

[54] HOUSING FOR AN AIR COOLED ENGINE
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[22] Filed: Dec. 4, 1970

FOREIGN PATENTS OR APPLICATIONS

[21] Appl. No.: 95,263

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Related U.S. Application Data

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 Assistant Examiner—John F. Gonzales
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[63] Continuation-in-part of Ser. No. 21,149, March 19, 1970, abandoned, which is a continuation-in-part of Ser. No. 878,304, Nov. 20, 1969, Pat. No. 3,545,565.

[52] U.S. Cl. 181/33 R, 181/33 C, 181/33 K
 [51] Int. Cl. G10k 11/00
 [58] Field of Search 181/33 R, 33 A, 33 B, 181/33 C, 33 HB, 33 G, 33 K; 123/193 CH, 195 C, 198 E, 191 B, 41.16

[57] ABSTRACT

An air cooled internal combustion engine housing having an inner wall, an outer wall spaced from said inner wall to form a cavity therebetween, and a high density metallic material substantially completely filling the cavity between the two walls. Cooling fins are provided on the outer wall to dissipate heat from the engine and a hood having a laminated layer of high density material and an outer protective layer thereon surrounds a portion of the housing.

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11 Claims, 7 Drawing Figures

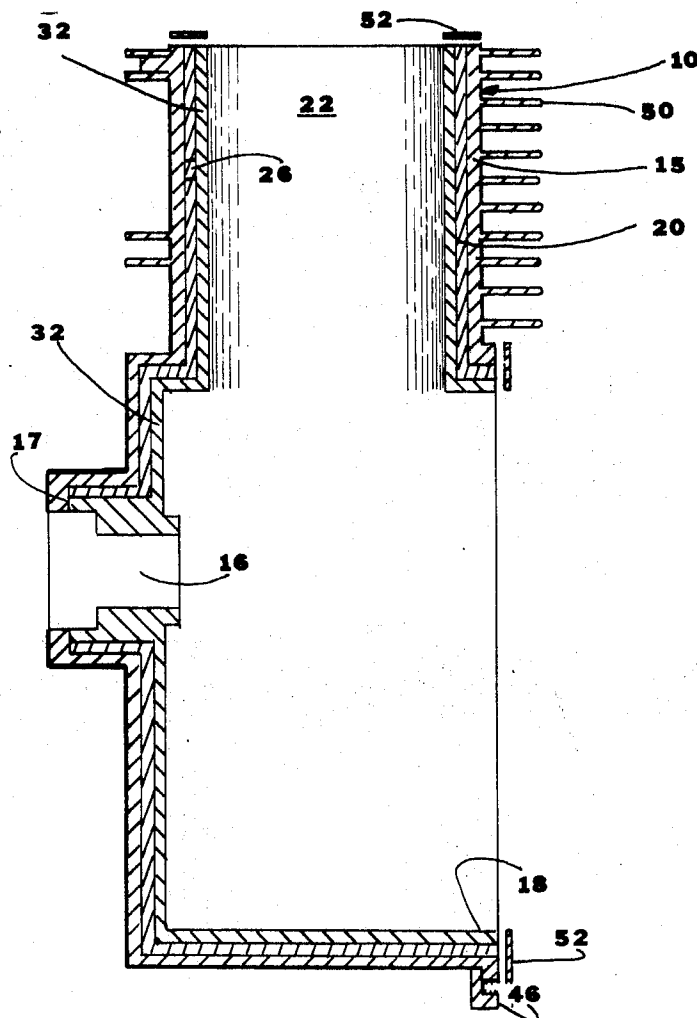


FIG 2

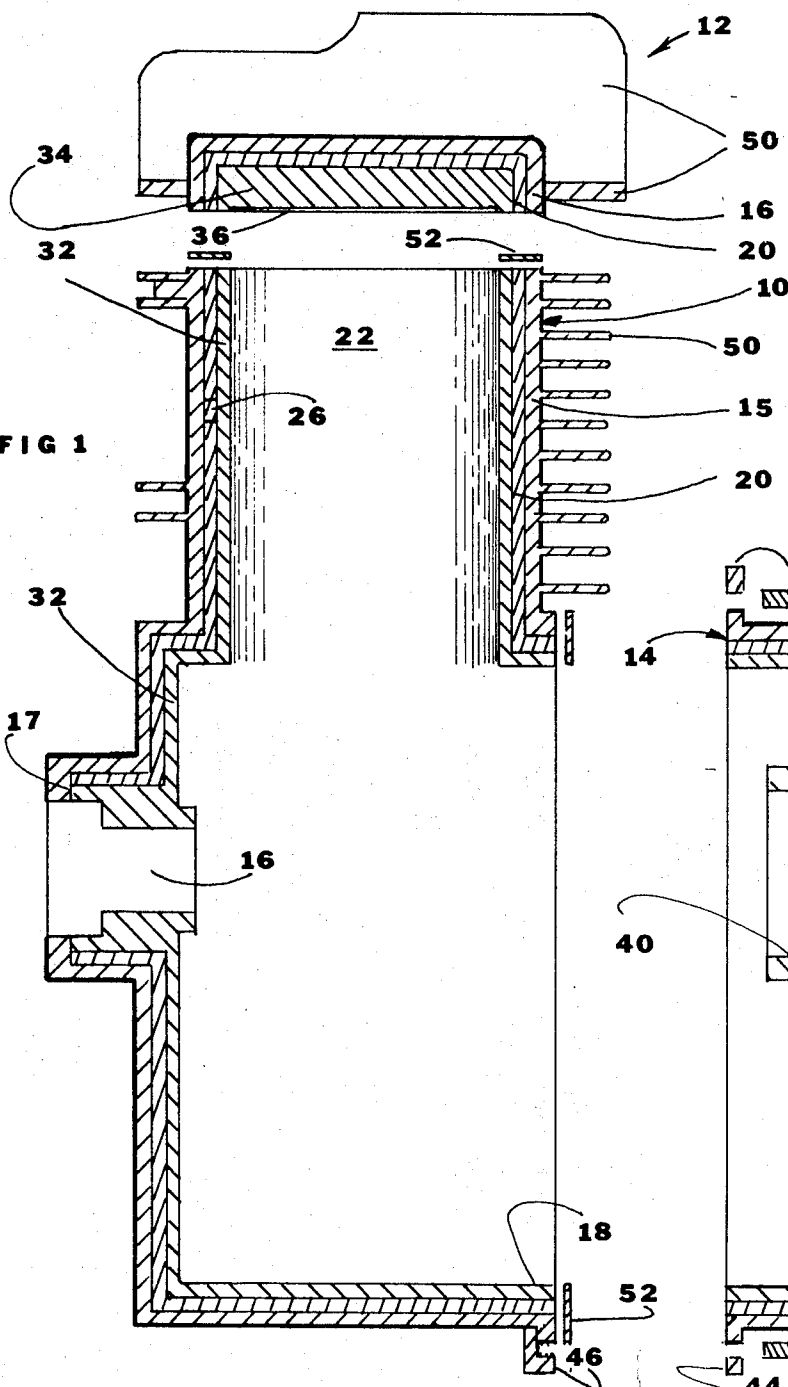


FIG 1

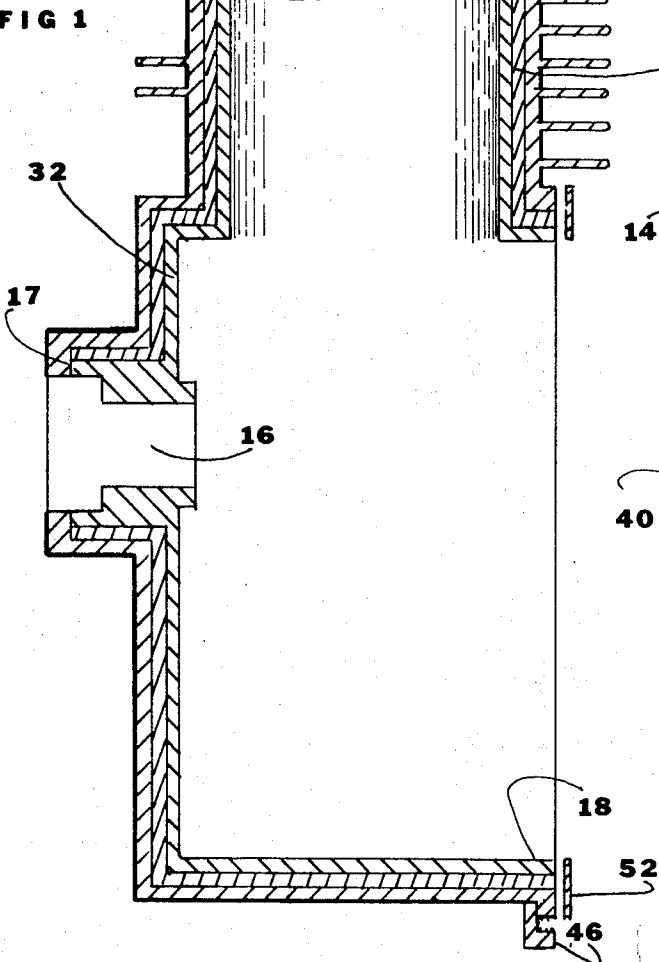
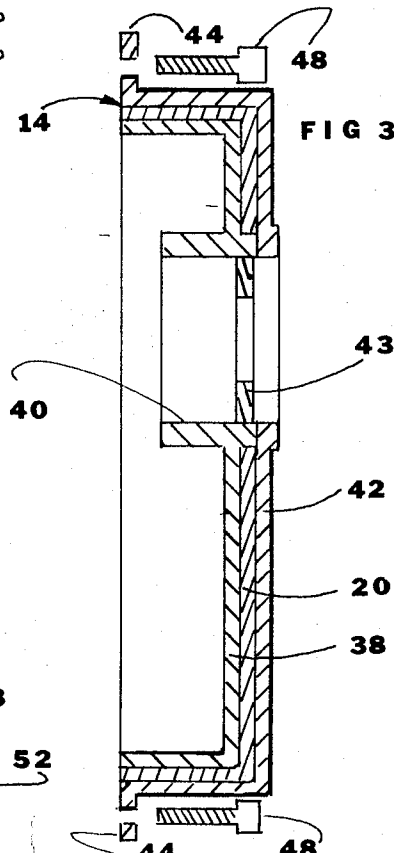
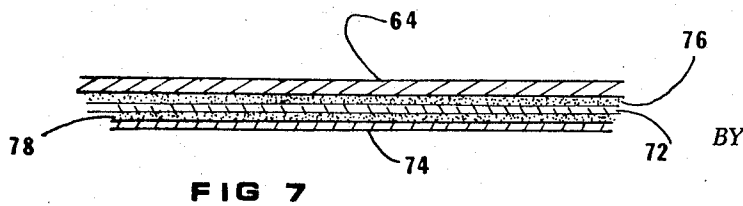
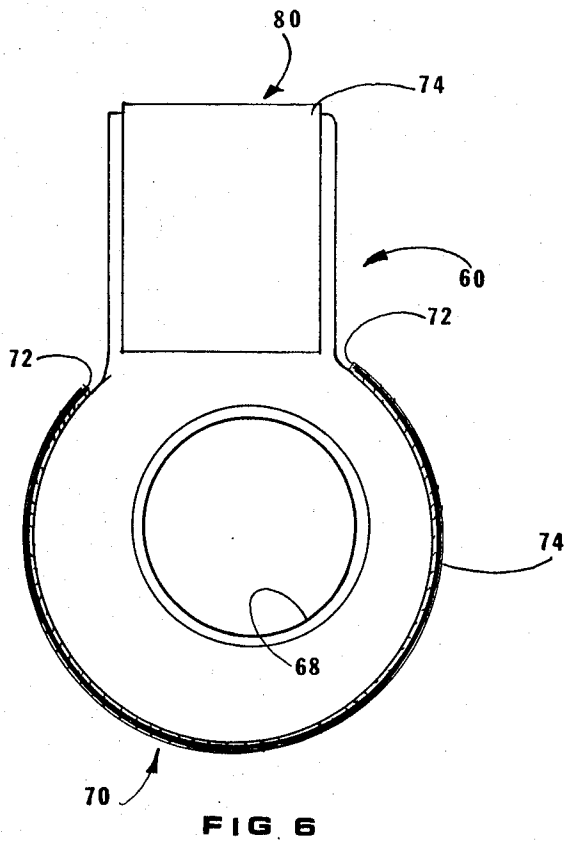
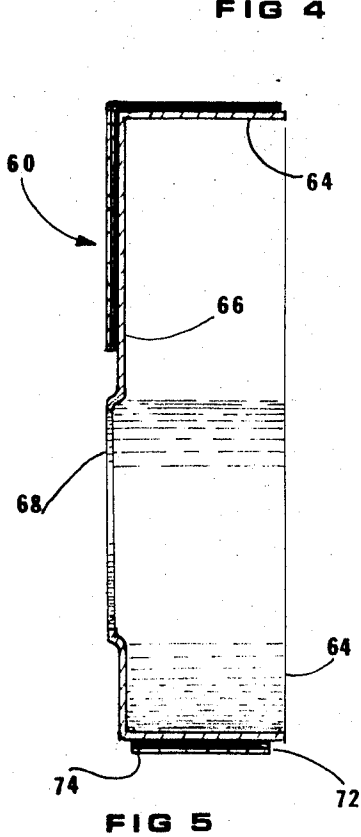
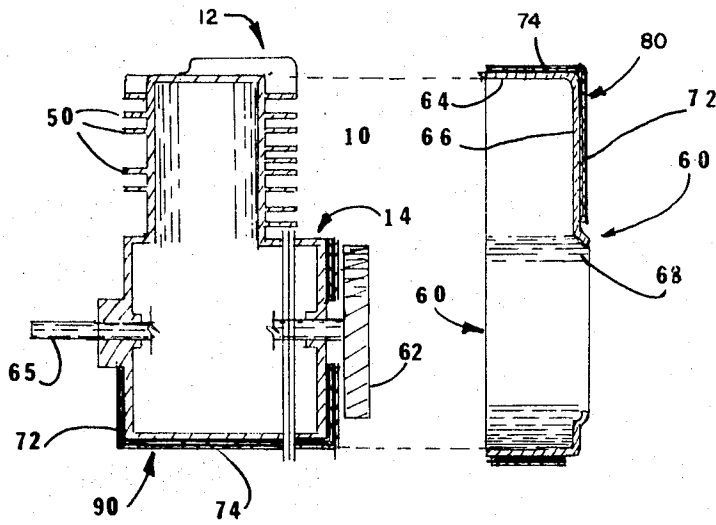


FIG 3





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HOUSING FOR AN AIR COOLED ENGINE

RELATED APPLICATIONS

This application is a continuation-in-part of my copending application Ser. No. 21,149, filed Mar. 19, 1970, entitled "Improved Housing for An Air Cooled Engine", and now abandoned, which is a continuation-in-part of my copending application Ser. No. 878,304, filed Nov. 20, 1969 and entitled "Sound Attenuating Structure," now U.S. Pat. No. 3,545,565.

BACKGROUND OF THE INVENTION

Noise, caused either by structural vibrations or air borne noises originating in an internal combustion engine, has always been an objectionable characteristic of these engines. Such noise has been so great that it is now considered to be a pollutant of our environment. Attenuation of such noises has been concentrated for the most part to noises originating within the exhaust of the engine in the form of mufflers. Little has been accomplished to lower the noises originating in the engine. The noise most commonly attributed to the engine results from vibrations emanating from the surface of the structure which set up air borne noises in the surrounding environment. Structural noises have been eliminated to a considerable extent by the use of vibration isolation mounts.

SUMMARY OF THE INVENTION

The engine housing and surrounding hood of this invention reduce the noise caused both by vibrations of the engine and air borne noises set up within the engine. This is accomplished by securing a layer of high density material to the engine housing walls and the hood and covering the high density material with an outer protective wall to form a laminated type structure which will damp structure borne vibrations and attenuate air borne noises. Lead and lead alloys have been found to be the ideal materials to use since lead has a high density and low modulus of elasticity. The ability of this material to both damp and attenuate noise is enhanced as the operating temperature of the noise source approaches or passes the melting point of the material. In instances where the operating temperature of the noise source does not approach the melting temperature of the lead or lead alloy, the high density material should be brought up to its melting temperature prior to use in order to completely fill the cavity and fuse the material to the two walls. At lower temperature operating conditions, the laminated structure can be secured to the walls by the use of a visco-elastic adhesive.

Other objects and advantages will be apparent from the following description when read in connection with the accompanying drawing.

THE DRAWING

FIG. 1 is a view in section of the main housing of an internal combustion air cooled engine;

FIG. 2 is a view in section of the head of the piston cylinder;

FIG. 3 is a view in section of the end plate for the crankshaft of the housing;

FIG. 4 is a side view in section of the air cooled engine showing the air flow hood removed from the housing;

FIG. 5 is an enlarged view of the air flow hood;

FIG. 6 is an end view of the same hood;

FIG. 7 is an enlarged view of a section of the laminated structure for the hood.

DESCRIPTION OF THE INVENTION

The internal combustion engine housing of this invention generally includes a main housing 10 (FIG. 1), a cylinder head 12 (FIG. 2) and an end plate 14 (FIG. 3). Noise emanating from this housing, whether from structural vibration or air borne noise vibration, is either damped or attenuated by means of a layer of high density metallic material 20 provided between the walls of the main housing 10, cylinder head 12, and end plate 14. The high density material 20 forms an enclosure about the engine and has a capability of becoming limp or liquid at the operating temperature of the engine. It has been determined that the ability of this high density material to melt or to become limp at the operating temperature of the engine could increase the attenuation of the noise from the engine. Although the reason for this possible increase in attenuation capability of the high density material is not known, it is believed to be due to the reduction in the modulus of elasticity when the material approaches the melting temperature.

In accordance with the invention and referring to FIG. 1 of the drawing, the main housing 10 includes an inner metallic shell or wall 32 and an outer metallic shell or wall 15, both of which can be formed in a conventional manner of any of the known engine housing materials such as aluminum. The inner shell 32 includes an opening 16 for the bearing of the crankshaft, an access opening 18, and a piston cylinder 22. The outer shell 15 is formed in half sections which when combined have the same inner shape as the outer surface of the inner shell 32. The outer shell 15 is spaced from the inner shell 32 a distance sufficient to define one or more cavities between the inner shell 32 and the outer shell 15 for the high density material 20. The high density material 20 can be formed in the shape of the outer surface of the inner shell 32 or wrapped about the shell in sheet form to form a laminate. The inner shell 32 is rigidly connected to the outer shell 15 around the opening 16 as indicated at 17. Since it is difficult to achieve absolute control of the width of the cavity between walls 32 and 15, spacer blocks 26, formed as an integral part of the walls, can be provided between the inner wall 32 and the outer wall 15.

The cylinder head 12 includes an inner wall 34 having a recess 36 of substantially an equal diameter to the diameter of the piston cylinder 22 and an outer wall or shell 16. The outer wall 16 is spaced from the inner wall 34 to form a cavity for a high density material 20. The head 12 can also be provided with spacer blocks 26 to maintain an equal spacing between the inner wall 34 and the outer wall 36.

The end plate 14 (FIG. 3) generally includes an inner wall 38 having an opening 40 for a crankcase bearing 43 and an outer wall 42. The outer wall 42 is spaced from the inner wall 38 to form a space for the high density material 20. Means are provided for securing the end plate to the main housing in the form of a flange 44 which is adapted to matingly engage a flange 46 around the opening 18 in the housing. Any means such as bolts 48 can be used to secure the end plate 14 to the housing.

The sound attenuating structure can also be formed as a laminate having a layer of high density material 20

secured to the inner shell 32, inner wall 34 or 38, by a visco-elastic adhesive. The outer shell 15, outer wall 17 or outer wall 42 is secured to the outer surface of the layer of high density material also by a visco-elastic adhesive. The visco-elastic material should have an operating temperature of approximately 300°F. Two visco-elastic adhesive materials which have been found to be satisfactory for this purpose are Nexus P-0003 made by U. S. Steel Corporation and Cybond 4010 made by American Cyanimid. Both of these materials can withstand operating temperatures up to 300° to 400°F.

Means can be provided for dissipating heat from the outer surface of the main housing 10 and cylinder head 12. Such means is in the form of a number of cooling fins 50 provided on the outer surface of the outer wall 15 and outer wall 16.

In FIGS. 4 through 7, the engine housing 10, cylinder head 12 and end plate 14 are shown enclosed in an air flow hood 60. The hood 60 is normally attached or mounted on the housing in a conventional manner and is used to direct cooling air from a fan 62 mounted on the drive shaft 65 through and around the fins 50. The hood 60 since it is attached to the housing 10, has been found to be a source of considerable noise. In accordance with this aspect of the invention, the hood 60 is laminated in the same manner as described above to attenuate this noise.

More particularly, the hood 60 is provided with a contoured side wall 64 and an end wall 66. An opening 68 is provided in the end wall 66 to allow for the admission of air to the fan 62. The bottom of the side wall 64 is treated to reduce noise by means of a laminated structure 70 which includes a layer of high density material 72 in the form of lead and a thin layer of steel 74. Referring to FIG. 7, it should be noted that the material 72 is secured to the outer surface of the side wall by a visco-elastic material 76 as described above. The outer layer of thin steel 74 is secured to the layer of lead also by a visco-elastic material 78.

The upper portion of the side wall 64 and front wall 66 are also covered by means of a laminate structure 80. This structure 80 includes a layer of high density material 72 secured to the outer surface of the hood by a visco-elastic material and an outer thin sheet of steel 74 secured to the sheet of lead by a visco-elastic material.

It should be noted in FIG. 4, that the engine housing 10 shown includes a laminated structure 90 on the bottom only. However, it is within the contemplation of this invention to use a laminated air control hood 60 as described above in combination with an engine housing as disclosed in FIGS. 1 through 3.

ASSEMBLY

The cylinder head 12 is attached to the main housing 10 with the outer and inner walls in mating engagement. Any appropriate means can be used to secure the head 12 to the main housing 10. The end plate 14 is secured to the housing by means of the bolts 48 which are positioned in the flanges 44 and 46, respectively.

Means are provided for sealing the housing 10 to the cylinder head 12 and end plate 14. Such means is in the form of a gasket 52 provided between the cylinder head 12 and housing 10 and between end plate 14 and the housing 10. The gaskets 52 are made from a suitable non-copper material. Expansion and contraction of the lead will be compensated for by means of the small

space remaining at the gasket areas between the walls.

Materials which have been found satisfactory for use as the liner material are lead and lead alloys, lead having a density of approximately 700 lbs. per cubic foot and a melting temperature from 200° to 700°F. depending upon the particular alloy. The lead can be positioned within the cavities formed between the inner and outer walls by merely applying sheets of the lead to the outer surface of the inner wall prior to assembly or by casting the housing with cavities and filling the cavities with liquid lead or lead alloy. If the engine is to operate at temperatures below the melting temperature of the high density material 20, the engine housing should be brought up to the melting temperature in order to melt the lead so that it fuses to the walls and substantially completely fills all the voids in the cavities. A fill port can be provided in the outer shell 16 of the cylinder head 12 to fill the cavity completely.

Although lead has been described as having a density of 700 lbs. per cubic foot, lead alloys having densities of 500 lbs. per cubic foot or higher are considered satisfactory for reducing noise levels. These metallic materials have the capability of becoming liquid at the operating temperature of the engine and are therefore limp to noise vibrations.

In the preferred embodiment of the invention, the inner shell or wall is formed of aluminum. The layer of high density material is thinner than the inner wall and is preferably approximately one-sixteenth inch thick. The outer shell or wall can be formed of the same material as the inner wall, i.e., aluminum, or can be formed from a thin sheet of steel. The basic requirement of good sound damping and sound attenuation is the formation of a laminated structure having a thin core of high density material. Substantially complete bonding or fusing of the surfaces of the core to the inner and outer walls is also required. This can be accomplished by the use of the visco-elastic adhesive or by fusing the core to the walls by the use of a flux.

The laminated structure described herein can also be used to achieve extensional damping of selected areas of the engine housing as well as the air control housing for the engine. Extensional damping refers to the adhering of a vibration absorbing material to a vibrating surface. In this regard, and referring to FIGS. 4 through 7, sheets of lead can be bonded to the outer surface of the engine housing or the air control housing by means of the visco-elastic adhesive material and a sheet of metal such as steel secured to the outer surface of the sheet of lead by means of the visco-elastic material which is the restraining member for shear vibration damping.

Sound attenuation of other parts attached to the engine housing can also be accomplished by securing laminated structures as described to the surface of such parts.

I claim:

1. A sound absorbing housing including a cylinder and a crankcase for an engine, said housing comprising, an inner metallic wall for said engine, a layer of lead having an inner surface in intimate contact with the outer surface of said inner wall, an outer metallic wall having an inner surface in intimate contact with the outer surface of said layer of lead, and means securing said inner and outer walls to said layer of lead to form a sound absorbing lam-

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inate, said layer of lead remaining solid at the operating temperature of said engine.

2. A sound absorbing housing for an engine, said housing comprising an inner metallic wall, a thin layer of metallic material secured to the outer surface of said inner wall, and an outer wall secured to the layer of material to form a laminate, said inner thin layer of metallic material is secured to said inner and outer walls by a visco-elastic adhesive.

3. The housing according to claim 2 wherein said inner and outer walls are formed of aluminum.

4. The housing according to claim 2 wherein said thin layer is formed of a material having a higher density than the density of said inner and outer walls.

5. A sound attenuating structure for an engine, said structure comprising, a laminated housing having an inner wall and an outer wall spaced therefrom,

and a layer of high density metallic material substantially filling the space between said inner and outer walls, a visco elastic material securing the entire inner and outer surfaces of said layer of high density material to the corresponding surfaces of said inner and outer walls,

whereby noises emanating from the engine will be damped and attenuated by the laminated structure.

6. The structure according to claim 5 wherein said high density metallic material contains lead.

7. The structure according to claim 5 including means for dissipating heat from the outer surface of said outer wall.

8. A housing for an internal combustion engine, said housing including an inner metallic shell, an outer metallic shell spaced from said inner shell to form one or more cavities between said shells, a high density metallic material substantially completely filling said cavities and a visco elastic adhesive securing to said material to said sheets.

9. The housing according to claim 8 wherein said metallic material is capable of melting at the operating temperature of the internal combustion engine.

10. A hood for reducing noise emanating from an engine, said hood including a number of walls for enclosing a portion of said engine and a laminate structure secured to said walls, said structure including a layer of lead having a inner surface and an outer surface, adhesive means securing the inner surface to the outer surface of said walls of said hood, an outer layer of high strength material, and adhesive means securing said high strength material to the entire outer surface of said layer of lead.

11. The hood according to claim 10 including a layer of viscoelastic material securing said lead to said hood and a layer of visco-elastic adhesive securing said high strength material to said lead.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,750,842 Dated August 7, 1973

Inventor(s) Horace McCaffrey, Jr.

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

Column 6, line 10, cancel "to" (first occurrence);

Column 6, line 10, cancel "sheets" and substitute ---shells---

Signed and sealed this 18th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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inate, said layer of lead remaining solid at the operating temperature of said engine.

2. A sound absorbing housing for an engine, said housing comprising an inner metallic wall, a thin layer of metallic material secured to the outer surface of said inner wall, and an outer wall secured to the layer of material to form a laminate, said inner thin layer of metallic material is secured to said inner and outer walls by a visco-elastic adhesive.

3. The housing according to claim 2 wherein said inner and outer walls are formed of aluminum.

4. The housing according to claim 2 wherein said thin layer is formed of a material having a higher density than the density of said inner and outer walls.

5. A sound attenuating structure for an engine, said structure comprising,

a laminated housing having an inner wall and an outer wall spaced therefrom, and a layer of high density metallic material substantially filling the space between said inner and outer walls, a visco elastic material securing the entire inner and outer surfaces of said layer of high density material to the corresponding surfaces of said inner and outer walls,

whereby noises emanating from the engine will be damped and attenuated by the laminated structure.

6. The structure according to claim 5 wherein said high density metallic material contains lead.

7. The structure according to claim 5 including means for dissipating heat from the outer surface of said outer wall.

8. A housing for an internal combustion engine, said housing including an inner metallic shell, an outer metallic shell spaced from said inner shell to form one or more cavities between said shells, a high density metallic material substantially completely filling said cavities and a visco elastic adhesive securing to said material to said sheets.

9. The housing according to claim 8 wherein said metallic material is capable of melting at the operating temperature of the internal combustion engine.

10. A hood for reducing noise emanating from an engine, said hood including a number of walls for enclosing a portion of said engine and a laminate structure secured to said walls, said structure including a layer of lead having a inner surface and an outer surface, adhesive means securing the inner surface to the outer surface of said walls of said hood, an outer layer of high strength material, and adhesive means securing said high strength material to the entire outer surface of said layer of lead.

11. The hood according to claim 10 including a layer of viscoelastic material securing said lead to said hood and a layer of visco-elastic adhesive securing said high strength material to said lead.

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