and convenience, said layer of sound insulating material comprising two layers of plastic with a relatively-thin lead sheet therebetween.

6. In a sonic tool having a walled housing, a work-engaging tool element adjacent said housing, a transducer of the piezoelectric type within said housing, the transducer having an intermediate substantially-nodal portion mounted to the housing and further having an impedance-transforming horn portion forwardly of its nodal portion for delivering vibratory energy to the tool element, the transducer exhibiting cyclic elastic deformations within the sonic acoustical range, and sound insulating material within said housing comprising a first layer of foamed plastic against the inner surface of the walled housing, a relatively-thin lead sheet against the other side of said first plastic layer, and a second layer of foamed plastic on the other side of the lead sheet.

7. In a portable sonic tool having a walled housing, handle means adapted to be grasped by an operator for applying the tools to a workpiece, a transducer mounted within said housing, said transducer exhibiting cyclic elastic deformations within the sonic acoustical range, and a layer of sound insulating material joined to the inner surface of said walled housing and enclosing at least a portion of said transducer to reduce the ambient noise level externally of said tool, said sound insulating material comprising a layer of sound-damping material enclosed between two layers of sound-absorbent material.

8. A portable sonic tool as claimed in claim **7** wherein said sound damping material comprises lead and wherein said sound absorbent material comprises a flexible plastic.

9. In an impact tool having a housing, a work-engaging tool element adjacent to the housing, a transducer within the housing for delivering vibratory energy within the sonic acoustical range to the tool element, and a layer of sound insulating material within the housing for substantially reducing the ambient noise level externally of the impact tool, thereby improving operator safety and convenience, said layer of sound insulating material comprising two layers of sound-absorbent material with a sound-dampening material therebetween.

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U.S. Cl. X.R.

173—171; 175—56; 310—9.1