Description

The invention relates to a head arm mounting device for one or more scanning heads in recording and/or playback apparatus for recording media, especially flexible recording media, the head arm, with the scanning head, being mounted on a pivot shaft provided between the U-legs of the mounting device and being capable of being pressed resiliently by means of a pressing spring to the recording medium against a further scanning head device.

For the purposes of the invention, recording media are magnetic tapes, magnetic films and all types of cards and disks carrying information, for the recording and/or playback of analog signals or digital signals.

It is known, on apparatus for flexible magnetic disks, to provide a spring which can be flexed in the transverse direction, for example a leaf spring, on the head-carrier arm on the one hand and on the head-carriage device on the other hand, as a result of which the head-carrier arm is given both a pivoting function and a pressing function, see for example GB-B-2 000 354. Such a head-carrier mounting device is disadvantageous with regard to a defined reproducible function and a cost-effective production. Even if the known head-carrier arm is additionally pressed to the recording medium by a special pressing spring, the result is still an imprecise head arm mounting, with a variable spring characteristic curve and an unfavourable characteristic curve shape, which is also temperature-dependent.

US-A-3 482 060 discloses a mounting device of the type defined at the beginning where a pivot shaft is mounted by means of ball bearings, bearing cones and bearing cups for a swivel arm in order to achieve a play-free design in assembly. The device is very complex to produce, therefore not suitable for mass production and not suitable for compensating a temperature-induced bearing play occurring after assembly. In addition, a

defined bearing friction characteristic cannot be adjusted and a normal progressive spring characteristic curve is produced as head characteristic contact pressure.

EP-A-44 151 discloses a swivel-arm mounting device in which the shaft is mounted ideally in bore holes of U-legs only in the ideal case, namely when the legs are exactly upright and thus circular-ring contact occurs. However, in practice, mechanical wear, temperature effects etc. cause elliptical-ring contact of the contact zone, as a result of which the pressing force of the legs to the swivel shaft inevitably varies. The known mounting device is, furthermore, mounted compliantly on the apparatus chassis by means of additional leaf springs and can thus only be employed for a dual-head apparatus. An adaptation of this known device for a single-head apparatus would inevitably likewise produce a progressive spring characteristic curve with a strong tendency for the positioner to vibrate. The suggestion in EP-A-44 151 of a compliant design of the U-legs for play-free assembly neither makes the mounting device suitable for mass production nor in any way effects a temperature compensation.

If head arm compression springs with progressive spring characteristic curve are used, it is extremely difficult to dimension the loading pressing spring and the loading actuation mechanism such that a satisfactory insertion/removal of the flexible disk without head damages is ensured, the latter being able to occur both by head tearing-off during introduction and by knocking of one or both heads during moving apart for removal of the flexible disk.

US-A-4 158 212 and the Patent Abstracts of Japan, Volume 4, No. 118 (P-24) (600) of 22.08.1980, page 74, p. 24 and JP-A-5 573 924 disclose spring adjustment devices, in particular for leg springs, for magnetic head positioners, but not in conjunction with a magnetic head mounting device according to the present invention.

It is known from the abovementioned GB-B-2 000 354 to provide apparatus for flexible magnetic disks with a

leg spring on the head-carrier arm on the one hand and on the head-carriage device on the other hand, as a result of which the head-carrier arm, with the head, is pressed to the recording medium. Such a head-carrier pressing spring is disadvantageous with regard to a defined pressing force in cost-effective production, since the spring forces are subject to a considerable spread due to the mass production (about 30% deviation from the desired value). The head-carrier arm is to be pressed by the pressing spring to the recording medium with a given pressing force, since otherwise there is an imprecise relative alignment of head and recording medium, which cannot be tolerated for the recording/playback processes.

The object of the present invention is to provide a head arm mounting device, of the type described at the beginning, for mass production and with a reliable technical function, especially in the case of temperature variations.

The object is achieved by a head arm mounting device for one or more scanning heads in recording and/or playback apparatus for recording media, especially for flexible recording media, as defined at the beginning, if the pivot shaft is mounted on the U-legs in a low-friction manner by means of pointed or spherical ends and, for play-free mounting, a spring is provided which acts on the U-legs and exerts an axial compressive force of from 5.1 to 20.4 Newtons on the ends of the pivot shaft, and that (sic) the pressing spring has an essentially horizontal spring characteristic curve.

It is consequently possible to use recording media of different thicknesses in one apparatus. Also particularly advantageous is use in apparatus in which a spring-loaded head-loading device is provided in which the coming into contact and breaking contact of the head or heads with the recording media or from the recording medium (sic) is determined by the loading pressing spring. If head arm pressing springs having proportionally rising pressing force with increasing deflection are used, it is extremely

difficult to dimension the loading pressing spring and loading actuation mechanism such that a satisfactory insertion/removal of the flexible disk without head damages is ensured, the latter being able to occur both by head tearing-off during insertion and by knocking of one or both heads during moving apart for removal of the flexible disk.

It is, furthermore, advantageous to prevent, according to the present invention, a vibrating of the head, which can occur when a "pivot spring" according to the prior art is used, as a result of the method whereby the heads are loaded or else independently thereof.

In a further development of the invention, the U-legs may be integrally formed with a tension spring.

This provides a cost-effective method of production which reduces still further the complexity of assembly. In addition, a fixed relative alignment of spring and U-legs is achieved, as a result of which the spring forces remain unchanged and constant.

In a further development, the integrally formed tension spring may have a meander shape.

It is very expedient if the characteristic curve of the pressing spring is adjusted such that it deviates by about $\pm$ 10 percent from the horizontal line. This provides a practical range for dimensioning.

Furthermore, it is advantageous for FlexyDisk drives if the axial compressive force acting between pivot shaft and U-legs is about 7.8 Newtons.

Further embodiments of the invention relate to adjustment devices for the pressing spring in conjunction with the head arm mounting device according to the invention, when the pressing spring is a leg spring.

Practical embodiments of this adjustment device concern the use of a rotatably mounted stepped disk having several steps, a stepless helix on a rotary disk, a vertically adjustable threaded pin and/or a longitudinally displaceable wedge-shaped member. In practice, all devices can be produced from plastic by injection moulding and are thus particularly inexpensive.

Consequently, a very cost-effective and simple-to-assemble mounting device is provided.

In the text below, details of the invention are described by reference to illustrative embodiments which are represented in the drawing, in which

Figure 1 shows a diagrammatic representation of the head device of a storage-unit drive for flexible data disks (plan view),

Figure 2 shows the drive represented in Figure 1, in side view, partially in section,

Figure 3 shows a magnetic-head carriage device with head arm mounting device according to the invention,

Figure 4 shows a mounting device with pivot shaft and separate compression spring,

Figure 5 shows a further mounting device with pivot shaft and separate tension spring,

Figure 6 shows a further mounting device with hollow pivot shaft and compression spring located therein,

Figure 7 shows a one-piece mounting device, according to the invention, with integrated spring,

Figure 7A shows the mounting device from Figure 7, without pivot shaft, in elevation,

Figure 7B shows the mounting device from Figure 7, with pivot shaft,

Figure 8 shows a spring characteristic curve of the mounting device according to Figure 7, in conjunction with a pressing spring according to Figure 3,

Figure 9 shows a magnetic-head carriage device with head arm mounting device according to the invention,

Figure 10 shows a view of the leg spring with stepped disk on an enlarged scale,

Figures 11a to 11d and 11a' to 11d' show diagrammatic practical designs of an adjustment device.

Figure 1 shows a magnetic storage unit 1 for Flexy-Disks(R) (registered trademark of BASF Aktiengesellschaft, Ludwigshafen), a FlexyDisk or magnetic disk 2 already having been inserted through the insertion flap 3. In this position of the disk 2, it is clamped, for example by

a clamping mechanism (not shown), and is set in rotation. After reaching the desired rotational speed, the head loading mechanism 4 is energized, the said mechanism comprising the head loading flap 5, an actuation device 6 and the actual magnetic head device 7, here with stationary head 8 and movable head 9 on the head arm 10, the head arm being pivotably mounted in a mounting device 11.

The loading flap 5 thereupon moves downwards, in the direction of the arrow C, and in doing so releases the head arm 10, via the projection 12, by the head arm 10 being pushed upwards by the spring 13 against the downwardly directed pressing force of the leg spring 18. The head 9 comes into contact with the disk 2, which is represented, for the sake of simplicity, without cover jacket. Head 9 presses with the force of the spring 18 against the disk 2 and, approximately opposite, the stationary head 8, which can of course also be resiliently movable, is in contact with the underside of the disk. The spring 13 is associated with the actuation mechanism 6, by virtue of which the loading flap 5 is prestressed in open position. Figure 2 shows the loading mechanism 4 in loading position (heads in operating position in contact with the disk 2).

From this position, the loading flap 5, under the action of the spring 13, brings the head 9 out of contact (against arrow C) with the disk 2 whenever the insertion flap 3 of the apparatus is opened. It is evident from Figure 2 that the design and arrangement of the actuation device 6 and of the spring 13 cause a movement of the heads 9 and 8 towards each other, at least during the loading process. The prestressing, and hence the bringing together of the heads 8 and 9, is determined by the dimensioning of the spring 18. During the separation of the heads 8 and 9, the speed at which head (sic) 8 and 9 are moved apart is determined only by the spring 13. Accordingly, head tearing-off and head knocking against the housing 14 may occur due to erroneously dimensioned spring 13 and actuation device 6. 40 is the drive motor of the

apparatus 1 and 41 the stepping motor for the positioning of the heads 8 and 9.

Figure 3 shows a head arrangement according to the invention, in perspective. In this, 15 is the carriage guide, 10 the head arm with head (not visible here), 16 a frame spring-mounting device for the head arm 10, and 17 connecting leads with plugs/sockets. The head arm 10 is pressed by means of the leg spring 18 arranged on its end behind the frame in the direction of the arrow D to the disk 2, that is to say prestressed with respect to the head 8. The frame spring-mounting device 16 is further represented in detail in Figures 7, 7A and B. The mounting yoke 19 can be secured to the carriage device (not shown here) by means of screws etc. in bore holes 42. The mounting yoke 19 is designed as a one-piece unit and is represented with an axial compression spring 20 of integrated design, here of meander shape. Here, as also in all other embodiments, the spring 20 exerts a defined axial force between frame parts and pivot shaft 21, so that the head arm 10 is mounted extremely free from play and low in friction, in order that the required head pressing force remains adjusted precisely and free from hysteresis, even in the event of temperature variations. In order to insert the pivot shaft 21 into the mounting parts 22, which are suitably secured, for example by pressing-in, bonding-in etc., in bore holes 25 in the legs 23 of the mounting yoke 19, it is possible to enter by means of pliers in notches 24 in the spring 20, stretch the spring 20, together with the legs 23, within the elastic range to an extent such that the pivot shaft 21 snaps into the mounting parts 22 and then is retained therein free from play. The ends of the pivot shaft 21 are, according to the invention, designed as points 26, in this case conical, and the mounting parts 22 contain corresponding conical depressions. According to the invention, it is also possible, as shown in Figure 5, to provide rounded or spherical ends 27 on a pivot shaft 28, which run in correspondingly dimple-shaped mounting parts 29.

Figure 7A shows by which deflections X the two legs of the mounting yoke 19 and the spring 20 can be stretched for the insertion of the pivot shaft 21. Following insertion, Figure 7B shows a vertical straightening of the leg device. If the material mentioned below is employed, the angle α may be approximately 5°, but may also be larger or smaller, depending on the material used in the case in question. The prestressing of the legs, and hence the axial compressive force continuously exerted on the pivot shaft, can be adjusted by the size of the deflections X.

Further mounting devices 11 are represented in Figures 4 to 6. Figure 4 shows a U-shaped frame 30 with compression spring 31 connecting the legs. Figure 5 likewise shows a U-shaped frame 32, with tension spring 33 hooked onto the ends of the legs. A mounting yoke 34, again a one-piece unit, is represented in Figure 6, this design dispensing completely with springs. In this case, the necessary axial compressive force is applied by means of a compression spring 35, which is provided inside a hollow pivot shaft 36. Here too, the pivot shaft may comprise the spring 35 and the points 37 connected thereto and may be mounted essentially free from play in a fitting bush in the head arm 10.

The mounting devices 11, 16 described have the advantage that they make possible, without adjustment, a play-free, low-friction and reliable mounting of the head arm on the principle of point bearing or ball bearing. It is consequently advantageously achieved that the spring force necessary for head contact pressure to transmit (sic) directly to the head arm 10 by means of a simple, non-adjustable pressing spring, which may be designed as leg spring 18 or else as some other spring, for example as leaf spring.

In the diagram in Figure 8, the preferred spring characteristic curve 38 of the head arm 10 is represented as a continuous line, being determined solely by the pressing spring 18. In the diagram, the progression is about + 20%, that is about 3 pond with a desired value of 18 pond.

A general deviation from the horizontal line of about ± 10% to, at most, ± 20% is regarded as allowable. An approximately horizontal characteristic curve therefore results, so that the head contact pressure is essentially independent of the respective head arm deflection. In contrast to this, a head arm characteristic curve 39 is represented which, in accordance with the prior art, is produced by a leaf spring as pivot and by an adjustable compression spring acting on the head arm perpendicularly to the plane of the leaf spring. The shape of the characteristic curve 39 is strongly progressive, as a result of which, disadvantageously, the spring 13 of the head-loading mechanism 4 has to be dimensioned considerably larger. Similarly, due to the strongly progressive leaf spring, high acceleration forces act on the heads 8 and 9 during the head-loading process, which forces can lead to the destruction of the heads and disk, or at least to their premature wear.

Even with the use of a leaf-spring pivot and a leg spring, as described in GB-PS-2 000 354, due to the leaf spring, more strongly progressive spring characteristics occur, which cannot be readily compensated. In addition, undesired head arm vibrations occur, and the known mounting device is extremely temperature-sensitive due to the different types of firmly bonded materials (plastic-metal). The leaf spring and the head arm materials have different coefficients of thermal expansion, the effects of which can likewise not readily be compensated.

The following advantages are obtained when the mounting devices according to the invention, as described above, are employed:

Any play occurring as a result of temperature variations is compensated by the axial compression springs, withhout any significant increase in the mounting friction, head arm vibrations are prevented by selecting the suitable axial pressure on the pivot shaft, adjustment operations on the mounting device or on the pressing spring are avoided, assembly operations of the head device

are simplified, adaptations of the spring of the loading devices to the spring forces of the head arm are avoided, production operations of the mounting device are simplified and become less expensive.

Frame parts or mounting yokes of the described illustrative embodiments of Figures 1 to 7 may be composed of any suitable material, preferably of plastic with suitable spring properties. A suitable material is, for example, polyacetal POM (Ultraform(R) registered trademark of BASF Aktiengesellschaft, Ludwigshafen). The use of plastic, if appropriate with a proportion of glass fibre, allows for mass production by injection moulding etc. at lost costs. Of course, the use of spring metals is also possible. For example, the legs of the mounting yoke may here be formed by spring metal strips. Commercially available helical springs or leaf springs may be used as metal springs in the embodiments of Figures 4 to 6. The pivot shaft 21, 28, 37 may be made of metal, for example, from a commercially available bearing needle. The ends 26, 27 may also be composed of other materials having relatively favourable friction and relatively low-wear properties. The mounting parts 22, 29 may be composed for example of precious stones or semi-precious stones, the hardness of which is adapted to the hardness of the ends of the pivot shaft. Such precious-stone mounts may also be set in suitable metal bushes, in order to achieve secure attachment to the frame. The head arm mounting devices according to the invention have been tested and yielded excellent results with regard to durability and reliability.

Figure 9 shows a further head arrangement according to the invention, similar to Figure 3. In it, 45 is the frame, 10 the head arm with head (not visible here), 16 a frame mounting device for the head arm 10 and 17 are connecting leads with plugs/sockets. The head arm 10 is pressed by means of the leg fields (sic) 18, arranged on its end behind the frame, in the direction of the arrow D to the disk 2, that is to say is prestressed towards the head 8.

The spring force necessary for head contact pressure may be transmitted directly to the head arm 10 by means of a simple pressing spring, which can be designed expediently as leg spring 18. 40 is an adjustment device for the rear leg of the leg spring 18. The adjustment device 40 is represented more accurately in Figures 9 to 11. The preferred spring characteristic curve of the head arm 10 is determined solely by the pressing spring 18. The progression is about ± 10%, that is about 2 pond with a desired value of 18 pond. A general deviation from the horizontal line of about ± 10% is regarded as favourable in practice. An approximately horizontal characteristic curve results, so that the head contact pressure is essentially independent of the respective head arm deflection.

The adjustment device 40 has the task of making the vertical position of the rear leg 18b of the spring 18 adjustable. The front leg 18a exerts, according to Figure 10 as a lever, a pressure on the carrier arm 10 and hence determines the head pressing force. The latter is surprisingly simple to vary by means of the adjustable vertical mounting of the rear leg 18b. In Figure 10, the adjustment device 40 may be one of the rotationally adjustable disks 41 or 42 represented in Figures 11a, 11a', 11b or 11b'. The disk 41 has, for example, 4 steps 44 and an adjustment part 43, which may be designed as a screw on the frame 45. The disk 42, on the other hand, has a stepless, helical track 49 with likewise a slotted screw as adjustment part 43. In Figures 11c, 11c', the adjustment device comprises a threaded pin 46, which is adjustable in the frame from below in the direction of the double-headed arrow and consequently makes the vertical position of the leg 18b (not represented here) adjustable. Figures 11d, 11d' show as a further variant a wedge-shaped member 47 with mounting pin 48, which is displaceable in a slot (not shown) of the frame 45 according to the double-headed arrow, as a result of which the pressing force exerted by the leg 18a can be adjusted by means of the vertical position of the leg 18b.

The respective range of adjustment of the spring 18 can be dimensioned according to the predetermined head pressing force. In the case of known drives, in which the pressing force is in the range from 18 to 22 pond, an adjustment of about ± 10% is expedient. However, an adaptation of the range of adjustment to the practical contact pressure values of any desired apparatus cannot readily be accomplished. If, for example, four steps 44 are used, in practice each step can be assigned a spring force variation of 1.5 pond. However, in principle any force variation assignment can be used, providing it can be accomplished simply in practice. The dimensioning of the individual steps of the disk 41 may also be carried out such that each step height of 0.5 mm is assigned a spring force variation of approximately 1 pond. Some of the spring force variation is usually required for compensation of the fields (sic) force tolerance.

A safeguard against rotation of the stepped disk 41 is provided if the end of the leg 18b bears against a step edge. In the case of the other adjustment devices 42, 46 and 47, the self-restraint of the mounting means is to be chosen such that a self-adjustment does not occur. As a possible variant in the case of the stepped disk 41 and the threaded pin 46, it is possible to provide as further adjustment a longitudinal displacement in longitudinal direction of the leg 18b, as a result of which the effective lever arm, and thus the force, is varied.

All described embodiments of adjustment devices may be composed of any suitable material and are preferably produced from plastic by injection moulding. With use of the same plastics material for the adjustment devices as for the frame 45, temperature effects due to different thermal expansions are avoided.

Claims

1. A head arm mounting device for one or more scanning heads (9) in recording and/or playback apparatus (1) for recording media, especially flexible recording media (2), the head arm (10), with the scanning head (9), being mounted on a pivot shaft provided between the U-legs of the mounting device (11) and being capable of being pressed resiliently by means of a pressing spring (18) to the recording medium (2) or against a further scanning head device, characterized in that the pivot shaft (21, 28, 36) is mounted on the U-legs (19, 30, 32, 34) in a low-friction manner by means of pointed or spherical ends (27) and, for play-free mounting, a spring (20, 31, 33, 35) is provided which acts on the U-legs and exerts an axial compressive force of from 5.1 to 20.4 Newtons on the ends of the pivot shaft, and in that the pressing spring (18) has an essentially horizontal spring characteristic curve (38).

2. A device according to claim 1, characterized in that the U-legs (23) are integrally formed with a tension spring (20).

3. A device according to claim 2, characterized in that the integrally formed tension spring (20) has a meander shape.

4. A device according to claim 1, characterized in that the spring characteristic curve (38) deviates by about $\pm$ 10%, but by no more than about $\pm$ 20%, from a horizontal line.

5. A device according to any of claims 1, 2 or 3, characterized in that the axial compressive force acting between pivot shaft (21, 28, 36) and frame (19, 30, 32, 34) is about 7.8 Newtons.

6. A device according to any of claims 1 to 4, characterized in that the pressing spring (18) is a leg spring, the one leg (18b) of which is mounted adjustably by means of an adjustment device (40) for varying the spring force.

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7. A device according to claim 6, characterized in that the adjustment device (40) is a rotatably mounted stepped disk (41) having several, especially four, steps (44).

8. A device according to claim 6, characterized in that the adjustment device (40) is a rotatably mounted disk (42) having a stepless helical track (49).

9. A device according to claim 6, characterized in that the adjustment device (40) is a vertically adjustable threaded pin (46).

10. A device according to claim 6, characterized in that the adjustment device (40) is a longitudinally displaceable wedge-shaped member (47).

11. A device according to any of claims 6 to 10, characterized in that the adjustment device (40) is composed of plastics material.

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