

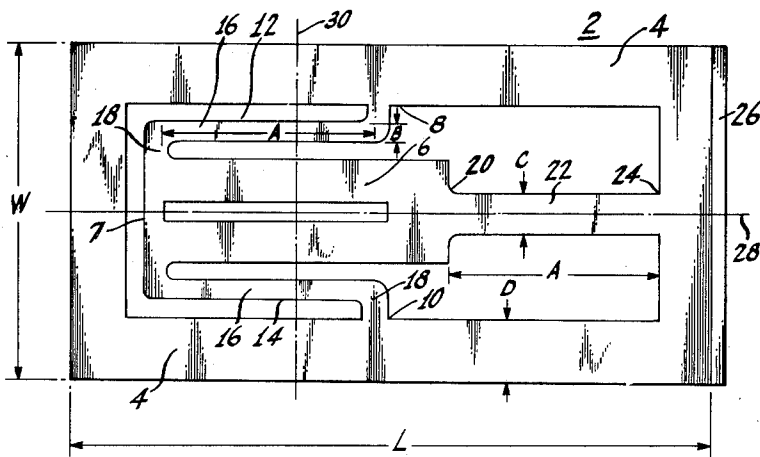
[54] **TRANSDUCING HEAD MOUNT APPARATUS**
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[51] Int. Cl. **G11b 5/60**
[58] Field of Search 179/100.2 CA, 100.2 P; 248/24, 248/204; 267/158, 160, 161, 163; 340/174.1 E

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[57] **ABSTRACT**
An arrangement is disclosed for supporting a transducer head on an air bearing. The system includes a planar three point resilient suspension system. The suspension system when acted upon by the air bearing deflects to form a parallelogram support for the transducer which provides desired mobility of the transducer.

5 Claims, 4 Drawing Figures



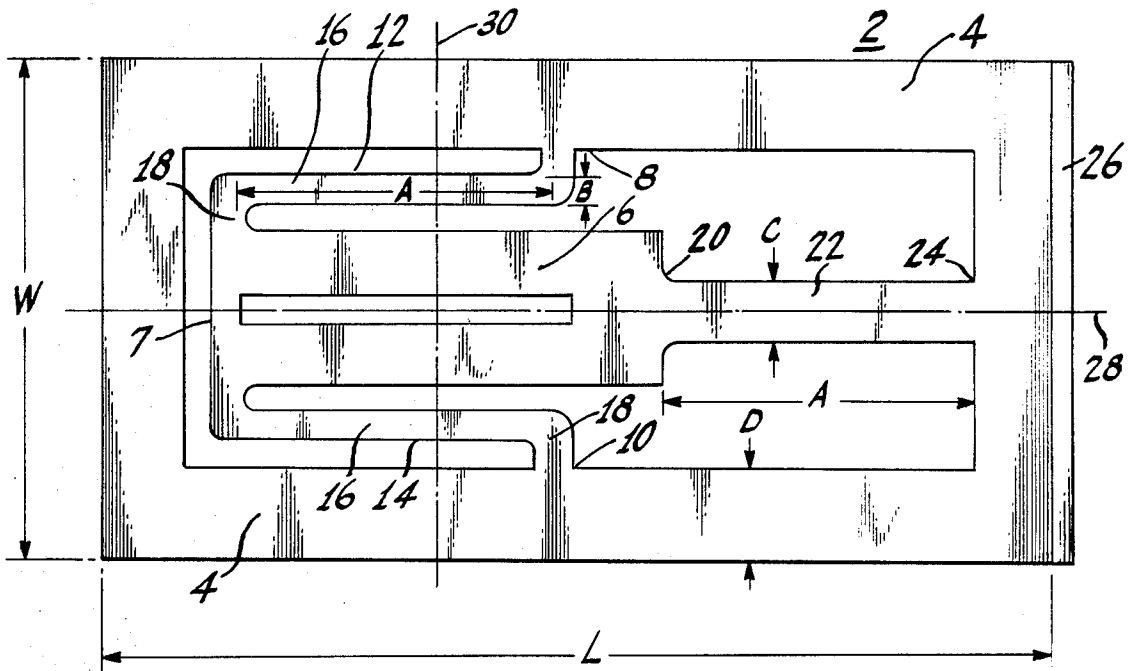


Fig. 1a.

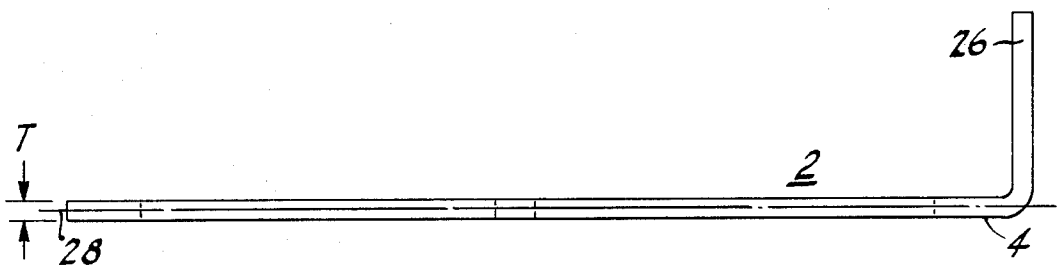
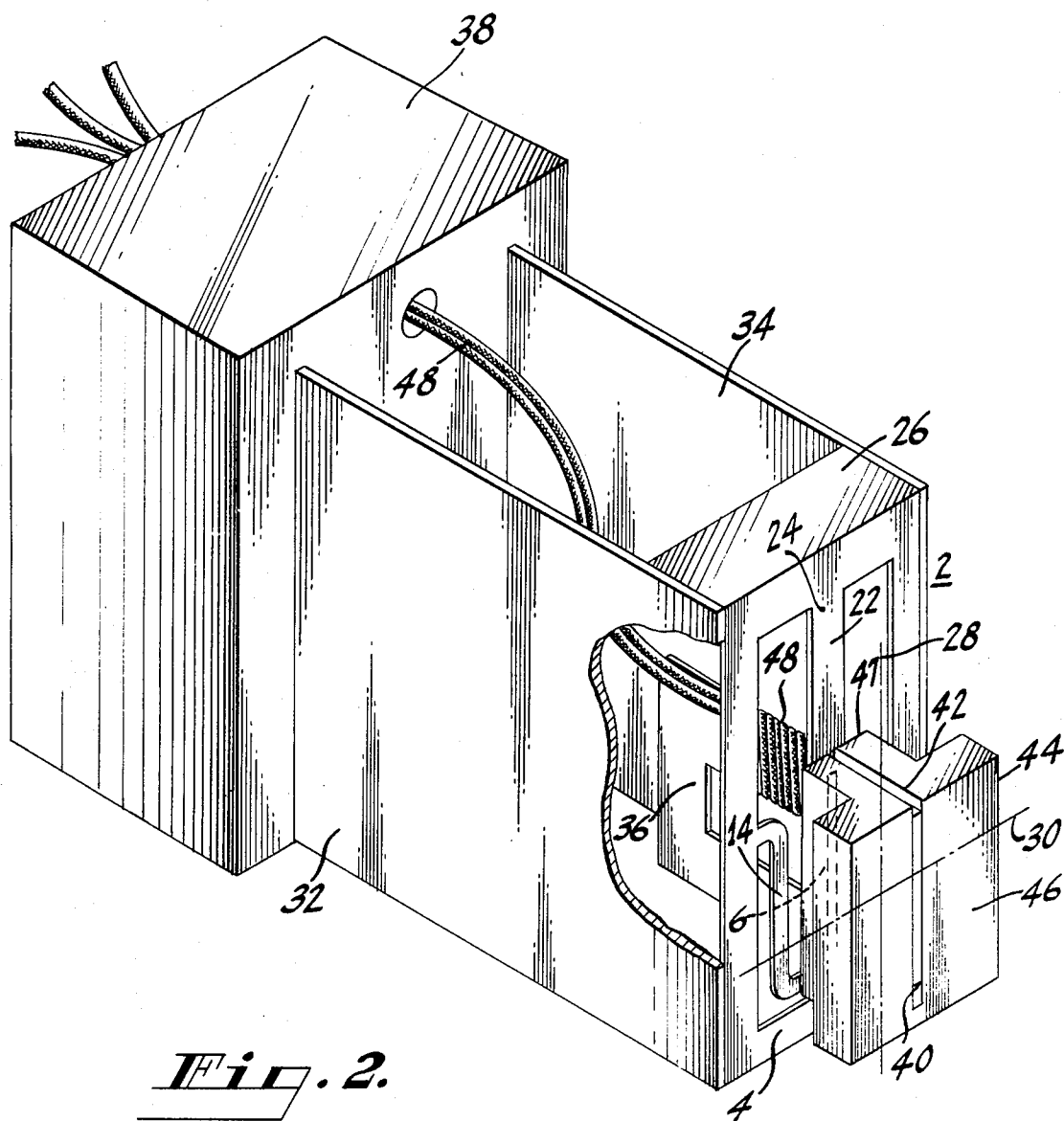


Fig. 1b.

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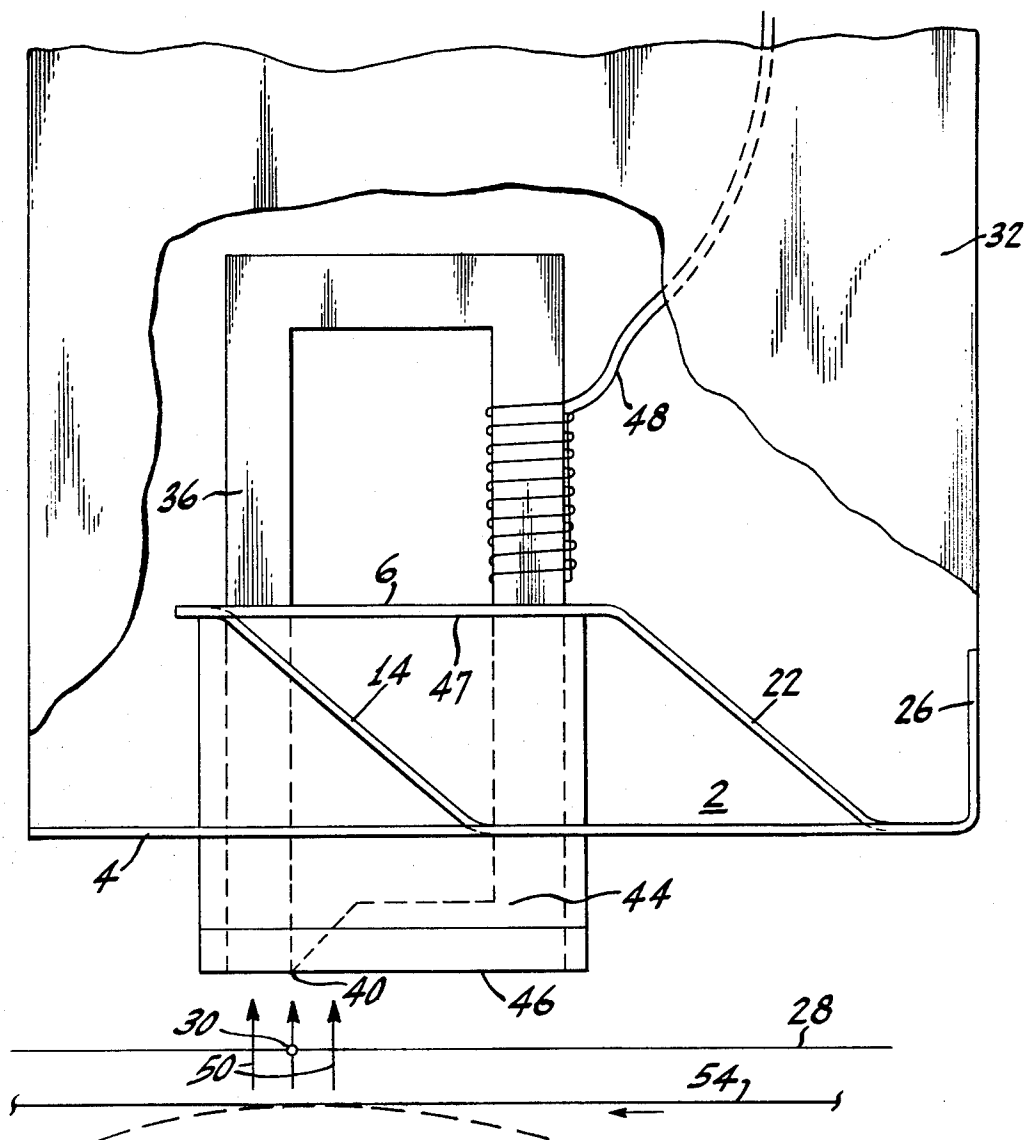


Fig. 3.

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TRANSDUCING HEAD MOUNT APPARATUS

This invention relates to apparatus for supporting a signal transducer with respect to a recording medium, and is especially useful where there is relative motion between the transducer and the recording medium.

The apparatus to which this invention relates is particularly, although not exclusively, adapted for use in combination with tape, drum or disc magnetic recorder-reproducer systems used as memory storage devices in computing machines and the like.

In the operation of systems where the recording medium moves relative to the transducer, it is desirable in some applications to space the transducer close to but not in contact with the recording medium. This close spacing is particularly important in systems where the recorded data is in the form of magnetic bits, since the spacing between the recording medium and the transducer determines the maximum bit density and hence the storage capacity than can be achieved. Conversely, continuous or prolonged contact between the transducer and the recording medium produces undue wear, the accumulation of dirt and results in degradation of the recorded signal.

It is well known that the rapid relative movement of the recording medium and transducer generates a laminar flow air or gas fluid layer between them. The rapidly moving fluid layer may be used to cause a transducer to "fly" or float at a given distance from the recording medium. The prior art discloses methods by which signal transducers may be caused to "fly" by utilizing a fluid bearing. However, many problems are encountered in devising practical means for controlling the relative position of a transducer and a recording medium. High relative speed may make many arrangements susceptible to acceleration forces that can be induced by vibration and positional changes. These forces may result in erratic positioning of the transducer and even undesirable "crashing" of the transducer on the surface of the recording medium.

To cope with such problems, transducers supports have been devised using gimbals or multiple springs arranged in separate planes. The gimbal apparatus may be of a conventional pivotal type or a planar spring having orthogonally arranged portions. This permits movement of the transducer about axes both parallel and perpendicular to the direction of relative motion of the transducer and record medium. While it is desirable to allow motion of the transducer with respect to the recording surface to permit the transducer to conform to the air bearing, this motion should be selective. That is, rotation of the transducer should be permitted about an axis which is in the direction of relative motion with the recording surface. But rotation of the transducer should be avoided about a second axis normal to the first axis and lying in a plane parallel to the recording surface or a tangent to the recording surface where it is of the drum shaped type. It is the motion about the second mentioned axis which is the problem encountered when utilizing the gimbal or multiple spring arrangement of the prior art.

In the arrangement of the present invention, a three point planar spring suspension is provided to mount the transducer such that it remains parallel to its initial position. That is, the flat spring elements which mount the head are three parallel arms that form a true parallelogram suspension, in which the arms remain parallel to one another as the head rides along the bearing. While the head can tilt or rotate about an axis through the transducer which is in the direction of relative motion of the transducer and recording surface, this axis remains parallel to the recording surface or tangent thereof and aligned with the recorded information track.

FIG. 1a and b are a plan view and side elevation view respectively of a portion of the transducer suspension arrangement of the invention.

FIG. 2 is a comprehensive perspective view of the support system for a transducer according to the invention.

FIG. 3 is a side elevation view of the support arrangement of FIG. 2 showing the transducer and suspension system in operative relation with a fluid bearing formed by the movement of an adjacent recording medium.

In FIGS. 1a and b there is shown a three point suspension assembly 2. The suspension assembly 2 has a plurality of interconnected portions which lie in a common plane in the absence of a stressing force at an angle to the common plane. The assembly 2 comprises an open frame member 4 surrounding a slotted portion 6 through which a transducer, not shown, may be mounted.

The slotted portion 6 is coupled at one end 7, to opposite portions 8 and 10 of the open frame member 4, by elongated web members 12 and 14. The members 12 and 14 are resilient generally Z-shaped elongated webs each having a relatively long central portion 16 and relatively shorter end portions 18 disposed generally transverse to the central portion 16. At the end 20 of the slotted portion 6, there is coupled a third resilient elongated web member 22 extending away from the portion 6 in a direction generally parallel to the central portion of the members 12 and 14, and secured to a further portion 24 of the open frame member 4.

Also as shown in FIGS. 1a and 1b, the assembly 2 has a planar portion 26, which is disposed substantially normal to the open frame member 4 and is preferably an extension thereof. The portion 26 is utilized in mounting the suspension assembly 2 to further portions of a comprehensive support structure as hereinafter shown and described. The axes indicated as 28 and 30 indicate a preferred orientation of the assembly 2 with respect to a relatively moving record medium. The axis 28 is in the direction of relative movement of a recording medium and the suspension assembly 2, with the axis 30 transverse to such direction.

In practice of the invention the assembly 2 is preferably fabricated from a single piece of resilient non-magnetic material such as beryllium-copper or plastic. The assembly 2 may be fabricated by etching, stamping or otherwise machining a piece of the described material into the form shown in FIGS. 1a and 1b. An overall length L of 0.337 inches, width W of 0.175 inches and thickness T of 0.002 inches for the assembly 2 of FIG. 1 has been found suitable in practicing the invention. The elongated web members 12, 14 and 22 preferably are of the same longitudinal dimension A. For the overall dimensions L, W and T given, a typical dimension A of 0.110 inches is suitable. The width B of the members 12, 14 is typically half or 0.010 inches the width C of the member 22, while the dimension D of the open frame member 4 is typically 0.030 inches. The slotted portion 6 may be approximately 0.160 inches long and 0.050 inches wide with a slot 0.115 inches by 0.010 inches.

In FIG. 2 there is shown a perspective view of a preferred complete transducer support arrangement. The member 32 and 34 form a shroud or enclosure for the transducer head core 36. Each of the members 32 and 34 are affixed at one end to a housing or main support member 38, with their free ends being spaced apart by approximately the width of the suspension assembly 2. In practice of the invention, the housing 38 is mounted in fixed relative relation with a recording medium by suitable means not shown. As shown and described with regard to FIGS. 1a and b, the suspension assembly 2 includes an open frame member 4 surrounding a slotted portion 6 which is intercoupled with the frame 4 by the members 12, 14 and 22. As shown in FIG. 2, the external periphery of the frame 4 and angle portion 26 of the assembly 2 are secured to the members 32 and 34. This is accomplished by bonding or means such as a groove, not shown, in the free edges of the members 32 and 34. The end portion of the head core 36 which contains the transducing gap 40 is mounted through the slotted portion 6 of the suspension assembly 2. The gapped end of the head core 36 is captively held in a slot 42 of a pad member 44 and is preferably flush with the end or working surface 46 thereof. The pad 44, which for example may be a non-magnetic ceramic, has its end 47 fixedly secured by known means to the slotted portion 6 of the suspension assembly 2, thereby rendering the portion 6 itself substantially rigid.

The axis 28 indicates the preferred direction of movement of a record medium, not shown, past the surface 46 containing the transducer gap 40 of the head core 36, with the axis 30

transverse to that direction. Leads 48 are shown extending to and about the head core 36 for transducing suitable signals.

FIG. 3, in which like reference elements correspond with those shown and described with reference to FIGS. 1a and b and 2, shows the transducer head 36 and suspension system 2 in operative relation with a fluid bearing indicated generally by the arrows 50. The fluid bearing 50 most commonly an air bearing, is produced by the movement of the recording medium adjacent the pad 44. The recording medium, or tangent thereto if it is a drum 52, is diagrammatically represented by the line with reference character 54. The air bearing exerts a force on the suspension assembly 2. The force which is in the general direction of air bearing arrows 50, is transmitted to the slotted portion 6 through the pad 44 and core 36 which are secured to the slotted portion 6. As shown in FIG. 3, the slotted portion 6, which is prevented from bending by the attached rigid pad 44, is deflected or translated out of the rest or common plane of the assembly 2 with the portion 6 and working surface 46 remaining substantially parallel to the axis 28.

The members 12, 14 and 22 remain secured between the members 4 and 6. However the relatively shorter portions 18 of member 12 and 14 are rotated or twisted in torsion and the extremities of the member 22 are rotated or flexed by the acting force of the air bearing 50. The relatively longer central portions of the member 12, 14 and 22, while retaining their substantially straight or lineal shape, form the sides or legs of a parallelogram shaped support. The assembly 2, while being resilient to facilitate the formation of the parallelogram, is chosen and proportioned in length, width and thickness such as that indicated, to prevent buckling or lineal elongation in this stressed condition. The transducer head 36 mounted to this parallelogram type suspension is thereby rendered free to move up and down in the direction of the air bearing 50 and has restrained rotation about the axis 28. This is due to the flexing and/or twisting at the connecting points of the portion 6 to which the transducer 26 is coupled, and the members 12, 14 and 22. The transducer head 36 is however prevented from rotating about a transverse axis such as 30, shown for example in end view in FIG. 3. This is due to the fact that, while as indicated the members 12, 14 and 22 form a parallelogram in which the sides are deflectable at their ends, the intermediate portions of the members 12, 14 and 22 do not buckle or change their lineal dimensions.

Thus an improved self-aligning support and suspension system is provided in which the transducer head has desired mobility for following an air bearing, but wherein undesirable rotation of the transducer is prevented.

What is claimed is:

1. Apparatus for supporting a transducing head, comprising:
 - a first member to which said transducer may be fixedly mounted,
 - an open frame,
 - first and second generally Z-shaped elongated resilient web members, each having a relatively long central portion and relatively shorter end portions,
 - one end of each of said Z-shaped members, being coupled to a first end of said first member, the other ends of said Z-shaped members being attached to opposite portions of said open frame, and
 - a third elongated resilient web member extending away

from said first member in a direction parallel to the central portions of said first and second members, said third member coupling the other end of said first member to a further portion of said open frame.

2. The invention according to claim 1, wherein said first member, said open frame and said first, second and third elongated resilient members are relatively thin planar members which form with said open frame a suspension system for a transducer, said suspension system in a first condition thereof having said first member and said elongated members disposed substantially in a common plane with said open frame member, said suspension system assuming a further condition in response to a force applied to said first member, in which said first member is disposed in a further plane parallel to said common plane with the central portion of said elongated resilient members being deflected to form substantially parallel arms intercoupling said first member with the open frame member in said common plane.

3. Apparatus for positioning a transducer with respect to a record medium in response to a fluid bearing formed by the relative movement of the record medium with respect to said transducer in said fluid, comprising:

a first support member fixedly mounted in spaced relation with said record medium;

- a second planar member to which said transducer may be fixedly mounted in a manner to render said second member substantially rigid;

a generally rectangular planar open frame member surrounding said second member;

- means for deflectably mounting said second member to and in the plane of said open frame member, said means including first and second generally Z-shaped resilient planar members, each having a relatively long central portion and relatively shorter end portions, one end of each of said Z-shaped members being coupled to a first end of said second member, the other ends of said Z-shaped members being coupled to opposite portions of said open frame, and a third resilient planar member extending away from said second member in a direction parallel to the central portions of said first and second Z-shaped members, said third member coupling the opposite end of said second member to a further portion of said open frame; and

means for mounting said open frame member to said first support member in a manner which allows said second member to be deflected out of the plane of said open frame in response to a force applied thereto by said fluid bearing.

4. The invention according to claim 3, wherein said open frame member, said second member and said means for mounting said second member, form portions of a single piece of resilient material.

5. The invention according to claim 3, wherein the central portion of said first and second Z-shaped members are disposed parallel to a first axis in the direction of relative motion of said record medium and said transducer, so that said second member and hence said transducer experiences restrained rotational motion about said first axis but is inhibited from rotational motion about a further axis transverse to said first axis.

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