Candidate's Answer – Paper A (E/M)

CLAIMS

1. Device for locking an actuator of a disk drive in a desired position, comprising means for preventing swinging (17, 21) of the actuator in case of rotational shock of the disk drive, said preventing means comprising a lock member (21), being arranged to rotate by means of inertia upon rotational shock, characterised in that said preventing means (17, 21) further comprises a counter inerta member (17), being arranged to rotate by means of inertia upon rotational shock, and being coupled to said member (21) whereby the configuration of said lock member (21) and said counter inertia member (17) is such that the effect of inertia on the counter inertia member (17) is arranged to balance the effect of inertia on the lock member (21).

2. Locking device as claimed in 1, wherein said counter inertia member (17) comprises a contact member having a constant radius and said lock member (21) comprises a corresponding contact member (22) also having a constant radius, said contact members being coupled to each other.

3. Locking device as claimed in 2, wherein the configuration is such that the ratio of the inertias of the counter inertia member (17) and the lock member (21) is equal to the ratio of the radius of the contact member of the counter inertia member (17) and of the radius of the contact member (22) of the lock member (21).

4. Locking device as claimed in 2 or 3, wherein the inertias of the counter inertia member (17) and the lock member (17) are the same.

5. Locking device as claimed in any of claims 1-4, wherein the counter inertia member (17) and the lock member (21) are coupled to each other by means of a meshed gear coupling.

6. Locking device as claimed in any of claims 1-4, wherein the counter inertia member (17) and the lock member (21) are coupled to each other by means of friction coupling.

7. Locking device as claimed in any one of claims 1-6, wherein said lock member (21) and said counter inertia member (17) are rotatable around parallel shafts.

8. Locking device as claimed in any one of claims 1-7, wherein said contact member (22) of the lock member (21) is integrally formed with an elongate wing portion and an abutment portion, for contacting the actuator.

9. Locking device as claimed in any one of claims 1-8, wherein the counter inertia member (17) and the lock member (21) each have a mass distribution balanced about their respective axes of rotation, in order to achieve protection against linear shocks.

10. Disk drive, comprising a disk holding unit and an pivotable actuator (5) being provided with a head (4) for reading or writing information on a disk (2) being arranged to be positioned in said disk holding unit, characterised in that the disk drive further comprises a device for locking said actuator (5) in a desired position, as disclosed in any one of the claims 1-9.

11. Disk drive as claimed in 10, wherein said locking device is arranged to lock said activator (5) in a non-data area of a disk positioned in said disk holding unit.

DESCRIPTION

The invention relates to a device for locking an actuator of a disk drive in a desired position. The invention also relates to a disk drive having such a locking device.

Actuator locking devices are often used (?) in disk drives for locking the actuator in a parking position when the disk drive is not in operation, in order to avoid physical contact between a read/write head, positioned on the actuator, and the data zone of a disk positioned in the disk drive, since this may damage the magnetic film of the disk. Such contact may occur when the disk drive is subjected to shock, and hence locking devices are especially important in portable computers, which are more frequently subjected to shock.

A disk drive according to the prior art, comprising such a locking device, will hereinafter be described.

~~Figures 1 and 2, taken from one of our published patents, are plan views from above of~~
A *disk drive 1 compris~~ing~~es a disk ~~2~~ with a storage area ~~3~~ for storing information. A read/write head 4 is mounted on an actuator ~~5~~ which pivots about an axis ~~6~~. A magnet ~~7~~ and a coil ~~8~~ form a motor ~~9~~ for rotating the actuator ~~5~~ about the axis ~~6~~ so that the head 4 can be placed over selected positions of the data storage area ~~3~~ on the disk ~~2~~ for reading and/or writing information. The head 4 has a well-known aerodynamic design such that, when the disk is rotating, an air cushion forms under the head ~~4~~ to prevent it touching and scratching the surface of the data storage area ~~3~~. In the present example the disk ~~2~~ rotates counterclockwise in operation as represented by the arrow ~~16~~.*

When the disk drive ~~1~~ is not in operation, the head 4 is parked in a parking zone ~~10~~ near the centre of the disk ~~2~~, outside the data storage area ~~3~~. In order to prevent the head 4 from leaving the parking zone ~~10~~, for example if the disk drive is subjected to external mechanical shocks, it is necessary to lock the actuator ~~5~~ so that the head 4 remains in the parking zone ~~10~~. To this end a lock ~~11~~ is provided. This lock operates without any electrical components, so that electrical power consumption is minimised.

~~state wherein the actuator 5 is unlocked~~. The lock ~~11~~ is pivotally mounted about a pivot ~~14~~ and includes a first portion ~~12~~ in the form of an elongate wing and a second portion ~~13~~ having at its end an abutment ~~13a~~ for contacting the actuator ~~5~~.

In the locked state, the abutment ~~13a~~ contacts the actuator ~~5~~, preventing the actuator ~~5~~ from rotating clockwise and thus preventing the head 4 from leaving the parking zone ~~10~~. The lock ~~11~~ is biased in a counterclockwise direction about the pivot ~~14~~ by means of a spring ~~15 shown schematically in Figures 1 and 2~~. In this position the lock ~~11~~ blocks clockwise movement of the actuator ~~5~~.

The mass distribution of the lock ~~11~~ is balanced with respect to the pivot ~~14~~ such that the lock ~~11~~ maintains its position when the disk drive is subjected to linear shocks. By a linear shock we mean a sudden and rapid (i.e. translational) movement of the disk drive.

However, even if the above prior-art solution provides a good solution for protection against linear shock, it provides a poor protection against rotational shock. One way of solving the problem with rotational shock has been suggested by D1, upon which the preamble of claims 1 and 10 is based. D1 discloses a locking device, in which *an inertia member ~~8~~ is rotatably mounted about a shaft ~~7~~. A pin ~~9~~ is attached to the surface of the inertia member ~~8~~. In the operational state of the actuator ~~1~~ the inertial lock ~~6~~ is in its rest position which is determined by means of a helical spring ~~10~~ extending between a fixed pin ~~11~~ and a pin ~~12~~ located on the inertia member ~~8~~. A finger ~~13~~ protrudes from the actuator ~~1~~ and is so arranged that, when the actuator ~~1~~ is in the park position, the locking pin ~~9~~ is able to engage the inner surface ~~14~~ of the finger ~~13~~ to block clockwise rotation of the actuator ~~1~~.*

If the disk drive is submitted to a counterclockwise rotational shock, the actuator ~~1~~, due to its inertia, tends to maintain its absolute position in space, or in other words, the actuator ~~1~~ rotates in a clockwise directon relative to the disk drive. The inertial lock ~~6~~ overcomes the force of the spring ~~10~~ and also rotates in a clockwise direction relative to the disk drive. The inertial lock ~~6~~, however, responds to the rotational shock much quicker than the actuator ~~1~~, whereby the inertial lock ~~6~~ rotates before the actuator ~~1~~ has hardly moved. Due to the rotation of the inertial lock ~~6~~, the pin ~~9~~ moves through an angle β, ~~*as shown in Fig. 3*~~ *until it strikes the inner surface ~~14~~ of the finger ~~13~~. In this position, the pin ~~9~~ blocks any clockwise movement of the actuator ~~1~~ relative to the disk drive.*

However, a problem associated with the locking device of D1 is that the lock may only be activated upon rotational shock in one direction. Hence, in order to lock this locking device for rotational shock in a counter direction further stop means must be provided. Hence, an object of this invention is to provide a locking member for an activator in a disk drive as well as a disk drive with such a locking member, which may be activated upon rotational shock in any direction, thereby providing a flexible and safe solution.

The present invention provides a locking device as claimed in claim 1 as well as a disk drive with such a locking device as claimed in claim 10. This provides the advantage of providing a locking device that works independantly of the rotation direction of the rotational shock, thanks to the two coupled, independantly rotatable members, i.e. the counter inertia member and the lock member.

This invention provides the further advantage that its lock position of the actuator may be positioned anywhere desired, such as in a centrally positioned non-data area of a disk, or in a perifer non-data area of the disk, or even in a centrally positioned non-data area, without any alterations of the construction of the locking member.