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(54) **AXIALLY DAMPED HYDRAULIC MOUNT ASSEMBLY**

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(57) **ABSTRACT**

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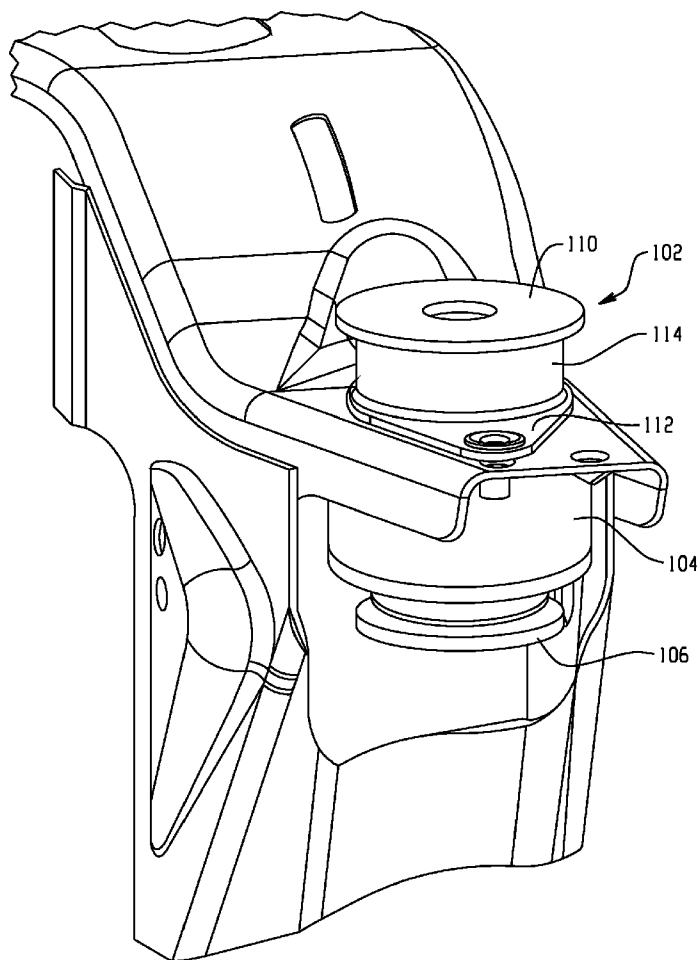
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A hydromount assembly includes a first fluid chamber and a second fluid chamber that communicate with one another through an inertia track. The inertia track is interposed between the first and second fluid chambers, and is used as a fluid actuating plunger to move relative to at least one of the first and second chambers in response to vibration to pump fluid from the first chamber to the second chamber, and vice versa, through the inertia track. An opening extends through the first and second fluid chambers and the inertia track and receives a shaft therein. The inertia track is secured to the shaft so that axial movement of the shaft results in axial movement of the inertia track. Elastomeric portions of the hydromount may be differently tuned from one another. The center mount hydromount may be selectively assembled with a body mount, or the body mount integrated into the hydromount whereby the center mount arrangement increases the functionality of the damper.

Related U.S. Application Data

(60) Provisional application No. 61/026,291, filed on Feb. 5, 2008.



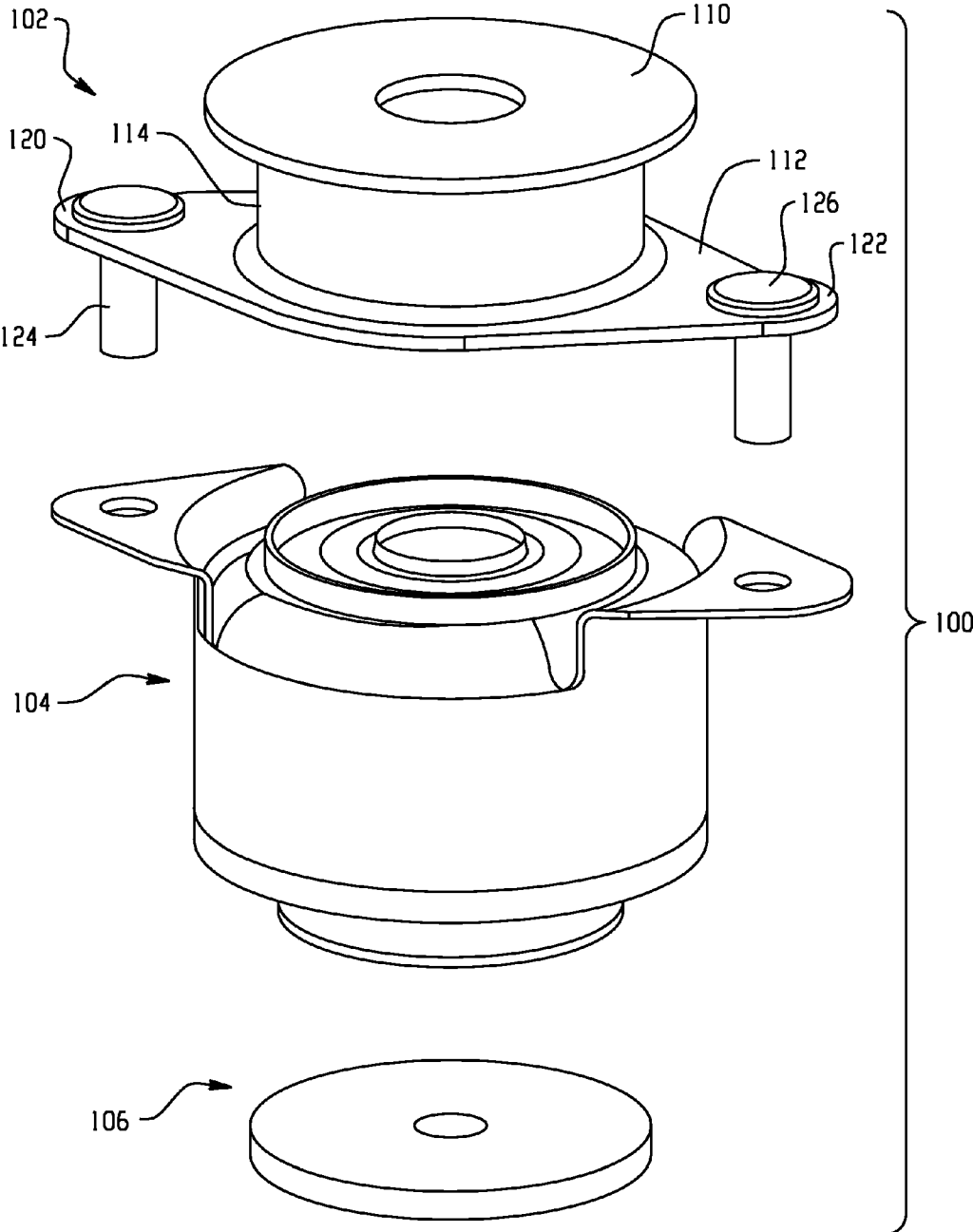


Fig. 1

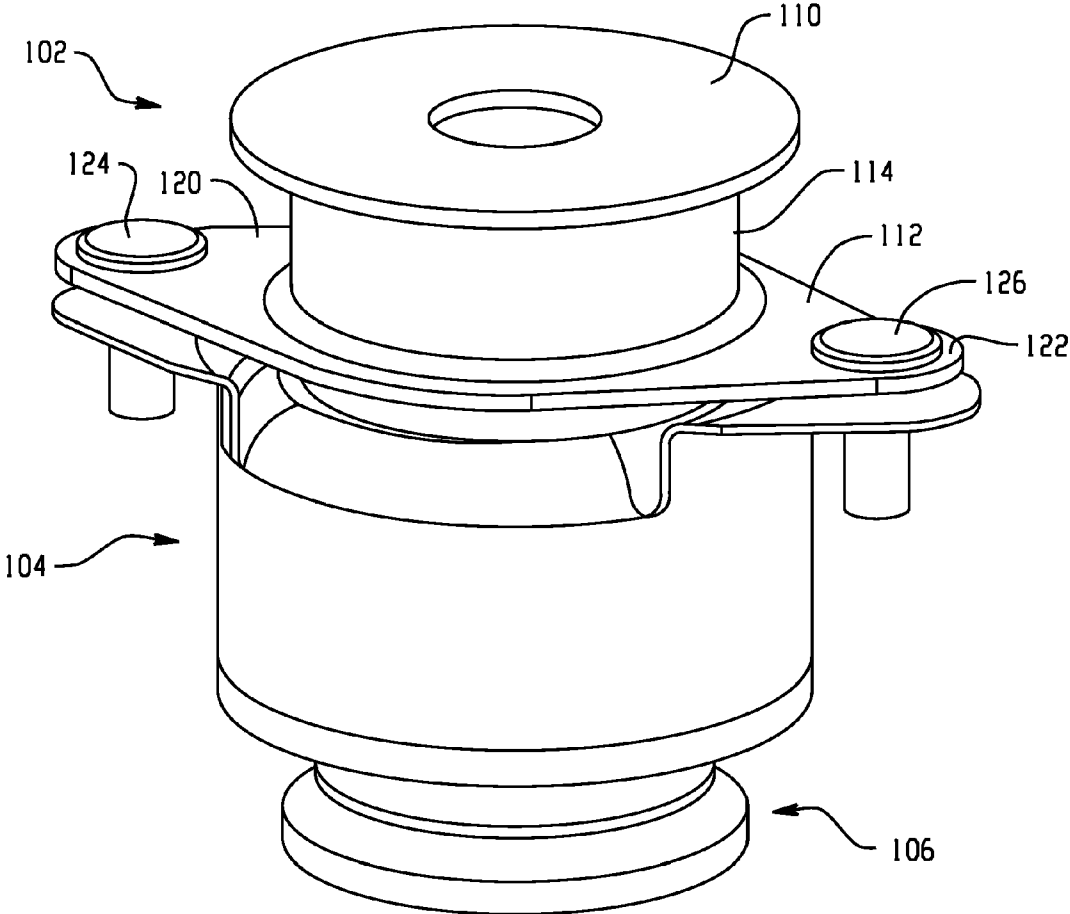


Fig. 2

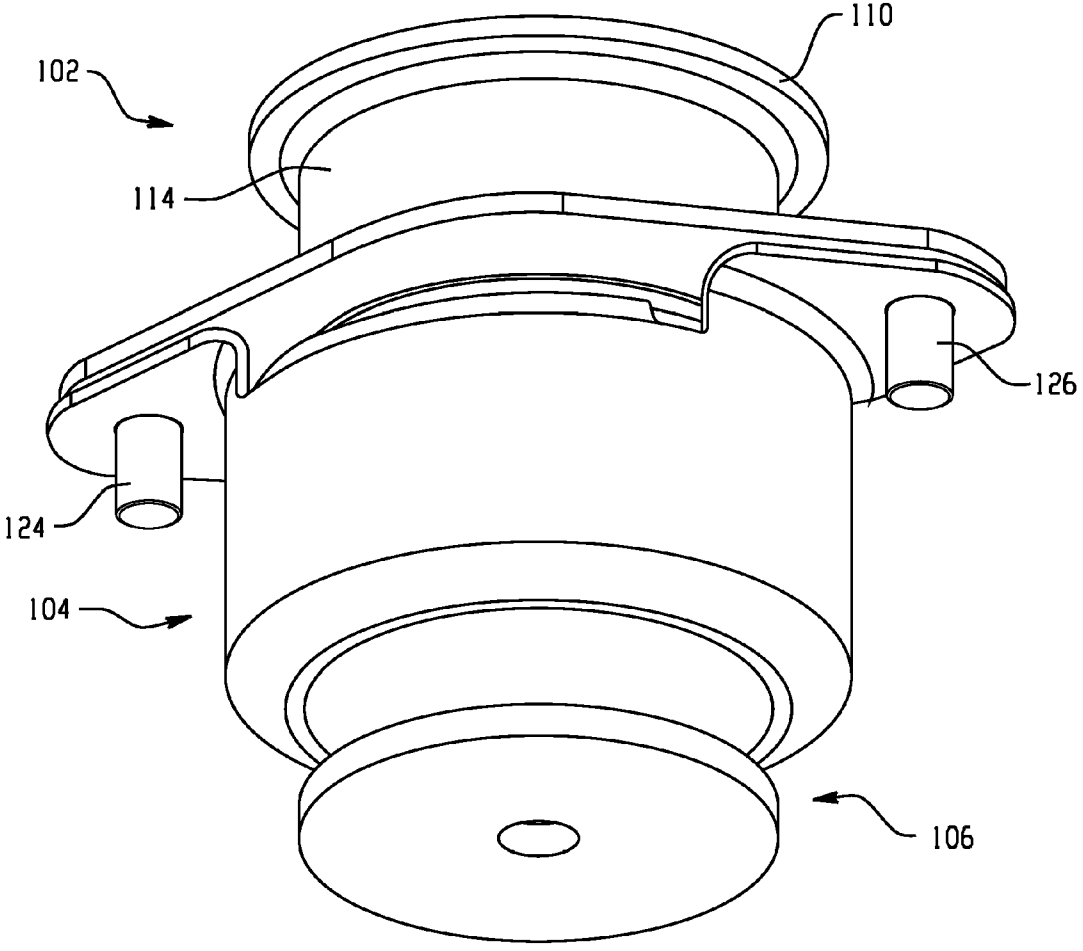


Fig. 3

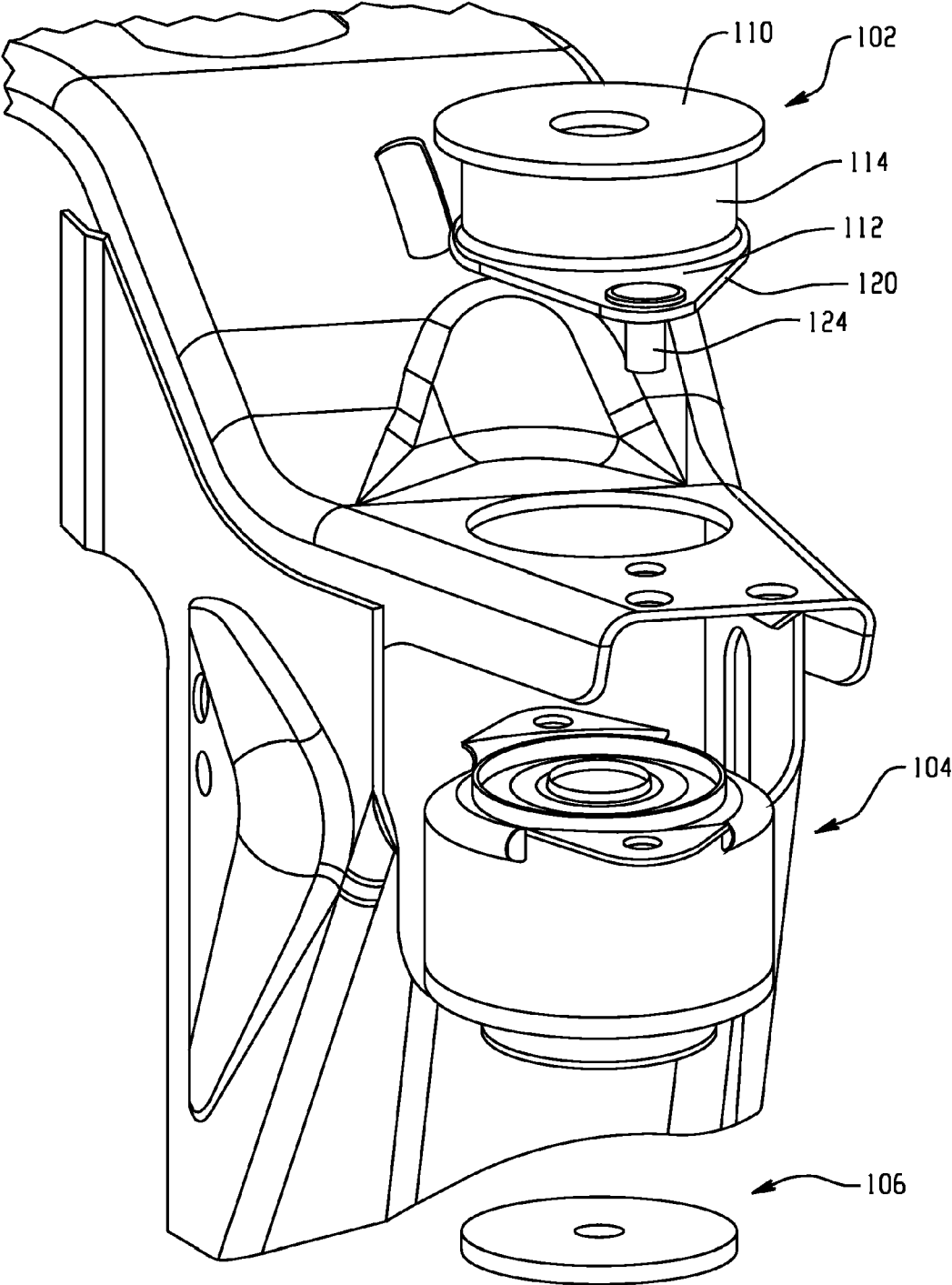


Fig. 4

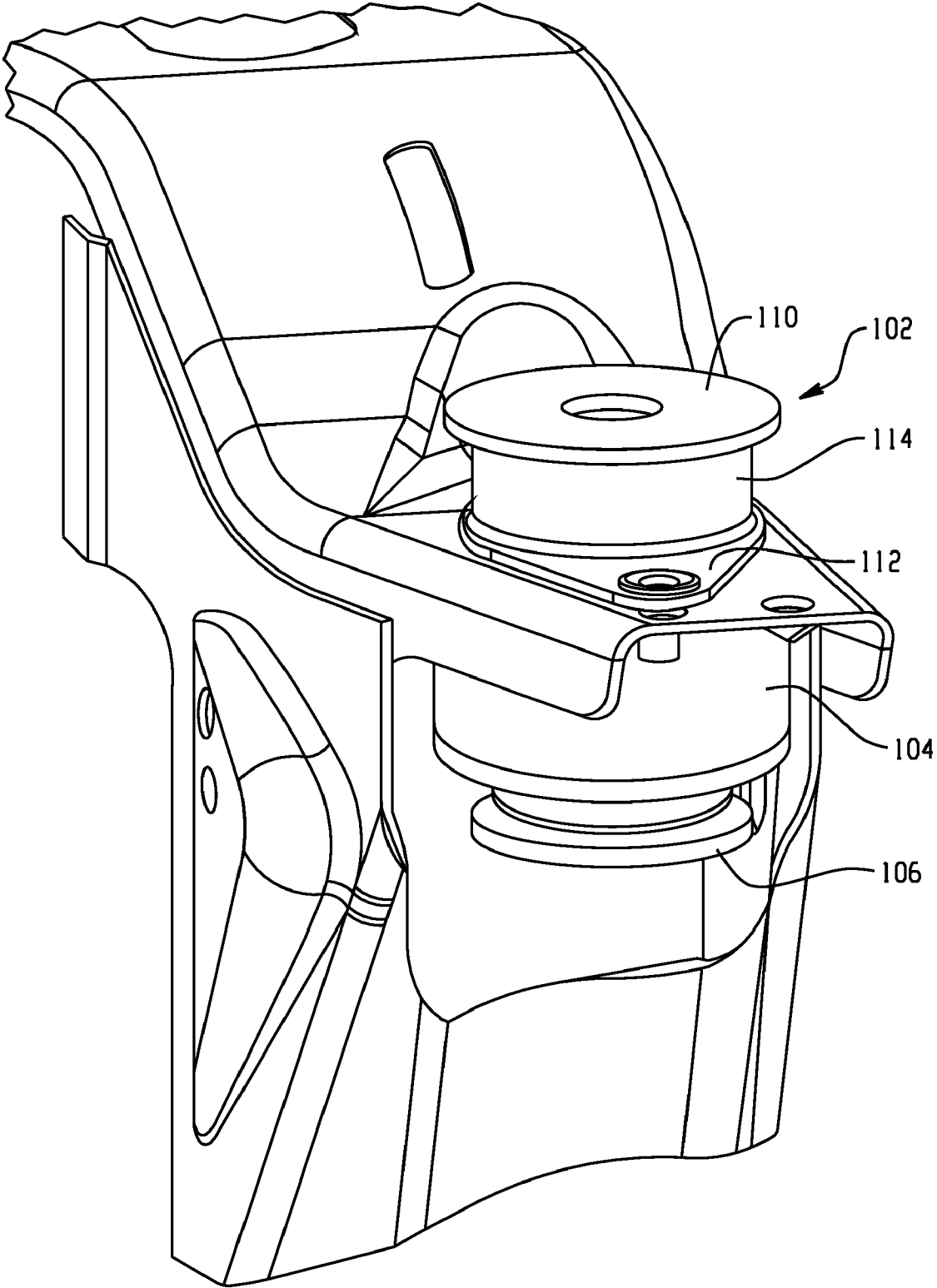


Fig. 5

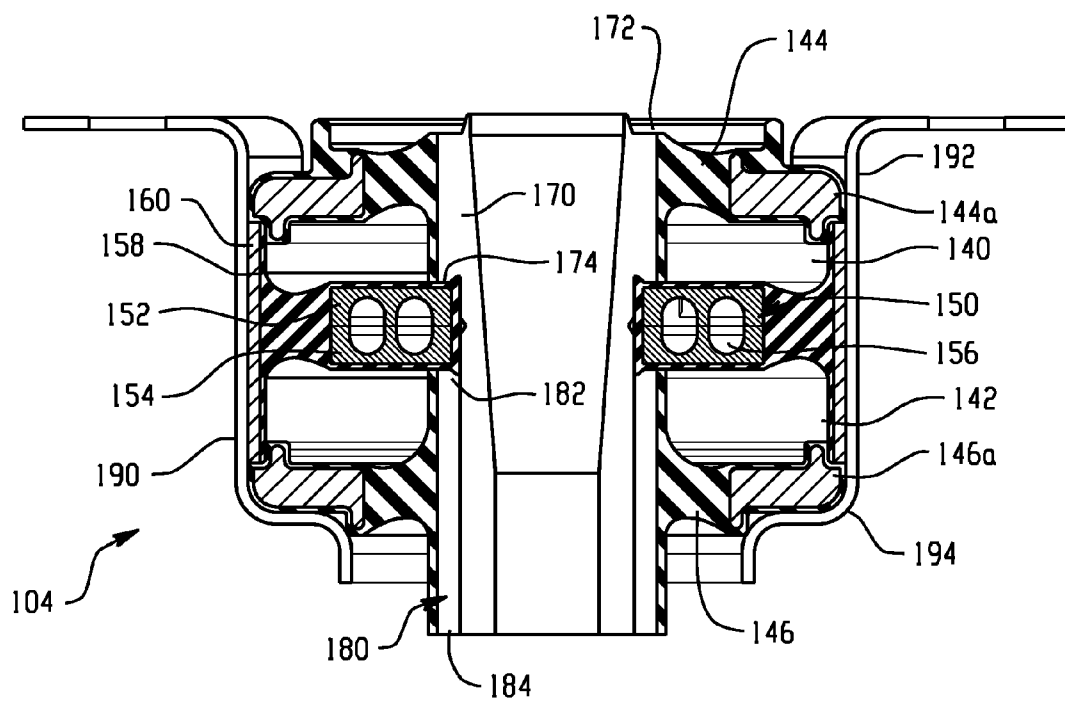


Fig. 6

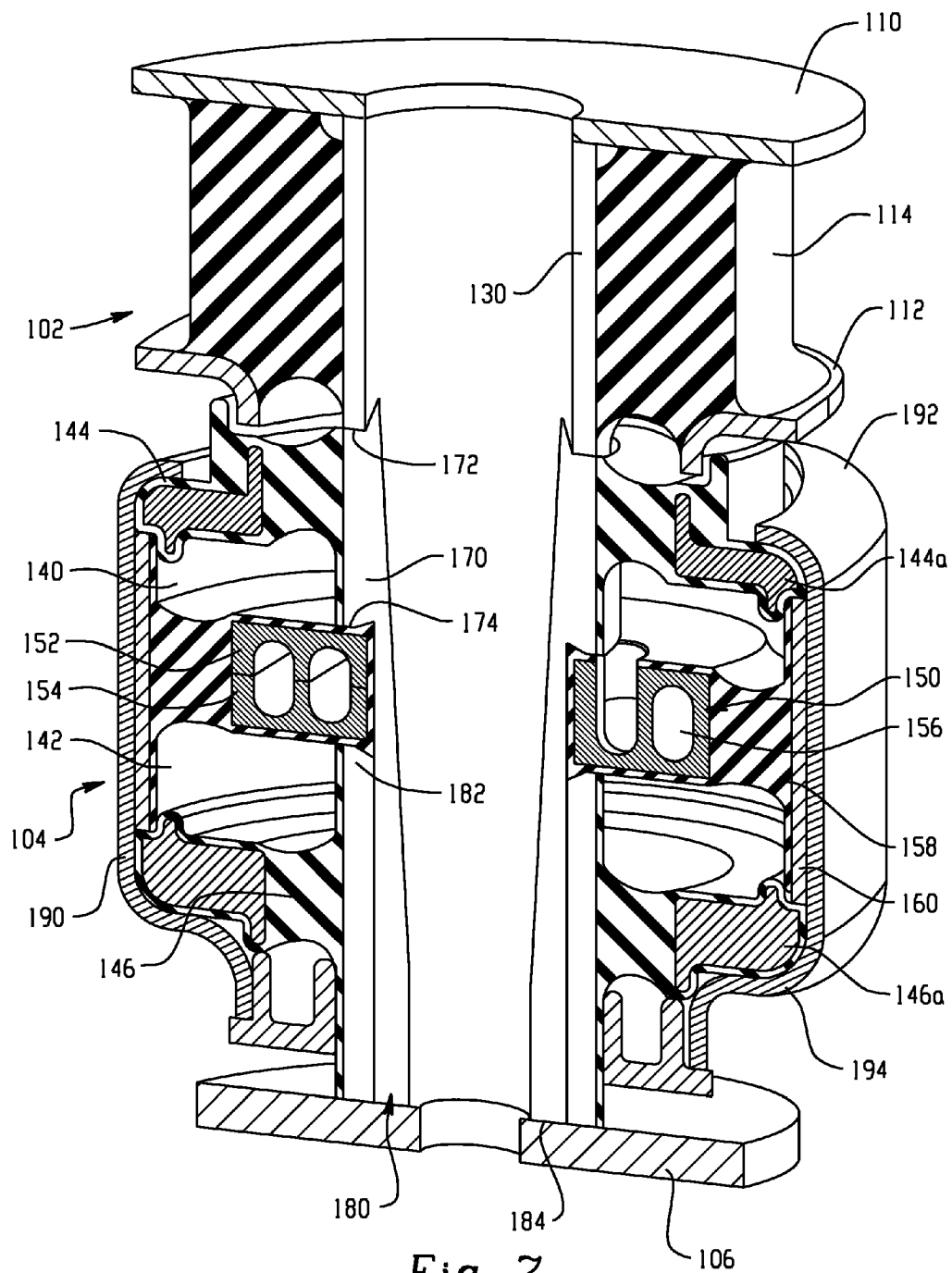


Fig. 7

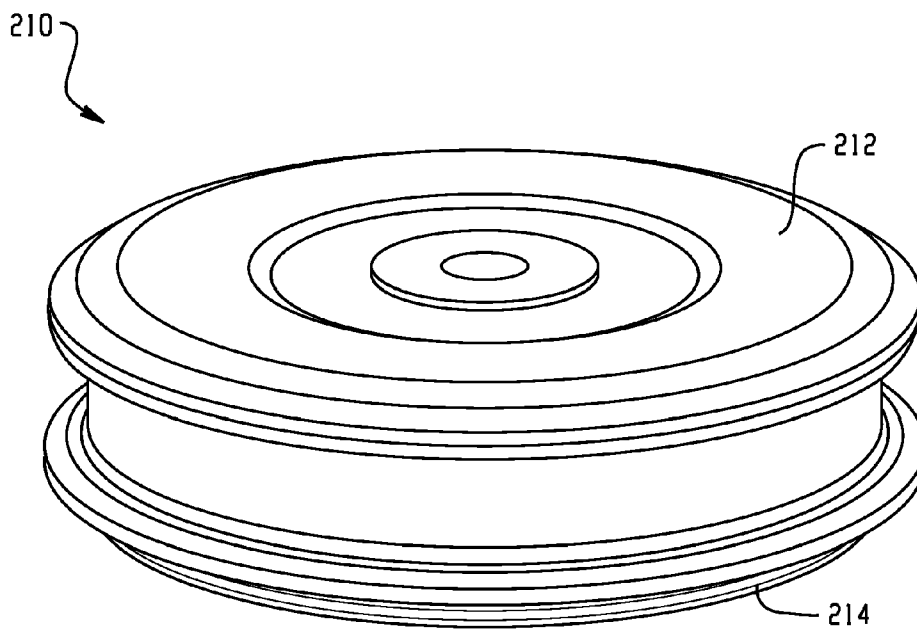


Fig. 8

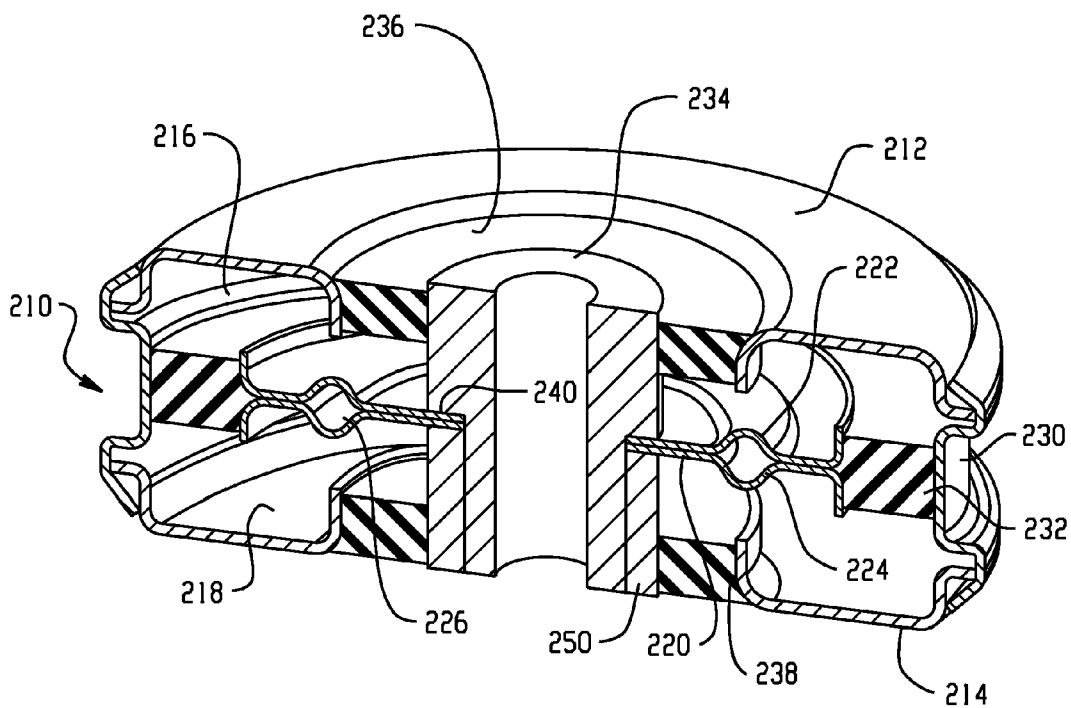


Fig. 9

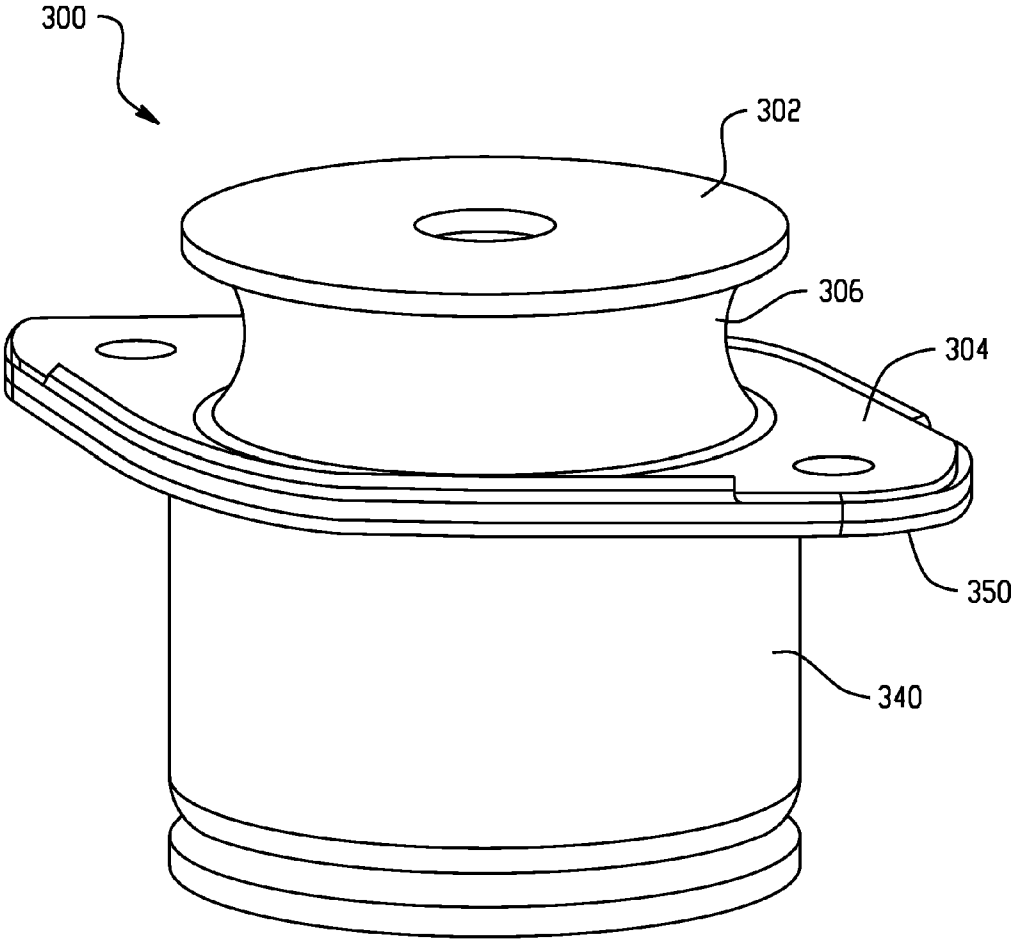


Fig. 10

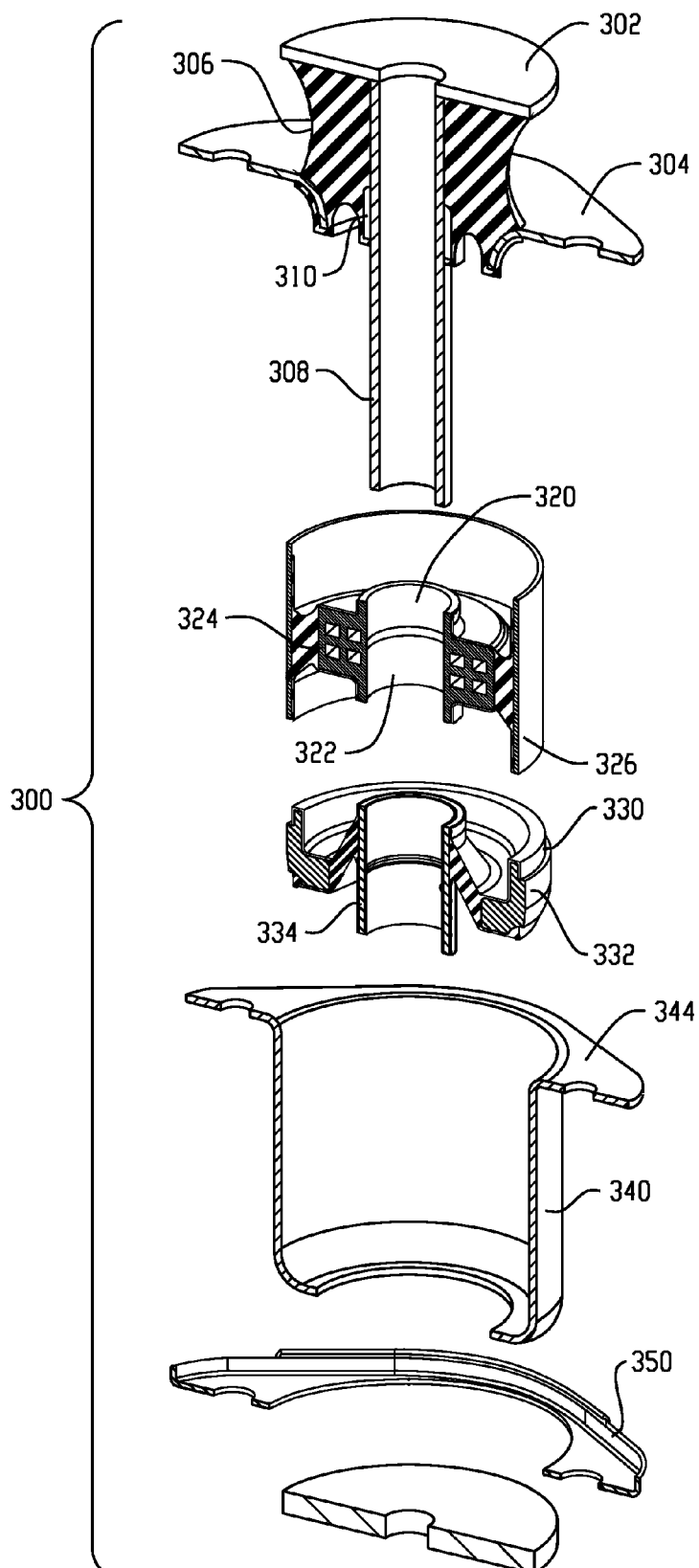


Fig. 11

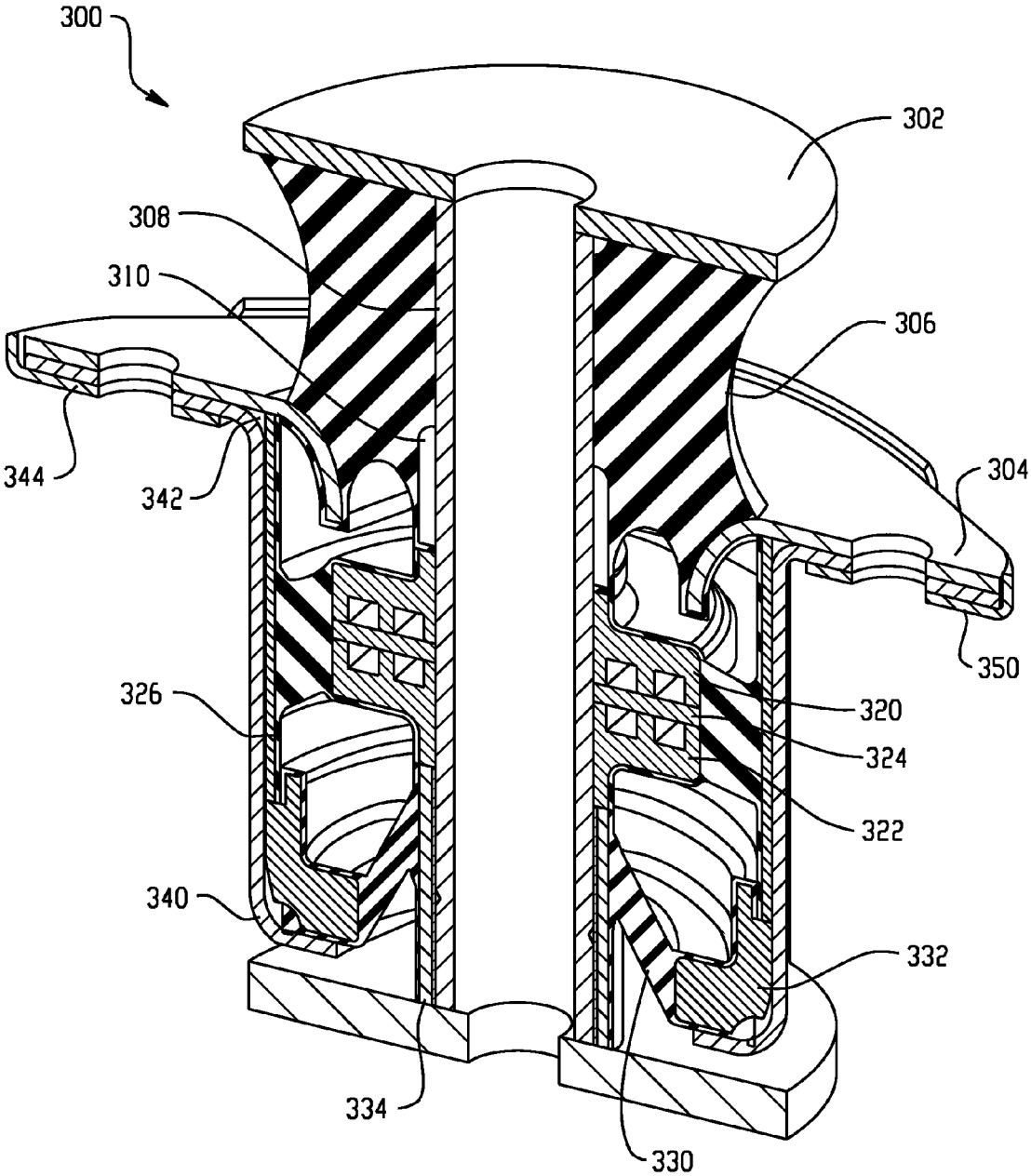


Fig. 12

AXIALLY DAMPED HYDRAULIC MOUNT ASSEMBLY

BACKGROUND OF THE DISCLOSURE

[0001] This disclosure relates to a mount assembly or damper, and particularly a mount assembly that damps vibrations imposed on the assembly in a load bearing environment, including a fluid effect damping that is a combination of frequency dependent resonant damping and broadband viscous damping.

[0002] Assemblies that damp vibrations and relative movement between components are well known. Many of these arrangements use an elastomer or natural rubber material disposed between first and housing portions that are secured to first and second vehicle components. It is desirable to limit vibration from the first component to the second component, for example, between a first component such as an automotive frame and a second component such as an engine. For example, an engine mount assembly includes a first housing portion mounted to the frame and a second housing portion secured to the engine and a material such as an elastomer or rubber interposed between the first and second housing portions that damps the vibrations.

[0003] When a component in a system is excited at its natural frequency, it can begin vibrating at high amplitudes. These high amplitude vibrations can be transferred from the origin of the excitation through a conventional mount to the side of the system where vibrations are not desirable. An axially damped hydraulic mount can be tuned to the natural frequency of the system and can reduce the transfer of vibrations from one side of the system to the other.

[0004] Other axially damped hydraulic mounts are known in the art. Moreover, it is also known to use a true double pumping hydraulic mount in which a hydraulic fluid is selectively conveyed between first (upper) and second (lower) chambers that are interconnected by an elongated path (inertia track). However, these types of hydraulic mounts have some functional limitations because of the need to secure the hydraulic mount via the housing to the surrounding environment.

[0005] It is also desirable to use the mount as a load bearing mount, or in combination with a typical shear style body mount in a rebound application, or an engine mount, or suspension mount application. Further, if used in such a combination, undue complexity in the assembly and sealing should also be avoided.

SUMMARY OF THE DISCLOSURE

[0006] A hydromount assembly includes first and second chambers separated by an inertia track having a passage that communicates with the chambers. An opening through a central portion of the inertia track is dimensioned to receive an associated fastener therethrough.

[0007] A hollow shaft extends through the first and second chambers and the inertia track, such that axial movement of the shaft results in axial movement of the inertia track to selectively pump fluid from one of the first and second fluid chambers to the other of the fluid chambers.

[0008] The inertia track is secured about an outer perimeter portion to an elastomeric material allowing the inertia track to selectively move in response to movement of the shaft that extends through the opening.

[0009] The inertia track preferably includes first and second portions separated along a plane perpendicular to an axis of the central portion opening.

[0010] The inertia track is secured about an outer perimeter portion to an elastomeric material allowing the inertia track to selectively move in response to movement of a shaft extending through the opening.

[0011] First and second, or first, second and third elastomeric elements have the same or different conformations or are formed from the same or a different material than one another.

[0012] A housing is received around the first and second fluid chambers and the inertia track, and a portion of the housing is crimped to compress inner perimeter portions of the inertia track and create a fluid seal.

[0013] An alternate sealing method comprises forming the inertia track from two stamped metal pieces and using the outer metal of the center molded component to crimp the upper and lower molded components.

[0014] A primary benefit of the disclosure relates to mounting through the center of the hydromount to significantly increase the functionality of the damper.

[0015] Another benefit resides in using the inertia track as a plunger that actuates fluids between the first and second fluid chambers to create a frequency dependent fluid effect damping.

[0016] Ease of assembly and a simplified manner of sealing the components together is also provided by the present disclosure.

[0017] Still other features and benefits will be found in the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. 1 is an exploded view of a three piece hydraulic body mount assembly.

[0019] FIGS. 2 and 3 are perspective views of the assembled hydraulic body mount assembly of FIG. 1.

[0020] FIGS. 4 and 5 are exploded and installed views of the hydraulic mount assembly of FIGS. 1-3 in a shear style body mount design.

[0021] FIG. 6 is a longitudinal cross-sectional view of the double pumping hydraulic damper or hydromount assembly.

[0022] FIG. 7 is a longitudinal cross-sectional view of the three-piece hydraulic body mount assembly.

[0023] FIG. 8 is a perspective view of a center-fastened double pumping hydromount assembly.

[0024] FIG. 9 is a longitudinal cross-sectional view of the hydromount assembly of FIG. 8.

[0025] FIG. 10 is a perspective view of another embodiment of a hydraulic body mount assembly.

[0026] FIG. 11 is an exploded view of the mount assembly of FIG. 10.

[0027] FIG. 12 is a longitudinal cross-sectional view of the mount assembly of FIG. 10.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Turning first to FIGS. 1-3, a mount assembly or damper 100 is illustrated. A preferred embodiment of a mount assembly 100 includes a load bearing body mount 102, a hydraulic damper 104, and a travel restricting washer 106. The assembly 100 allows for a fastener such as a bolt (not shown) to pass through the center of the hydraulic damper,

and in this case the body mount, while still creating damping in the axial direction. More particularly, the load bearing body mount **102** includes an upper, first component such as bearing plate **110** spaced from a lower, second component or mounting plate **112**. The load bearing body mount further includes a damping member (sometimes referred to as a main rubber element or MRE) such as an elastomeric material or natural rubber **114** that is secured at opposite ends to the first component **110** and the second component **112**, respectively. For example, the damping member may be mold bonded to the plates **110**, **112** in a manner well known in the art. The mounting plate preferably includes first and second flanges **120**, **122** that extend laterally outward and include openings that receive fasteners **124**, **126**, respectively. As perhaps best evident in FIG. 7, the body mount further includes a central hollow rigid sleeve **130** that extends through the elastomeric member and is mold bonded along an external surface thereof with the elastomeric member. The rigid components of the mount (e.g., plates **110**, **112** and sleeve **130**) are preferably formed from any suitably hard material (composite, aluminum, steel, etc.), and any suitably performing compliant substance (generally referred to as an elastomer which includes an elastomer, natural rubber, etc.) can be used in the compliant portion of the system. The plate **110** and the sleeve **130** are preferably formed from separate metal components that are subsequently joined (e.g., welded) together for ease of assembly, although it will be understood that the sleeve and the plates **110**, **112** may be formed from the same type of rigid material (for example, metal) or from a rigid composite material. Further, the bearing plate **110** and the sleeve **130** could be a deep drawn integral or homogeneous structural arrangement, however, the least expensive arrangement is to form the bearing plate and sleeve as separate components, and subsequently join the individual components together.

[0029] The hydraulic damper or hydromount **104** is illustrated in FIGS. 1-5 and more particular details are shown in the cross-sectional views of FIGS. 6 and 7. The hydraulic damper is a “double pumper” design where hydraulic fluid is forced back and forth by the pumping action of opposing elements, i.e., upper and lower fluid chambers **140**, **142**. The concept of a double pumping hydraulic mount is known in the art; however, what makes this preferred arrangement unique is that the hydraulic damper **104** allows for a fastener such as a mounting bolt (not shown) to extend through the hydraulic damper without adversely impacting the functional operation of the hydraulic damper portion of the assembly. Particularly, in the illustrated preferred embodiment, an upper or first main rubber element (MRE) **144** forms a first or upper end of the upper fluid chamber **140** and similarly a lower or second main rubber element **146** for a first or lower end of the lower fluid chamber **142**. The first and second fluid chambers are separated by an inertia track **150** which is an elongated, preferably serpentine interconnecting passage that ads in damping vibrations between the upper and lower ends of the hydromount. For example, the inertia track is typically a stationary component that has a winding path shown here as being formed from first and second stamped components **152**, **154** that abut against one another, and together form a continuous passage **156**. The passage **156** communicates with the upper fluid chamber **140** at one end and with the lower fluid chamber **142** at the other end. Vibrations are damped by the inertia track in a manner well known in the art and in addition this structural arrangement provides for viscous fluid damping where the fluid flow through the passage is limited due to the cross-

sectional dimension of the passage and thereby provides the viscous fluid damping between the first and second fluid chambers. In the present arrangement, the inertia track **150** is a movable component that spans between the first and second fluid chambers and is resiliently mounted about an outer peripheral portion with elastomer sidewall **158**. The sidewall **158** may be formed at least partially from a rigid component such as a generally cylindrical rigid element or sidewall **160**, and likewise portions of the end **144** of the first fluid chamber **140** and the end **146** of the second fluid chamber **142** may include rigid components **144a**, **146a**. Preferably, however, the remainders of the first and second fluid chambers are formed from an elastomeric/rubber material so that the ends **144**, **146** may selectively move or deflect and cause a pumping action of the fluid through the inertia track passage and between the first and second chambers.

[0030] Further, a rigid inner hollow shaft **170** extends through the hydromount and is adapted to receive a fastener (not shown) therethrough. As seen in FIG. 7, the shaft **170** in the hydromount preferably aligns with the sleeve **130** in the body mount in order to easily assemble these damping components together. An opening through shaft is shown as preferably having a tapered conformation that decreases in size as the shaft extends axially from the first fluid chamber to the second fluid chamber. A first shoulder **172** is dimensioned to abuttingly engage and align the shaft with the sleeve at the upper end of the hydromount. A second shoulder **174** is dimensioned to abuttingly and sealingly engage the inertia track, namely a first or upper surface thereof, at a radial inner location. As a result of molding the inertia track in an elastomeric material, the elastomeric material at this inner radial location serves as a seal between the shaft second shoulder **174** and the inertia track **150**. Similarly, a rigid hollow tube **180** is received over the other end of the shaft so that a first end **182** of the tube seals against a second or underside surface of the inertia track at the inner radial location. In this manner, the first and second fluid chambers are sealed from one another along the inner radial region as a result of the shaft second shoulder and the tube **180**. A second end **184** abuts against the washer **106**.

[0031] The hydromount further includes a rigid, metal housing (sometimes referred to as a can or shell) **190** that encompasses the separately molded first and second main rubber elements **144**, **146** disposed at axial opposite ends of the first and second fluid chambers **140**, **142**, and the separately molded inertia track. Preferably, a first or upper end **192** of the housing sealingly engages the first main rubber element **144** and by deforming or crimping the first end **192** radially inward, the hydromount is sealed at the first/upper end. That is, the housing first end seals against an outer peripheral region of the first main rubber element **144**. An inner peripheral region of the first main rubber element, that preferably includes rigid insert **144a**, is sealed or mold bonded to a radial outer surface of the shaft **170** to form a first subassembly of the hydromount assembly. The second main rubber element **146**, which also preferably includes the rigid insert **146**, is sealed (preferably by mold bonding) to an outer peripheral surface of the tube **180** to form a second subassembly of the hydromount assembly. A second or lower end **194** of the housing receives the second subassembly or second main rubber element therein. Rigid sidewall **160** is connected to an outer periphery of the inertia track via an elastomeric material that is preferably mold bonded thereto to form a third subassembly. The elastomeric material preferably extends along

the entire height or interior surface of the sidewall **160** so that when assembled in the housing, the sidewall forms outer peripheral portions of the first and second fluid chambers and axially spans and seals against the first main rubber element **144** at a first or upper end to the second main rubber element **146** at a second or lower end.

[0032] To assemble the hydromount, the sidewall **160** is advantageously located in a mold with the first and second components **152, 154** of the inertia track to form one of the molded subassemblies. The first main rubber element is molded to an external surface of the shaft to form another of the molded subassemblies. Likewise, the second main rubber element is molded to an external surface of the tube to form still another of the molded subassemblies. The three subassemblies are introduced into the housing one atop another and the second shoulder abuttingly seals against the upper, inner peripheral portion of the inertia track and the tube is pressed over the shaft to compress and seal along a lower, inner peripheral portion of the inertia track. A single deformation or crimp is formed in the housing at the first end **192** with the three subassemblies received in position in the housing to compress the housing against the first main rubber element, and likewise compress the three subassemblies together.

[0033] As illustrated in FIGS. **8** and **9**, an alternative hydromount assembly **210** that a first or upper molded component **212** and a second or lower molded component **214**, that form a first/upper portion of a first fluid chamber **216** and a second/lower portion of a second fluid chamber **218**, respectively. The fluid chambers are in fluid communication via an inertia track **220** that includes first and second stamped metal inertia track portions **222, 224**, for example, that abut one another to form an elongated inertia track passage **226** that communicates with the first fluid chamber at one end and the second fluid chamber at the other end. A third or center molded component **230** is radially spaced and interconnected with the inertia track portions **222, 224** by an annular elastomeric or rubber member **232** that is preferably secured (e.g., mold bonded) along an inner periphery to the metal components and along an outer periphery to the third molded component **230** to form one of the subassemblies. A second molded subassembly includes shaft **234** molded along an outer surface thereof to an inner perimeter portion of a second annular elastomeric/rubber member **236**, and an outer perimeter portion of the second rubber element **236** is mold bonded to the molded component **212** to form a second subassembly. A third annular elastomeric/rubber member **238** is molded along an outer perimeter portion with the inner surface of the second molded component **214** and also molded along an inner perimeter portion with a tube **250**. Further, the shaft includes a shoulder **240** that abuttingly engages and seals with an inner diameter region of the inertia track. Likewise, a sleeve **250** is press fit over the shaft **240** and the sleeve abuttingly engages an underside of the inertia track to seal thereagainst. The center molded component includes flanges at opposite axial ends that are crimped or deformed into locking engagement with outer peripheries of the first and second molded components to hold the three subassemblies together in a single assembly.

[0034] FIGS. **10-12** have similar structures and functions to the previously described embodiments. Again, separately molded subassemblies are compressed together in a housing, although in this arrangement, the body mount is integrated into the first main rubber element. More specifically, body mount **300** includes an upper, first component or bearing plate

302 spaced from a lower, second component of mounting plate **304**. The plates **302, 304** are spaced by a first main rubber element **306** which also serves to form an upper surface of the first fluid chamber. The first main rubber element is molded to the two plates **302, 304**, and also to shaft **308** extending downwardly from a first or lower surface of the plate **302**. If desired, rigid ring member or tube **310** is molded in the rubber element **306** along a lower, inner perimeter portion of the first rubber element.

[0035] The second subassembly includes a three-piece inertia track assembly which extends the length of the passage almost two-fold in comparison to the passages of the prior embodiments by using inner and outer radial passages formed in a first or upper portion **320**, a second or lower portion **322**, and a separating plate **324** that has an opening that connects passage portions in the upper inertia track portion **320** with the passage portions in the lower inertia track portion **322**. Sidewall **326** has an inner surface that is molded to the inertia track assembly by an elastomeric member that preferably encompasses the three-part inertia track assembly.

[0036] The third subassembly includes a second main rubber element **330** that preferably includes a rigid insert **332** along an outer radial portion and is molded to a tube **334** along an inner radial portion. The third subassembly in conjunction with the inertia track portion forms the second or lower fluid chamber.

[0037] Housing **340** receives the third subassembly, then the inertia track subassembly, and then the first subassembly through an open top **342**. The housing further includes a radially extending flange **344** that abuts with a lower or underside surface of the mounting plate **304**. A crimping member **350** then joins the flange **344** and plate **304** together to press the first, second and third subassemblies together in sealed relation in the housing.

[0038] Independent axial dynamic tuning, using the fluid effect of the mount, as deemed necessary by the system in which it is installed can be provided while providing mounting through the center of the shaft, and with the inertia track mounted to the shaft. In these designs, the shaft with through fastener or through bolt is allowed to move relative to the outer housing/third molded component. The inertia track therefore becomes the physical member or plunger that actuates the fluid between the upper and lower chambers thereby creating frequency dependent fluid effect damping. An inertia track also pumps resulting in additional viscous damping. The combination of viscous damping and a tuned track (inertia track) to create simultaneous broad-band and resonating fluid damping is believed to be unique, and substantially different than known hydromounts.

[0039] These multi-piece designs of the assembly allow a great range of rubber tuning as the upper load bearing mount can use a different rubber hardness and/or compound than that of the lower hydraulic damper. For example, butyl rubber could be used in the load bearing body mount and natural rubber could be used in the hydraulic damper, or vice versa.

[0040] A fastener through the center of the mount significantly increases the functionality of the damper. Although these mounts can be used as load bearing mounts, one of the unique characteristics is that the hydromounts could be used in conjunction with a typical shear style body mount in a rebound application. Further applications for these designs as either a load bearing mount, or as an addition to a load bearing mount, are engine mount or suspension mount applications.

These designs also reduce the assembly and sealing complexity that would be expected of center fastening, double pumping, hydraulic mounts.

[0041] As noted above, the axially damped hydraulic mount uses the inertia track as the fluid actuating plunger and allows a fastener to pass through the center of the mount. This axially damped hydraulic mount uses a configuration that allows for the same triaxial static rates and travels as a conventional elastomeric mount. The present disclosure improves the durability of a hydraulic actuated mount by separating the load bearing portion of the mount from the damping (fluid filled) portion of the mount.

[0042] The axially damped, double pumping, hydraulic mount of the present disclosure can be used in applications where higher levels of damping than conventional elastomeric mounts are capable of are required. The embodiments of the present disclosure can be used in applications where the only means of fastening the mount to the system in which it is being used is through the center of the mount. The mount can be used in packaging situations where other mounts would not otherwise fit.

[0043] Additional tuning flexibility is achieved because the three legs or main rubber elements (MRE) can be tuned independently of each other. It will be further understood by those skilled in the art that the shape or conformation of the mount need not be round but can also adopt other shapes, e.g., rectangular, square, etc.

[0044] This hydraulic mount design works well in shear style body mount designs because it allows the hydraulic damping portion of the body mount to be located under the "pedestal" or frame side bracket (see FIGS. 4 and 5 where the hydromount 104 is located beneath the pedestal). This allows for considerable design flexibility for the frame and body structures. It will be appreciated, however, that the hydraulic portion of the mount can also be installed below the vehicle frame bracket.

[0045] The damper of this disclosure also allows for independent axial dynamic tuning, using the fluid effect of the mount as deemed necessary by the system into which it is installed.

[0046] Another key feature of the present disclosure is the ease of assembly and unique sealing method for a double pumping hydraulic mount. The damper portion of the mount is sealed with a single crimp, which compresses the seal on the inner molded components. A tube is pressed over the inner shaft to compress the seals at the inertia track. An alternate sealing method comprises forming the inertia track from two stamped metal pieces and using the outer metal of the center molded component to crimp the upper and lower molded components. A tube press-fit over shaft seals the inertia track.

[0047] The invention has been described with reference to the preferred embodiment. Modifications and alterations will occur to others upon reading and understanding this specification. It is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims or the equivalents thereof.

1. (canceled)

2. The assembly of claim 6 wherein the shaft is a hollow shaft extending through the first and second chambers and the inertia track.

3. The assembly of claim 2 wherein the inertia track is mounted for selective movement relative to the first and second chambers.

4. The assembly of claim 6 wherein the inertia track is mounted for selective movement relative to at least one of the first and second chambers.

5. The assembly of claim 17 wherein the shaft includes a shoulder for sealingly engaging an inner perimeter portion of the inertia track.

6. A hydromount assembly comprising:

first and second chambers separated by an inertia track having a passage that communicates with the chambers; an opening through a central portion of the inertia track dimensioned to receive an associated fastener there-through; and

a shaft including a shoulder for sealingly engaging an inner perimeter portion of the inertia track, wherein a tube is operatively cooperating with the shaft and sealingly engaging the inner perimeter portion of the inertia track.

7. The assembly of claim 6 wherein the shoulder engages a first inner perimeter face of the inertia track and the tube engages a second inner perimeter face of the inertia track.

8. The assembly of claim 6 wherein the inertia track includes first and second portions separated along a plane perpendicular to an axis of the central portion opening.

9. The assembly of claim 6 wherein the inertia track is secured about an outer perimeter portion to an elastomeric material allowing the inertia track to selectively move in response to movement of a shaft extending through the opening.

10. The assembly of claim 6 further comprising a first component having a central portion spaced from the inertia track and forming a first fluid chamber therewith, and a second component having a central portion spaced from the inertia track and forming a second fluid chamber.

11. The assembly of claim 10 further comprising a third component mechanically interconnecting the first and second components.

12. The assembly of claim 6 further comprising first and second elastomeric elements operatively associated with the first and second fluid chambers, respectively.

13. The assembly of claim 12 wherein the first and second elastomeric elements are tuned differently from one another.

14. The assembly of claim 13 wherein the first and second elastomeric elements are tuned by having different conformations.

15. The assembly of claim 13 wherein the first and second elastomeric elements are tuned by being formed from different material.

16. The assembly of claim 12 further comprising a housing encompassing the fluid chambers and sealing the elastomeric elements to the shaft.

17. A hydromount assembly comprising:

first and second chambers separated by an inertia track having a passage that communicates with the chambers; an opening through a central portion of the inertia track dimensioned to receive an associated fastener there-through;

first and second elastomeric elements operatively associated with the first and second fluid chambers, respectively; and

a body mount having a central opening that aligns with the opening through the inertia track, the body mount including a third elastomeric element.

18. The assembly of claim **17** wherein the third elastomeric element has one of a different conformation or is formed from a different material than at least one of the first and second elastomeric elements.

19. The assembly of claim **17**, wherein the inertia track is interposed between the first and second fluid chambers and in fluid communication with each fluid chamber; and

an opening extends through the first and second fluid chambers and the inertia track and receiving a shaft therein such that axial movement of the shaft results in axial movement of the inertia track to selectively pump fluid from one of the first and second fluid chambers to the other of the fluid chambers.

20. The assembly of claim **19** wherein the inertia track is resiliently mounted about its outer radial periphery relative to the first and second fluid chambers.

21. The assembly of claim **19** wherein the inertia track is fixed along an inner perimeter portion to the shaft.

22. The assembly of claim **19** further comprising a housing received around the first and second fluid chambers and the inertia track, a portion of the housing being crimped to compress inner perimeter portions of the inertia track and create a fluid seal.

23. (canceled)

* * * * *