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(54) **Resilient transducer mounting with vibration damper**

(57) A magnetic head supporting mechanism comprises a plate spring 2 supporting a magnetic head 3, a holder 1 for said plate spring, and vibration damping means, e.g. rubber strips 11 disposed to contact a surface of the spring 2 or head 3. The strips are secured to the holder, or to a frame (403) mounted thereon, Figs. 18, 19, not shown.

Alternative embodiments have a rubber disc (18), Fig. 5 (not shown) or rubber strips (19), Fig. 6 (not shown) extending only over the spring and secured to its central portion 204. The portion 204 alternatively has a rubber coating. Where the holder (10) and plate spring (12) confront each other, a rubber pad (40) may be interposed between holder and head, or holder and spring, Figs. 12—17 (not shown).

FIG. 1

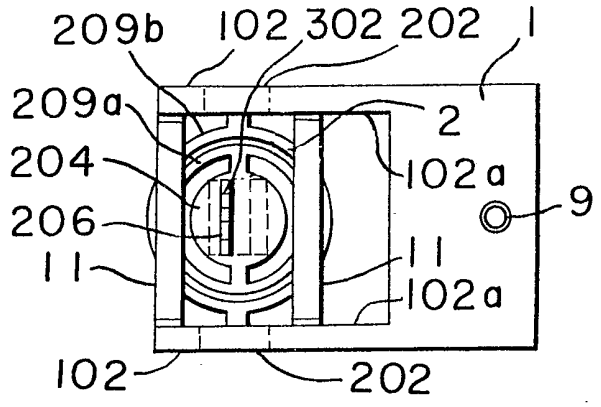

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FIG. 1

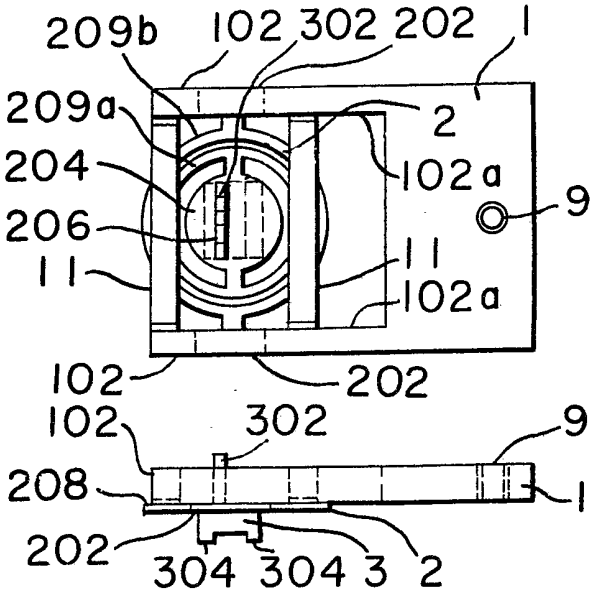


FIG. 2

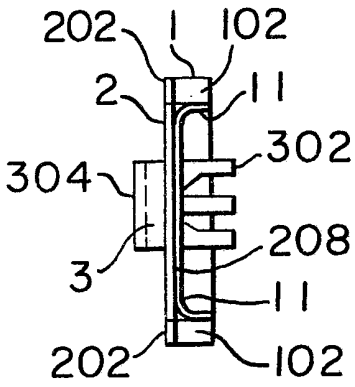


FIG. 3

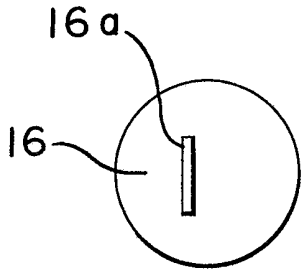


FIG. 4

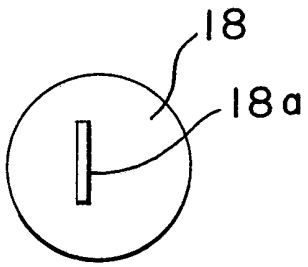


FIG. 5

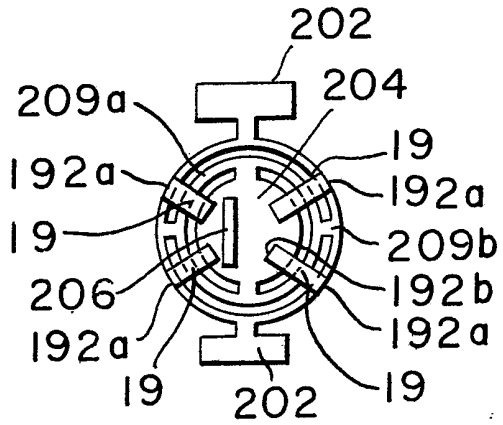


FIG. 6

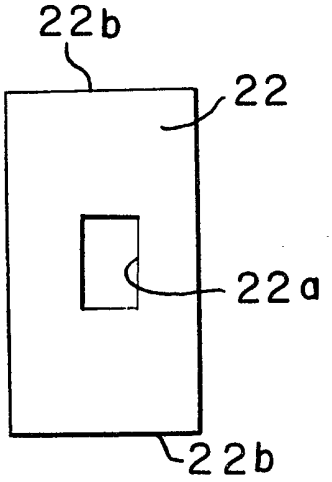


FIG. 7

FIG. 8

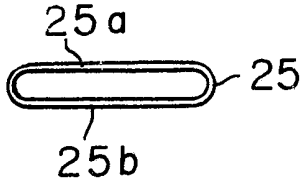


FIG. 9

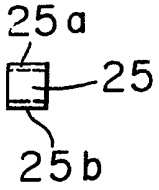


FIG. 10

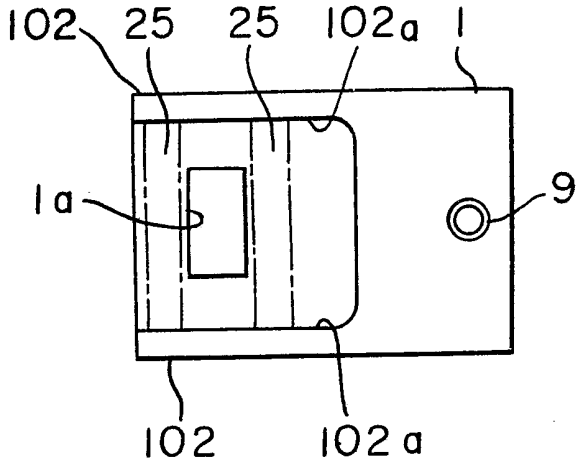


FIG. 11

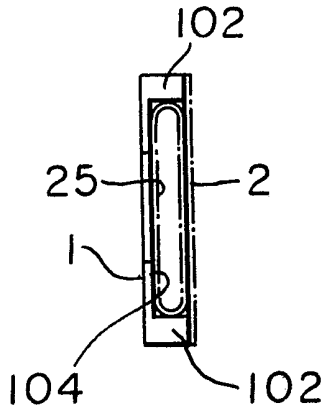


FIG. 12

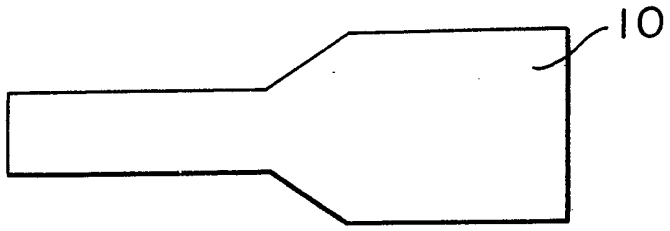


FIG. 13

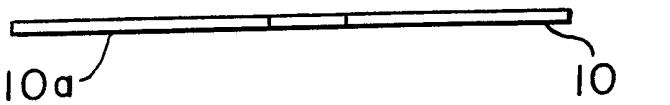


FIG. 14

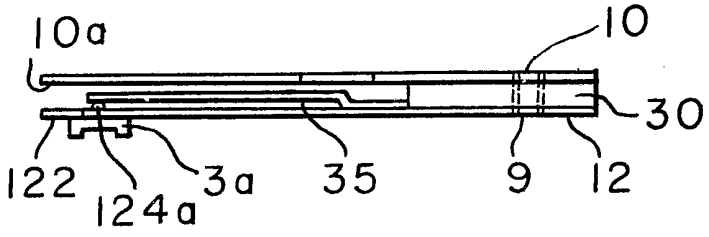


FIG. 15

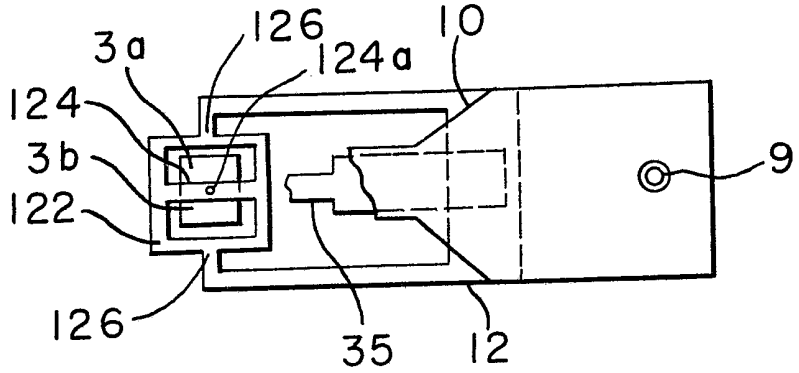


FIG. 16

FIG. 17

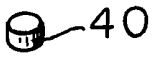


FIG. 18

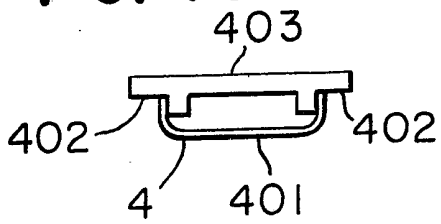
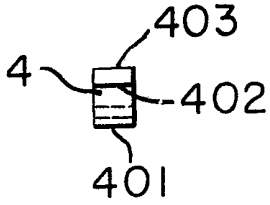


FIG. 19



SPECIFICATION

Magnetic head supporting mechanism

Background of the invention:

Field of the invention:

The present invention relates to a magnetic head supporting mechanism which absorbs vibration of a spring operation part of a plate spring with a damper connected between the spring operation part and a holder for mounting the plate spring.

Description of the prior arts:

In the conventional magnetic head supporting mechanism, a magnetic head is usually supported through a thin plate spring by a supporting arm or a holder for mounting. The plate spring is usually a rectangular or rectangular frame spring or a gimbal spring. Beside these structures, it has been known to combine the supporting arm with the gimbal spring in one-piece. These are disclosed in U.S. Patent 4,089,029 (Daniel Owen Castrodale et al.) and U.S. Patent 4,129,891 (Herbert U. Ragle); as well as U.S. Patent Application Serial No. 43,367 (corresponding to Japanese unexamined Utility Model Publication Nos. 7140/1980 and 7141/1980 and U.S. Patent Application Serial No. 152,818 (corresponding to U.K. Patent Application No. 8016325) both filed by the applicants.

Summary of the invention:

It is an object of the present invention to provide a magnetic head supporting mechanism which imparts remarkable effect for improvement of quality of signal amplitude given by a magnetic head in a driving device of any disc device such as a contact start type disc device, a non-contact start type disc device, and a double side type flexible disc device.

The foregoing and other objects of the present invention have been attained by providing a magnetic head supporting mechanism wherein a damper made of a rubber sheet etc. is connected between a spring operation part of a head supporting plate spring for holding a magnetic head and a holder supporting the plate spring so as to absorb vibration of the spring operation part under certain surface friction between the damper and the spring operation part.

In accordance with the present invention, in the contact start type disc device, remarkable effect for reducing wear loss of the disc and the head can be expected at the start and in the non-contact start type disc device, the effect for shortening the head loading time for loading the head can be expected and in the double side type flexible disc device which has been highly developed in the uses, the effect for shortening the seek-settling time can be expected and the effect wear for reducing the wear loss at the contact of the head with the disc especially loss of the disc referred to as tapping life is expected.

Brief description of the drawings:

Figure 1 is a plane view of a head supporting mechanism of the present invention.

Figure 2 is a side view of the embodiment of Figure 1;

Figure 3 is a side view of the embodiment of Figure 1 in the vertical direction;

Figure 4 is a plane view of a gimbal spring (2) as the important part in the second embodiment of the present invention;

Figure 5 is a plane view of a thin rubber sheet (18) as the important part in the third embodiment of the present invention;

Figure 6 is a plane view of the fourth embodiment of the present invention;

Figure 7 is a plane view of a thin rubber sheet (22) used in the sixth embodiment of the present invention;

Figure 8 is a front view of a rubber sheet (25) used in the seventh embodiment of the present invention;

Figure 9 is a side veiw of the embodiment of Figure 8;

Figure 10 is a plane view of a holder (1a) used in the seventh embodiment of the present invention;

Figure 11 is a side view of the embodiment of Figure 10;

Figure 12 is a plane view of a holder (29) used in the eighth embodiment of the present invention;

Figure 13 is a side view of the holder of Figure 12;

Figure 14 is a side view of the eighth embodiment;

Figure 15 is a plane view of the parts of Figure 14 from the disc side with a partially broken view of a pushing plate spring (35) and a holder (29) to be easily understood;

Figure 16 is a plane view of the pushing spring which is shown by the partially broken view;

Figure 17 is a schematic view of pad (40) as the important part in the eighth embodiment;

Figure 18 is a front view of a damper assemble having frame as the important part of the first embodiment of the present invention; and

Figure 19 is a side view of the embodiment of Figure 18.

Detailed description of the preferred embodiments:

Referring to Figures 1, 2 and 3, the first embodiment of the present invention will be illustrated.

The reference (1) designates a holder which has a forked plate shape; (2) designates a support spring for supporting a head (3) as a gimbal spring in this embodiment; (202) designates a edge of the spring (2), on which the edge (102) of the holder (1) is firmly mounted by a spot welding or a binder; (204) designates a ground part of the gimbal spring (2) and a head core (302) of the head (3) is inserted into a rectangular hold (206) formed on the ground part (204) to fix them with a

binder; (304) designates a sliding surface of the head (3) which has two-rail shape in this embodiment; (9) designates a female screw screwed in the holder (1); (11) designates a rubber sheet which is a damper functional part as the important part of the present invention and is a thin rubber sheet in this embodiment. The rubber plate (11) is bonded on the inner surface (102a) of the forked edge (102) of the holder (1) to contact in parallel with the upper surface (208) of the gimbal spring (2). The contact condition is preferably in slight pushing condition or non-pushing contact though it is possible to contact them when the gimbal spring (2) bends for a specific degree.

In this embodiment, two rubber sheets (11) are used to hold the ground part (204) and the head (3). It is important, in the assemble for the head supporting mechanism, to adjust in the assembly so as to prevent deformation of the sliding surface (304) for the holder (1) of the head (3) by the pressure of the rubber sheet (11). In this embodiment, the rubber sheet (11) is placed in the plane so as to contact with the ring springs (209a), (209b) of the gimbal spring (2).

The second embodiment will be illustrated. The second embodiment has substantially the same structure as that of the first embodiment shown in Figures 1 to 3 except that a reinforcing plate (16) shown in Figure 4 is placed on the assemble of the first embodiment. A rectangular hole (16a) is formed on the reinforcing plate (16) and the size of the hole is substantially the same as that of the rectangular hole (206). The diameter of the reinforcing plate (16) is substantially the same as the diameter of the outer ring (209b) of the ring spring of the gimbal spring (2). As a result, it is clear that when the reinforcing plate (16) is mounted on the ground part (204) in the upper side (208) of the gimbal spring (2), the reinforcing plate is placed to cover the gimbal spring (2). In this embodiment, the rubber plate (11) is brought into contact through the reinforcing plate (16) with the gimbal spring (2). The condition for mounting the rubber sheet (11) is the same as that of the first embodiment. As a result, the rubber sheet (11) does not contact with the ring type springs (209a), (209b), but contacts with the head (3) to be different from the first embodiment. The reinforcing plate (16) is prepared by a metallic thin plate or a hard plastic plate.

In the third embodiment, a thin rubber sheet (18) shown in Figure 5 which has substantially the same shape as the reinforcing plate (16) used in the second embodiment and has a rectangular hold (18a) is bonded on the ground part (204) as the second embodiment instead of the reinforcing plate (16) with a binder. In this embodiment, the strip rubber sheet (11) used in the first and second embodiments is not used. As a result, the thin rubber sheet (18) bonded on only the ground part (204) is always kept in contact with the gimbal spring (2) in any condition. The rubber sheet used should have soft and high flexibility.

Referring to Figure 6, the fourth embodiment will be illustrated. The most parts are the same as those of the first, second and third embodiments except that the structure on the gimbal spring (2) is different. As shown in Figure 6, in this embodiment, the thin rubber sheet (19) extended radically from the upper part of the ring springs (209a), (209b) to the ground part and the edges (192a), (192b) of the thin rubber sheet is bonded to the outer ring part (209b) and the ground part (204) with a binder. In the fourth embodiment, the flexibility of the thin rubber sheet (19) is the same as that of the former embodiment.

The gimbal spring (2) having the above-mentioned structure is equipped with the holder (1) in the same manner. The number of the rubber sheets (19) can be varied in view of the spring constant of the gimbal spring (2) without any adverse effect of the present invention.

In the fifth embodiment, the ground part (204) of the gimbal spring (2) is coated with a rubber with or without masking of the ground part (204) and with masking of the edge (203). In this embodiment, the other parts are substantially the same as the parts used in the first embodiment except of non-use of the strip rubber sheet (11); the second embodiment except of non-use of the rubber sheet (11) and the reinforcing part (16); the third embodiment except of non-use of the round rubber sheet (18); or the fourth embodiment except of non-use of the rubber sheet (9).

In the sixth embodiment, the thin rubber sheet (22) shown in Figure 7 is used.

In Figure 7, the rectangular hole (22a) is formed so as to prevent the contact with the head core (302) of the head (3) on the ground part (204). The diagonal length of the rectangular hole (22a) of the rubber sheet (22) in this embodiment is shorter than the diameter of the ground part (204). In this embodiment, the rubber sheet (22) can be equipped by bonding the end surface (22b) of the rubber sheet (22) on the inner surface (102a) of the forked edge of the holder (1) instead of the rubber sheet (11) of the first embodiment in the same manner for adjusting the rubber sheet (11). As it is clear, the rectangular hole (22a) is smaller than the diameter of the ground part (204) whereby the rubber sheet (22) will contact with only the ground part (204) in the bending of the gimbal spring (2). In the non-operation state, such as the step of departing the head (3) from the disc or the departed stop state, the ring type springs (209a), (209b) are vibrated, however, the vibration is attenuated by contacting the springs with the rubber sheets (22).

Referring to Figures 8, 9, 10 and 11, the seventh embodiment will be illustrated. The shapes of the holder (1), the gimbal spring (2) and the head (3) and the bonding method thereof are the same as those of the first embodiment. In this embodiment, the condition for the rubber sheet is different from the suspending condition in said embodiments. The rubber sheet (25) is used in this embodiment. As shown in the drawings, one end (25a) of the thin rubber sheet (25) is bonded to the bottom part (104) of the holder (1) and

curved by the gimbal spring (2) to apply a slight pressure and the other end (25b) is brought into contact with the surface of the ground part (204) of the gimbal spring (2). The rectangular hole (1a) of the holder (1) has a size large enough to prevent the contact of the core (302).

As a modification of this embodiment, it can be considered to contact the rubber sheet with only the ring parts (209a), (209b) without extending it to the ground part (204) but by extending it near the inner surface of the inner ring (209a).

Referring to Figures 12, 12, 14, 15, 16 and 17, the eighth embodiment will be illustrated. In comparison with the structures of the first to seventh embodiments, the structure of this embodiment is slightly different though the fundamental concept is substantially the same.

The reference (10) designates a holder which is a plate having the shape shown in the drawings as one example. Figure 14 is a side view of the assembly. The base of the head-supporting spring (12) is connected through the spacer (30) to the holder (10) in one-piece by a spot welding etc. The plane view of the plate spring (12) is shown in Figure 15. A frame (122) for supporting the head (3a) is formed at the end and a beam (124) is connected in one-piece at the center of the frame. The plate spring (12) can be fabricated by an etching method etc. A projection (124a) is formed at the center of the width and the center of the length of the beam (124) by a punching method etc. The head (3a) is firmly bonded to the beam (124) with a binder and is placed to coincide the center of the projection (124a) with the configuration center of or the floating force center of the head (3a). The reference (35) designates a pushing spring and the edge (35a) of the pushing spring pushes the projection (124a) in the contact. The base of the plate spring (12) in one-piece by a spot welding etc. The reference (40) designates a rubber pad as the important part of this embodiment. The pad (40) is fabricated by using a sponge rubber etc. and should be made of a soft flexible material. The pad (40) is inserted between the inner surface (10a) of the edge of the holder (10) and the back surface (3b) of the head (3a) and is bonded to only either of the surface (10a) or the surface (3b). In the modification, the pad can be placed at the point (126) connecting the supporting plate spring (12) to the frame (122). The flexibility of the pad should not be to prevent the flexibility of the supporting plate spring (12) and the pressure of the pushing plate spring (35). In the assembly with the pad (40), the pad (40) should be kept in slight compression or only non-compressing contact in the operation as shown in Figure 14 so as to attain the important effect. As the modification, it is possible to attain the same effect by reducing spring force of the pushing plate spring (35) for the pressure corresponding to the compression of the sponge pad (40).

The structures of the first to eighth embodiments of the present invention have been illustrated. Now, the effects in the operations of these embodiments will be illustrated.

In the first embodiment, the rubber sheet (11) is brought into contact with only the ring parts (209a), (209b) of the gimbal spring (2). The ring parts are vibrated by pitching and rolling motions of the head (3) caused by the rotation of the disc. The pitching and rolling motions are damped by friction of the rubber sheet to improve the following property of the head (3) to the surface of the disc. In the case of the sliding type head, the close contact is improved to improve the quality of the signal. In the case of the floatation type head, it contributes to give a constant floatation gap. In the low speed region of the sliding type head at the start or before the stop, the vibration having low frequency can be also damped, because of the characteristics of the rubber whereby the vibration and shock between the disc and the head can be reduced to reduce wear loss.

In the second embodiment, it is substantially equal to the contact of the rubber sheet on the head (3) whereby the vibration of the head can be reduced regardless of the vibration of the spring. In this embodiment, the friction damping of the head (3) is imparted thereby damping rapidly the vibration of the head supporting spring caused by overshoot because of remarkably large spring constant of air film in the loading of the head (3) on the disc. When this embodiment is applied to the contact side type disc driving device wherein the head is put on during the rotation of the disc, the wave motion of the disc and the vibraiton of the head supporting plate spring caused by the contact shock (different frequency) can be absorbed and damped. The same effect can be obtained when the head (3) in contact sliding is shifted to the other data track, because the vibration of the head (3) caused by the wave motion of the disc and the vibration of the head (3) caused by the head-supporting plate spring resonated to the wave motion can be damped. Therefore, the seek-settling time can be shortened.

In the first embodiment, the damping effect is given by the rubber sheet (11) placed between the holder (1) and the gimbal spring (2) whereas in the third, fourth and fifth embodiments, the damping is imparted in the spring itself. The effect is similar. The ring parts (209a), (209b) of the gimbal spring (2) have different inherent (normal) vibration to cause the comprehensive vibration of the head. The vibration of the head can be internally absorbed.

The sixth embodiment imparts the effect similar to the second embodiment. The seventh embodiment also imparts the effect similar to the second embodiment. The eighth embodiment has the structure different from the first to seventh embodiments, however the principle and the effect of the eighth embodiment are similar to those of the other embodiments.

The plate spring (12) extended to the longitudinal direction has the tendency to be easily swing in the plane direction of the disc, however, the tendency is saved by the surface friction and the internal friction of the pad (40)

placed between the holder (10) and the plate spring whereby the transversal vibration of the head (3a) is absorbed and damped.

As described above, in accordance with the head-supporting mechanism of the present invention, all kinds of vibrations of the head are reduced or absorbed and damped, whereby the quality of the read-out signal by the head is improved and the wear loss between the head and the disc is reduced and the signal amplitude stabilizing period in the head-load can be reduced.

The female screw (9) of the holder (1), (10) is used for fixing the mechanism to the vertical operation arm or the swing arm or the fixed substrate.

Thus, the same effect can be given by replacing the pad (40) used in the eighth embodiment to the strip rubber sheet (11) used in the first embodiment. The same effect can be also given by holding and fixing a ring rubber compressed to the center direction, between the end surface (10a) and the holder (10) and the head (3a) etc. When the rubber damper (4) having a frame shown in Figure 18 or 19 is prepared for easy assembly of the rubber sheet (11) used in the first embodiment, the operation and adjustment can be easy.

In Figures 18 and 19, the reference (401) designate a rubber sheet bonded on the frame (403) in one-piece and the lower surface of the rubber sheet is brought into contact with the ground part (204) etc.; and (402) designates a surface for fixing on the forked part (102) of the holder (1). The fixing can be easily made by using a binder. The frame (403) is a molded product made of a plastic.

CLAIMS

1) A magnetic head supporting mechanism which comprises a damper placed between a spring operation part of a head-supporting plate spring for supporting and mounting a magnetic head and a holder for supporting and fixing said plate spring thereby damping vibration of said spring operation part by surface friction between said damper and said spring operation part.

2) The magnetic head supporting mechanism according to Claim 1 wherein said head-supporting plate spring is a gimbal spring comprising an edge for fixing on a holder having a forked edge, and a central ground part and a plurality of ring parts connecting middle parts.

3) The magnetic head supporting mechanism according to Claim 2 wherein two sheets of rubber sheets are used as said damper and are placed to hold said head and said ground part of said head-supporting plate spring.

4) The magnetic head supporting mechanism according to Claim 1 wherein said damper is brought into contact with both of a non-spring operation part and a spring operation part of said head-supporting plate spring.

5) The magnetic head supporting mechanism according to Claim 1 wherein said damper is brought into contact with a non-spring operation part of said head-supporting plate spring, or a back surface of said head or a part fitting to said non-spring operation part without reduction of spring function and the vibration of said head is damped by surface friction of said damper or internal friction of said damper.

6) The magnetic head supporting mechanism according to Claim 1 wherein said damper is placed in suspension between said spring operation part and said non-spring operation part of said head-supporting plate spring.

7) A magnetic head supporting mechanism which comprises a damper fixed to a non-spring operation part of a head-supporting plate spring for supporting and fixing a magnetic head or to a back surface of said magnetic head and said damper being extended to contact with a whole or part of said spring operation part of said plate spring thereby damping vibration of said spring operation part by internal friction or surface friction of said damper.

8) A magnetic head supporting mechanism substantially as herein described with reference to any of the accompanying drawings.

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