

5 This application claims priority to United States
Provisional Application No. 60/101, 873 entitled LAMINATE
STAMP ARM OVERMOLD ASSEMBLY FOR HARD DISC DRIVES, filed
September 25, 1998.

The present invention relates generally to arm assemblies for disc drives. More particularly, the present invention relates to a laminated stamped arm for use in the head stack assembly of a disc drive, although the invention is not limited to that application.

20 With the increasing data density now being achieved
in magnetic discs, the operational performances of disc
drives are becoming more and more susceptible to
vibration. Such vibration arises not only from the
spindle motor driving the disc, but also from other
25 components in the computer, as well as external sources.
Vibration is a particularly serious problem when it
occurs at or near the resonant frequencies of critical
components. The head stack assembly has been found to be
particularly prone to resonance, thus adversely affecting
30 the performance of the disc drive.

- Damper on the head gimbals assembly (HGA).

35 This method is used to damp out some of the vibrations at the resonant frequency of the HGA. However, the method is only effective if the HGA is the source of the resonance that is causing the problem.

▪ Frequency tuning.

The head stack assembly is designed so that its resonant frequencies are not within the frequency range in which the servo control system is considered to be significantly affected by vibrations. However, it is difficult to predict actual resonant frequencies at the design stage, as resonances can be affected by several factors.

▪ Damping of the pivot cartridge bearing.

Such damping aims to minimise transmission of vibrations from the pivot cartridge bearing to the head stack assembly.

US Patent No. 5,666,242 filed November 21, 1995 by Edward et al for DISK DRIVE HAVING ELASTOMERIC INTERFACE IN PIVOT BEARING ASSEMBLY and US Patent No. 5,675,456 filed November 21, 1995 by Myers for ACOUSTIC VIBRATION DECOUPLER FOR A DISK DRIVE PIVOT BEARING ASSEMBLY describe methods of damping vibratory motion imparted to the head stack assembly through the pivot bearing. The former uses an elastomeric interface between the stationary member of the pivot bearing and the head stack assembly. The latter uses axial decoupling between the pivot shaft and the head stack assembly to minimise the transmission of acoustic vibration from the pivot shaft. US Patent 5,790,348 describes a head stack assembly having a cantilevered coil portion to provide damping of vibrations induced in the head stack assembly.

The present invention aims to provide a solution to the vibration problems mentioned above, and offers other advantages over the prior art.

Summary of the Invention

This invention provides a laminated arm member for a head stack assembly of a disc drive. In particular, the invention provides a laminated construction for an actuator arm of a head stack assembly which has improved

damping characteristics and is therefore less susceptible to vibrations. The laminated arm member has at least two self-supporting layers with a damping layer therebetween. Vibrations along the laminated arm member are damped by
5 the damping layer. Hence the arm member has an inherent damping function. The materials and dimensions of the layers can be selected to provide desired damping characteristics, e.g. to maximise damping at resonant frequencies.

10 Preferably, each self-supporting layer is metal, such as aluminium or steel, and the damping layer is an adhesive which binds the two self-supporting layers.

Preferably, the arm member is punched from laminated sheet.

15 In another form, the invention provides a head stack assembly for a disc drive, the head stack assembly having a body portion and at least one separately-formed actuator arm mounted to the body portion. Typically, the actuator arm is press fitted to the body portion in an
20 interference fit.

The actuator arm is preferably of laminated construction as described above, with at least two self supporting layers (typically metal) and a damping layer (typically adhesive) between the two self-supporting
25 layers.

Each actuator arm is preferably stamped from a laminated sheet before fitting to the body portion. The sub-assembly is then overmolded with plastic material.

The laminated arm of this invention can also be used
30 as a cantilevered support arm in other applications in which vibrations are to be reduced.

These and various other features of the present invention will be apparent upon reading of the following detailed description and review of the associated
35 drawings.

Brief Description of the Drawings

FIG. 1 is a perspective view of a head stack assembly according to a preferred embodiment of the present invention.

FIG. 2 is an exploded perspective view of part of
5 the head stack assembly of FIG. 1.

FIG. 3 is an exploded perspective view of top actuator arm of the head stack assembly of FIG. 1.

FIG. 4 is an exploded perspective view of the bottom actuator arm of the head stack assembly of FIG. 1.

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Detailed Description

Referring now to FIG. 1, a head stack assembly 10 is shown in operative engagement with a magnetic hard disc
15 11. The disc 11 is normally mounted on a spindle motor fixed to a base. The head stack assembly is typically mounted on a pivot bearing cartridge, and is pivotable about a shaft of the pivot bearing cartridge which is fixed to the base. As the general construction of such
20 disc drives is well known in the art, the base, spindle motor and pivot bearing cartridge have been omitted from FIG. 1 for clarity.

As shown more clearly in FIG. 2, the head stack assembly has a top actuator arm 12 and a bottom actuator
25 arm 13, both of which are fitted to a body portion 14. The actuator arms 12, 13 extend radially from the body portion 14 as cantilevered arms. Read/write heads (not shown) are normally mounted at the free ends of the actuator arms 12, 13.

30 A coil portion 15 also extends from the body portion 14. The coil portion is cantilevered from the body portion in the opposite direction to the actuator arm 12, 13.

Each actuator arm 12, 13 is formed separately from
35 the body portion 14, but fixed to the body portion during assembly. A particularly advantageous feature of the present invention is the laminated construction of each actuator arm 12, 13. Each actuator arm typically

comprises top and bottom layers, with a damping layer sandwiched therebetween. The damping layer may be of any suitable material, typically of a gel-like or elastomeric nature. Preferably the damping layer is an adhesive.

5 The top and bottom layers are preferably supporting layers.

As shown in FIG. 3, the top actuator arm 12 of the preferred embodiment comprises a top plate 12' which is stamped out of a metal sheet (typically steel, or
10 aluminium), and a bottom plate 12'' also stamped out of a metal sheet (typically aluminium). A layer of damping adhesive 12''' is sandwiched between top plate 12' and bottom plate 12''.

Similarly, as shown in FIG. 4, the bottom actuator
15 arm 13 comprises a top plate 13' typically punched out of an aluminium (or steel) sheet and a bottom plate 13'' typically punched out of a steel sheet. A layer of damping adhesive 13''' is sandwiched between top plate 13' and bottom plate 13''.

20 The actuator arms 12, 13 are made by first laminating two metal sheets with a layer of damping adhesive between them. The laminated sheets may be treated, typically by heat curing, to ensure adequate curing of the adhesive and proper lamination of the
25 sheets. The actuator arms are then stamped out of the laminated sheets with the desired arm profile.

The laminated actuator arms 12, 13 are preassembled together by press fitting them onto the body portion 14 in an interference fit. As shown in FIG. 2, the arms 12,
30 13 have a circular aperture dimensioned to receive part of the body portion 14 therein in an interference fit. The body portion 14 is typically made of aluminium, and serves as a spacer for the actuator arms. A coil is suitably mounted to the body portion 14 as well.

35 The sub-assembly of actuator arms, body portion (and coil) are then firmly held together by overmolding plastic material 16 over the sub-assembly (and coil 15), to provide the head stack assembly shown in FIG. 1. Any

suitable plastic material, such as a settable thermoplastic compound, may be used.

The foregoing apparatus and method have several inherent advantages, including:

- 5 ▪ The laminated actuator arms have inherent damping characteristics due to the damping layer of adhesive between the laminated plates.
- 10 ▪ The plate material, the plate thickness, the adhesive type, the adhesive thickness and the actuator arm profile can be varied to achieve optimal damping characteristics, damping frequency and structural rigidity.
- 15 ▪ The process of stamping out the actuator arms from pre-laminated metal layers with damping adhesive is clean, simple and cost effective, yet produces highly precise components.
- 20 ▪ The plastic overmold holds the whole assembly together firmly to ensure that all the critical dimensions are maintained, yet it allows minute or micro movement between the laminated layers for effective damping characteristics.
- 25 ▪ The manufacturing process provides cost advantages over the traditional method of manufacturing the actuator arms using extrusion and machining. Since the method of this invention involves very little in machining, the cost associated with such machining and deburring is reduced or eliminated.
- 30 ▪ The press fit or interference fit mounting of separate actuator arms to the body portion (before overmolding), allows the use of the laminated stamped arms. Moreover, the profile of the arms can be readily changed by using a different stamp cutter.
- 35 ▪ The laminated stamped arms provide damping characteristics which are superior to non-laminated arms.
- Shock pulse propagation could be reduced by the

laminated stamped arms, thus preventing or reducing head slap on the disc and increasing its handling damage margin.

5 It is to be understood that even though various characteristics and advantages of the preferred embodiment of the present invention have been set forth in the foregoing description, together with details of its structure and its method of manufacture, this disclosure is illustrative only, and changes may be made
10 within the principles of the present invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed. For example, the particular arm profile, sheet materials and damping layer may vary depending on the particular
15 application of the head stack assembly, while maintaining substantially the same functionality without departing from the scope and spirit of the present invention. The number of layers in each laminated actuator arm may also be varied if desired.

20 In addition, although the preferred embodiment described herein is directed to a head stack assembly for a magnetic disc drive, it will be appreciated by those skilled in the art that the teachings of the present invention can be applied to other systems, such as
25 optical disc drives, without departing from the scope and spirit of the present invention.



What is Claimed is:

1. An arm member for a head stack assembly of a disc drive, the arm member being of laminated construction and having at least two self-supporting layers with a damping layer therebetween.
2. An arm member as claimed in claim 1, wherein each self-supporting layer is metal.
3. An arm member as claimed in claim 2, wherein the metal is selected from a group consisting of aluminium and steel.
4. An arm member as claimed in claim 1, wherein the damping layer is an adhesive which binds the two self-supporting layers.
5. An arm member as claimed in claim 1, wherein the arm member is punched from laminated sheet.
6. An arm member as claimed in claim 1, wherein the arm member has a plastic overmold over at least a portion thereof.
7. A head stack assembly for a disc drive including an arm member of claim 1, comprising:
 - (a) a body portion; and
 - (b) the separately-formed actuator arm member mounted to the body portion and extending therefrom.
8. A head stack assembly as claimed in claim 7, wherein the actuator arm member has an aperture therein dimensioned to receive the body portion in an interference fit, the actuator arm being press fitted to the body portion.
9. A method of making an arm member for a head stack



assembly of a disc drive, the method comprising steps of:

- 5 (a) forming a laminated sheet comprising at least first and second layers, with a damping layer interposed between the first and second layers; and
- (b) stamping the arm member from the laminated sheet.

10 10. A method as claimed in claim 9, wherein the forming step (a) comprises utilizing an adhesive which binds the first and second layers as the damping layer.

15 11. A method as claimed in claim 10, further comprising a step (c) of treating the laminated sheet prior to stamping the arm member therefrom to cure the adhesive.

20 12. A head stack assembly as claimed in claim 7, further comprising a plastic overmold covering at least part of the body portion and actuator arm.

25 13. A laminated cantilevered arm member comprising at least two self-supporting layers and a means for reducing vibration of the arm member.

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REPLACED