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MAGNETIC DISC ASSEMBLIES

This invention relates to magnetic disc assemblies, to magnetic disc cartridges which contain such a magnetic disc assembly, and to apparatus which uses the magnetic disc cartridge to record and/or reproduce signals on the magentic disc.

Magnetic disc cartridges are known wherein a magnetic disc assembly is housed within a jacket which serves to protect the magnetic disc from crumpling, folding or other damage, particularly when the magnetic disc cartridge is not in use or when the cartridge is shipped. One type of magnetic disc which is housed within such a jacket is the so-called "floppy" disc or discette. To permit a magnetic transducer to gain access to the disc and thus record or reproduce signals thereon, the jacket is provided with a window through which the transducer is inserted into magnetic contact with the surface of the disc. Also, the jacket is provided with a generally central aperture through which a disc drive shaft may be inserted into driving engagement with the centre hub of the disc so as to rotate the disc when the shaft is driven.

To permit satisfactory rotation of the disc within the jacket, it may be desirable to provide sufficient play of the disc hub relative to the drive shaft opening in the jacket. However, such play, which generally permits lateral movement of the disc within the jacket, may affect the proper positioning of the disc when the jacket is loaded into a recording/reproducing apparatus. More particularly, when such a jacket is loaded into a recording/reproducing apparatus, the lateral movement of the disc due to the play of the disc hub relative to the jacket opening may result in mis-positioning of the disc such that the magnetic transducer is off-set from the desired relative position thereof on the disc. Hence, if a particular track has been recorded on the disc by a transducer during a previous recording operation, the play of the disc within the jacket may mis-position the transducer when the jacket subsequently is loaded into the same or different recording/reproducing apparatus for a subsequent playback operation. This mis-positioning of the transducer may result in a mis-alignment thereof relative to the desired track.

Another difficulty which may arise due to the play of the disc relative the jacket is that when the jacket is loaded into a recording/reproducing apparatus, the centre of the disc may not be coincident with the axis of the drive shaft that is inserted into the disc hub. Such non-coincidence may result in eccentric rotation of the disc by the shaft.

To provide proper centring of the disc housed within a jacket when the jacket is loaded into a recording/reproducing apparatus, it has been proposed to form the hub with a non-circular opening for receiving the drive shaft of the recording/reproducing apparatus. One example of a magnetic disc assembly having a hub with a non-circular opening is described in U.S. Patent No. 4149207. The non-circular opening described in that patent includes two straight edges which form an angle with each other of about 60°. When a drive shaft is inserted into the non-circular opening, both of these straight edges are brought into tangential contact with the drive shaft and thereby bring the centre of the disc into coincidence with the axis of the shaft. However, the minimum diameter of this non-circular opening is greater than the diameter of the drive shaft. Hence, although the straight edges of this opening are in tangential contact with the drive shaft, the shaft is free to rotate within the opening without also rotating the hub and the disc. Rather, to effect rotation of the disc, an additional pin on the drive mechanism is inserted into a separate aperture on the disc, and the pin is driven to rotate with the drive shaft, thereby exerting a rotary force on the aperture into which it is inserted and, thus, resulting in rotation of the disc. Thus, the angled straight edges of the non-circular opening in the disc serve to centre the disc on the drive shaft, but a separate rotary pin is needed to drive the disc.

The disc drive described in the above-mentioned patent is not satisfactory for use with a magnetic disc having a relatively small diameter. For example, if the disc has a diameter of 50 mm, there is not enough room on the disc for a separate aperture into which a drive pin may be inserted.

According to the present invention there is provided a magnetic disc assembly comprising a magnetic disc and a hub member centrally positioned on said magnetic disc and having a non-circular opening for receiving a circular drive shaft rotatably to drive said magnetic disc, said hub member including two reference surfaces which converge towards each other and respectively form two walls of said opening, and resilient means forming a

unitary part of said hub member and having a surface which forms a third wall of said opening, said three walls being positioned and dimensioned such that both before and when a circular drive shaft is received in said opening, said reference surfaces and said surface of said resilient means are all parallel to the axis of said drive shaft, and when said drive shaft is received in said opening said reference surfaces and said surface of said resilient means all tangentially contact said drive shaft so that said magnetic disc is rotated when said drive shaft rotates.

According to the present invention there is also provided a magnetic disc cartridge comprising a jacket; a magnetic disc rotatably disposed in said jacket; a hub member centrally positioned on said magnetic disc and having a non-circular opening for receiving a circular drive shaft rotatably to drive said magnetic disc; and an aperture in said jacket through which said hub member is accessed; said hub member including two reference surfaces which converge towards each other and which form two respective walls of said opening, and resilient means forming a unitary part of said hub member and having a surface which forms a third wall of said opening, said two reference surfaces being equally radially distant from the centre of said magnetic disc and said resilient means being positioned with respect to said two references surfaces such that both before and when a circular drive shaft is received in said opening, said reference surfaces and said surface of said resilient means are all parallel to the axis of said drive shaft, and when said drive shaft is received in said opening said reference surfaces and said surface of said resilient means all tangentially contact said drive shaft so that said magnetic disc is rotated when said drive shaft rotates.

According to the present invention there is also provided apparatus for recording and/or reproducing signals on a magnetic disc assembly comprising a rotatable magnetic disc; a hub member centrally positioned on said magnetic disc and having a non-circular opening for receiving a circular drive shaft; a jacket containing said magnetic disc and having a first aperture through which said drive shaft passes to be received in said non-circular opening and a second aperture through which said magnetic disc is accessed by transducer means; said hub member having two reference surfaces which converge towards each other and form two walls, respectively, of said opening, and resilient means forming a unitary part of said hub member and which forms at least a third wall of said opening; a

circular drive shaft insertable into said opening, said three walls being positioned and dimensioned such that both before and when said drive shaft is inserted into said opening, said reference surfaces and said surface of said resilient means are all parallel to the axis of said drive shaft, and when said drive shaft is received in said opening said reference surfaces and said surface of said resilient means all tangentially contact said drive shaft so that said magnetic disc is rotated when said drive shaft rotates; and transducer means positionable through said second aperture to record and/or reproduce signals on said magnetic disc.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like references designate like elements, and in which:

Figure 1 is a top plan view of a cartridge containing a flexible magnetic disc, which is shown partly broken away;

Figure 2 is a bottom plan view of the cartridge shown in Figure 1;

Figure 3 is an enlarged sectional view taken along the line 3-3' in Figure 1;

Figure 4 is an enlarged fragmentary top plan view of the cartridge and disc shown in Figure 1; and

Figure 5 is a plan view of another cartridge and disc.

Referring initially to Figures 1, 2 and 3, it will be seen that a cartridge 1 intended for use in a flexible disc recording and/or reproducing apparatus comprises a substantially flat rectangular jacket or housing 2 which may be moulded of a suitable plastics material and has opposed walls 2a and 2b between which a flexible disc 3 of magnetic material is freely rotatable. The disc 3 is of a suitably small diameter, for example, no more than about 50 mm, so that the jacket 2 can be of correspondingly small size, for example, measuring 60 mm by 54 mm by 3 mm, for convenience of handling, storage and shipping, as by mail, and for use in a very compact recording and/or reproducing apparatus which may, for example, be part of a still picture camera which is not substantially larger than a conventional 35 mm single-lens reflex camera. The opposed walls 2a and 2b of the jacket 2 have aligned openings or windows 4 therein which extend, in the radial direction of the disc 3, at least to the inner and outer effective limits of circular recording tracks on a recording surface 3a on the disc 3. A door member 5 straddles the disc 3 and is slidable along an edge portion of the jacket 2 with portions of the door member 5 disposed against the inner surfaces of the walls 2a and 2b for slidable movement in the direction of an arrow 5a in Figure 1 from the illustrated closed position to an open position in which the door member 5 clears the windows 4. A tension spring 5b may be connected to the door member 5 for urging it to its closed position, and a projection 5c extends from the door member 5 and may be acted upon by a suitable member provided on the apparatus which receives the cartridge 1 in the camera (not shown) for opening the door member 5 upon the insertion of the cartridge 1 into the recording and/or reproducing apparatus. When the door

member 5 is thus opened, one or more magnetic heads can extend through one of the windows 4 for magnetically recording information signals, for example recording a still image or picture, in a selected one of concentric circular record tracks on the surface 3a (Figure 3) of the disc 3.

A hub 6 is provided at the centre of the disc 3 and has a hole 7 extending therethrough for receiving a drive shaft (not shown) of the recording and/or reproducing apparatus. The hole 7 is non-circular so as to define a pair of relatively angled positioning surfaces 8 arranged tangentially to engage the circular periphery of the drive shaft for centring the disc 3 relative to the axis of the drive shaft. A resilient chordal element 9 extends across the hole 7 at the side of the latter opposite the surfaces 8. The element 9 is backed up on an elongated hole 10 extending along the element 9 at the side thereof opposite to a surface 9a thereof which faces towards the surfaces 8. The described hub 6 can easily be moulded of suitable plastics material which further lends elasticity to the element 9. The hole 7 is dimensioned so that, when the drive shaft is inserted therein, the element 9 is flexed away from the surfaces 8 by the drive shaft, whereby to maintain firm contact of the surfaces 8 with the outer periphery of the drive shaft.

The hub 6 is further shown to have an annular magnetic member 11 suitably mounted on its lower surface. A magnetic detecting pin 13 for use in detecting the rotational phase or position of the disc 3, and a non-magnetic balancing pin 14 of substantially the same weight as the pin 13 are embedded in the hub 6 at diametrically opposed locations. In one embodiment, at least three supports or feet 16 extend from the lower surface of the hub 6 at equally angularly spaced apart locations which are radially outward with respect to the annular magnetic member 11. The bottom surfaces 16a of the feet 16 project slightly from the underside of the hub 6 and define a reference level with respect to the recording surface 3a of the disc 3. In another embodiment, the feet 16 are replaced by a continuous annular rim. The walls 2a and 2b of the jacekt 2 have central openings 17a and 17b in which the hub 6 is loosely rotatable.

As mentioned above, and as best shown in Figure 4, the non-circular opening 7 of the hub 6 is provided with the two reference or positioning surfaces 8 which converge towards each other and which form two respective walls of the hole 7. Although the surfaces 8 converge towards

each other, it is seen that the converging surfaces 8 do not intersect. The angle formed by the surfaces 8 is not critical; it merely is sufficient that the surfaces 8 tangentially contact a drive shaft of the recording/reproducing apparatus when the cartridge 1 is loaded. The surfaces 8 are equally radially distant from the centre of the disc 3. That is, the shortest radius lines from the centre of the disc 3 to each of the surfaces 8 will be equal.

Figure 4 also illustrates the resilient chordal element 9 as a generally elongated member that is interposed between the non-circular hole 7 and the elongated hole 10, the latter being substantially parallel to the member 9. The surface 9a of the element 9 forms a third wall of the hole 7. In the embodiment of Figure 4, the hub 6 is formed of a suitable plastics material and is of unitary construction. The flexible element 9 is spaced from the surfaces 8 by a fourth wall extending from one of the surfaces 8 to one end of the element 9 and by a fifth wall extending from the other surface 8 to the other end of the element 9.

When the cartridge 1 is loaded into a suitable recording/reproducing apparatus, a circular drive shaft 20 provided in that apparatus is inserted into the non-circular hole 7 of the hub 6. The radius of the drive shaft 20 exceeds the radial distance from the centre of the disc 3 to each of the surfaces 8 and to the surface 9a of the element 9. Consequently, when the drive shaft 20 is inserted, as shown in Figure 4, the resilient element 9 flexes away from the surfaces 8. Hence, the surfaces 8 as well as the surface 9a are in tangential contact with the drive shaft 20; and a resilient bias force urges the drive shaft 20 into firm contact with the surfaces 8 and 9a. More accurately, since the drive shaft 20 is generally fixed in the recording/reproducing apparatus and restrained from lateral movement, the resilient bias force exerted by the element 9 urges the surfaces 8 into firm contact with the drive shaft 20. The contact between the surfaces 8, the surface 9a and the drive shaft 20 is sufficient such that when the drive shaft 20 is rotatably driven, the hub 6 is rotated thereby correspondingly to rotate the disc 3.

From Figure 4, it will be recognized that the angle formed between the surfaces 8, although not critical, is such that lines drawn from the axis of the drive shaft 20 to the tangential contact points on each of the surfaces 8

will be normal to such tangential contact points and intersect at the centre of the disc 3. Thus, the surfaces 8 serve as reference surfaces which, in co-operation with the element 9, serve to bring the centre of the disc 3 into coincidence with the axis of the drive shaft 20.

Preferably, the free end of the drive shaft 20 is conically shaped so that the drive shaft 20 may be easily inserted or guided into the hole 7 along the conical surfaces thereof.

Since the element 9 is integrally formed as a portion of the hub 5, the particular plastics material of which the hub 5 and the element 9 are formed may be suitably selected so as to provide the desirable elasticity or resilience to the element 9.

An alternative hub 6 is illustrated in Figure 5. In this alternative, the single elongated resilient chordal element 9 is replaced by a pair of legs or fingers 9b and 9c which extend towards each other and which are separated by a gap. The legs or fingers are integrally formed with the hub 6 and, thus, are resilient.

Normally, when the drive shaft 20 is not received by the non-circular opening 7, the surfaces of the flexible legs or fingers 9b and 9c are substantially coplanar and, with the gap therebetween, form the third wall of the non-circular hole 7 similar to the third wall formed by the surface 9a of the chordal element 9 in Figure 4. However, when the drive shaft 20 is inserted into the hole 7 of Figure 5, the fingers 9b and 9c flex in a direction away from the surfaces 8, as shown. Hence, the surface of each finger 9b and 9c which faces the hole is in tangential contact with the drive shaft 20.

The geometrical shape of the hole 7 differs in Figure 5 from that shown in Figure 4. In the absence of the drive shaft 20, the hole 7 of Figure 5 exhibits a substantially trapezoidal shape with the fingers 9b and 9c forming the base of the trapezoid and the surfaces 8 forming the angled sides thereof. In the foregoing examples, at least three separated surfaces or walls of the hub 6 are in tangential contact with the drive shaft 20 when it is inserted thereinto. This establishes a fixed relationship between the reference surfaces or walls and the periphery of the drive shaft 20 so as to make the centre of the disc 3 coaxial with the axis of the drive shaft 20. Furthermore, the resilient urging of the element 9 (or the embodiment of either Figure 4 or Figure 5) results in firm contact between at least three walls or surfaces of the hub 6 and the drive shaft 20 such that when the

drive shaft 20 rotates, the hub 6 and, thus, the disc 3, also rotate therewith.

If desired, an additional number of surfaces of walls of the hub 6 may be in tangential contact with the drive shaft 20. Figure 5 illustrates four surfaces in contact with the drive shaft 20, and a greater number of surfaces may be used if desired.

Returning to Figure 1, the cartridge 1 is also provided with an indicator 28, for example, which includes a rotatable dial 29 having a pointer thereon which is rotatable with respect to suitable index marks to provide an indication of the numberof circular tracks which have been recorded on the disc 3. The dial 29 rotates in a step-wise manner linked with the magnetic transducer, or head, which advances from one circular track to the next. The indicator 28 provides an indication of that portion of the recording capacity of the disc 3 which has been consumed or, alternatively, that portion of the recording capacity which remains available for further recording.

Various modifications are of course possible. For example, the converging surfaces or walls 8 may intersect. However, such intersection requires a relatively large space which might not be available with the small dimensions of the disc 3 and the hub 6. Also, the walls in Figure 4 which extend between each of the surfaces or walls 8 and the respective ends of the resilient element 9 may be curved or may be formed as discrete segments if desired.

* C L M S *

CLAIMS

1. A magnetic disc assembly comprising a magnetic disc and a hub member centrally positioned on said magnetic disc and having a non-circular opening for receiving a circular drive shaft rotatably to drive said magnetic disc, said hub member including two reference surfaces which converge towards each other and respectively form two walls of said opening, and resilient means forming a unitary part of said hub member and having a surface which forms a third wall of said opening, said three walls being positioned and dimensioned such that both before and when a circular drive shaft is received in said opening, said reference surfaces and said surface of said resilient means are all parallel to the axis of said drive shaft, and when said drive shaft is received in said opening said reference surfaces and said surface of said resilient means all tangentially contact said drive shaft so that said magnetic disc is rotated when said drive shaft rotates.

2. An assembly according to claim 1 wherein said resilient means comprises a resilient member spaced from each of said two reference surfaces.

3. An assembly according to claim 2 further comprising a fourth wall extending from one of said two respective walls of said opening to said resilient member and a fifth wall extending from the other of said two respective walls of said opening to said resilient member.

4. An assembly according to claim 1 wherein said resilient means comprises first and second resilient members separated by a gap therebetween and each having a surface tangentially to contact said drive shaft when said drive shaft is received.

5. An assembly according to claim 4 wherein the surfaces of said first and second resilient members normally form said third wall of said opening in the absence of said drive shaft, said third wall containing said gap.

6. An assembly according to claim 4 wherein said first and second resilient members are positioned adjacent to said two reference surfaces, respectively.

7. An assembly according to claim 1 wherein said resilient means urges said drive shaft, when said drive shaft is received, into tangential contact with said two reference surfaces.

8. An assembly according to claim 1 wherein said two reference surfaces form an angle such that normals to the tangential contact points of said drive shaft, when received, at each reference surface intersect at the centre of said magnetic disc.

9. An assembly according to claim 1 wherein said two references surfaces are equally radially distant from the centre of said magnetic disc.

10. A magnetic disc cartridge comprising a jacket; a magnetic disc rotatably disposed in said jacket; a hub member centrally positioned on said magnetic disc and having a non-circular opening for receiving a circular drive shaft rotatably to drive said magnetic disc; and an aperture in said jacket through which said hub member is accessed; said hub member including two reference surfaces which converge towards each other and which form two respective walls of said opening, and resilient means forming a unitary part of said hub member and having a surface which forms a third wall of said opening, said two reference surfaces being equally radially distant from the centre of said magnetic disc and said resilient means being positioned with respect to said two references surfaces such that both before and when a circular drive shaft is received in said opening, said reference surfaces and said surface of said resilient means are all parallel to the axis of said drive shaft, and when said drive shaft is received in said opening said reference surfaces and said surface of said resilient means all tangentially contact said drive shaft so that said magnetic disc is rotated when said drive shaft rotates.

11. A magnetic disc cartridge according to claim 10 wherein said hub member is of unitary construction formed of resilient material, and said resilient means comprises a chordal element having a surface which forms said third wall and backed by an elongated hole, said chordal element being disposed between said non-circular opening of said hub member and said elongated hole.

12. A magnetic disc cartridge acording to claim 11 wherein said non-circular opening of said hub member is dimensioned such that when a circular drive shaft is received, said chordal element flexes away from said two reference surfaces.

13. A magentic disc cartridge according to claim 12 wherein said chordal element comprises a pair of legs extending towards each other and separated by a gap.

14. Apparatus for recording and/or reproducing signals on a magnetic disc assembly comprising a rotatable magnetic disc; a hub member centrally positioned on said magnetic disc and having a non-circular opening for receiving a circular drive shaft; a jacket containing said magnetic disc and having a first aperture through which said drive shaft passes to be received in said non-circular opening and a second aperture through which said magnetic disc is accessed by transducer means; said hub member having two reference surfaces which converge towards each other and form two walls, respectively, of said opening, and resilient means forming a unitary part of said hub member and which forms at least a third wall of said opening; a circular drive shaft insertable into said opening, said three walls being positioned and dimensioned such that both before and when said drive shaft is inserted into said opening, said reference surfaces and said surface of said resilient means are all parallel to the axis of said drive shaft, and when said drive shaft is received in said opening said reference surfaces and said surface of said resilient means all tangentially contact said drive shaft so that said magnetic disc is rotated when said drive shaft rotates; and transducer means positionable through said second aperture to record and/or reproduce signals on said magnetic disc.

15. Apparatus according to claim 14 wherein said resilient means comprises a substantially elongated member and an elongated hole, said substantially elongated member being interposed between said non-circular opening and said elongated hole.

16. Apparatus according to claim 15 wherein said hub member further has a pair of walls each of which extends between one of said two walls and a respective end of said substantially elongated member.

17. Apparatus according to claim 14 wherein said resilient means comprises a pair of flexible fingers extending towards each other and separated by a gap, each flexible finger being in contact with said drive shaft when said drive shaft is received in said opening.

18. Apparatus according to claim 17 wherein said opening is substantially trapezoidal and said flexible fingers form the base of the trapezoid.

19. A magnetic disc assembly substantially as hereinbefore described with reference to Figures 1 to 4 of the accompany drawings.

20. A magnetic disc assembly substantially as hereinbefore described with reference to Figures 1 to 4 as modified by Figure 5 of the accompanying drawings.