Description

"METHOD OF BALANCING AN OPTICALLY READABLE STORAGE DISC AND A DISC BALANCED BY THE METHOD"

The invention relates to a method of balancing an interchangeable optically readable storage disc whose mass centre is situated eccentrically of the disc. The invention relates particularly to a method of balancing an interchangeable optically readable storage disc of the kind (hereinafter referred to as the "kind described") comprising a flat transparent substrate having flat sides and a circular periphery, a recording layer which can be modified locally by a radiation beam and which is situated on a flat side of the substrate, a cover which is secured to a flat side of the substrate near the periphery thereof by annular means at a distance from at least that part of the recording layer which is intended for recording, in such a way that a space is enclosed between the substrate and the cover, and protective circumferential means which form part of the annular means and which comprise an outer edge portion with an external diameter which is larger than that of the periphery of the substrate. The invention also relates to a storage disc balanced by the method.

A storage disc of the kind described is disclosed in, for example, Japanese Patent Application 57-172541 (Patents Abstracts of Japan, Vol. 7, No. 18(8-170), (1163), Jan. 25, 1983). The storage disc comprises two flat disc members which are secured to each other by an adhesive with the aid of interposed concentric annular means in the form of annular spacers. These annular means are arranged near a centre hole and near the circumference of the storage disc.

A storage disc which has been used most frequently until now comprises two glass substrates and interposed concentric annular spacers which are secured to each other by means of an adhesive, see US-PS 4,074,282. On the side which faces the sealed space each of the glass substrates is provided with a recording layer. Thus a two-sided storage disc is obtained, one substrate serving as the cover for the other substrate. Another storage disc of the

specified type is described in the Applicants' previously filed European Patent Applications 0,117,576 and 0,118,146. This storage disc comprises only one transparent substrate. The cover is made of a thin aluminium sheet material and the annular means are integral with the cover. The cover is hat-shaped, the brim of the hat having the function of said annular means and the other portion being spaced from the substrate.

Especially when glass substrates are employed problems may arise due to the eccentric location of the mass centre of the storage disc. This may be attributed to various causes. Firstly, glass has a comparatively high specific mass, so that slight eccentricities are liable to give rise to comparatively large out-of-balance forces. A second cause is that it is difficult to manufacture a glass substrate having a perfectly plane parallel shape. The cross-section of the substrate will be substantially wedge-shaped, resulting in an eccentric mass distribution of the substrate. A further cause is the fact that storage discs comprising glass substrates may have diameters of up to substantially 30 cm and are rotated at comparatively high speeds up to 25 or 30 revolutions/sec. In the case of a one-sided storage disc, even if it is not made of glass but, for example, of a plastics, it is rather difficult to ensure that the mass centre coincides exactly with the geometrical centre. When a plurality of disc members, such as a substrate and a cover or two substrates, are secured to each other, the problems multiply.

The invention aims at providing a simple and inexpensive method of balancing an interchangeable optically readable storage disc of the kind described whose mass centre is situated eccentrically of the disc. The method according to the invention comprises correcting the eccentricity of the mass centre by locally and selectively removing portions from the protective circumferential means or by securing balancing mass thereto.

The advantage of the invention is that in the balancing of the optically readable storage disc a part is used which is present anyway, namely the protective circumferential means. In many cases

the substrate in itself is not suitable for balancing purposes, for example, for mounting an additional balancing mass on the substrate or, conversely, removing mass from the substrate. This applies in particular to a glass substrate. A part which is separate from the substrate and which is disposed on the circumference of the storage disc is better suited for this purpose.

A further advantage is that balancing is effected at the periphery, where the effect of removing or adding mass is largest. In particular in the case of interchangeable storage discs, to which the scope of the invention is limited, this is an advantage, because these storage discs have no portions near the centre of the disc which may be used for this purpose. In contrast, in the case of magnetic-disc memories with fixed, rather than interchangeable, storage discs balancing has been effected at the location of a central hub (see for example US-PS 3,838,464).

The invention also provides an interchangeable optically readable storage disc which is balanced by the method according to the invention.

In one embodiment of the storage disc according to the invention said annular means and the protective circumferential means are together constituted by a flat ring which has portions removed from it or balancing mass secured to it to correct the eccentricity of the mass centre of the disc. This is the simplest embodiment of the storage disc according to the invention. The protective circumferential means together with the annular means comprise merely a flat ring of a minimal mass, so that they contribute only to a small extent to the mass intertia and to the eccentricity of the mass centre of the storage disc.

In another embodiment of the storage disc according to the invention the annular means are provided with an outer circumferential edge portion which extends perpendicularly to a flat annular edge portion at some radial distance from the periphery of the substrate and balancing mass is mounted against the outer edge portion to correct the eccentricity of the mass centre of the disc. Said outer edge portion can take up the

centrifugal forces produced by the balancing mass. In this respect, balancing mass is mounted preferably on that side of the outer edge portion which faces the centre of the storage disc. The centrifugal forces now urge the balancing mass against the outer edge portion.

For mounting and securing balancing mass comparatively simple techniques may be used. If the outer edge portion has the shape of an uninterrupted circular outer edge, this provides total freedom as regards the location where balancing mass is removed or added. Preferably, the mass distribution of the storage disc remains substantially symmetrical despite the presence of the protective circumferential means. This has the advantage that if the storage disc should be balanced on one side only it is irrelevant which side faces upwards during balancing on the balancing machine. Some storage discs are centred on one side with centring means which differ from the centring means for the other side. In that case the storage disc cannot be balanced perfectly and a compromise must be found between the two balancing operations which are necessary. Therefore, it is important that balancing mass can be removed or added on each of the two sides of the storage disc.

Embodiments of the invention will now be described in more detail, by way of example, with reference to the drawings, in which Figs. 1 to 6 are perspective and partly sectional views of six interchangeable optically readable storage discs embodying the invention.

In the various figures corresponding parts bear the same reference numerals to which the respective figure number has been prefixed.

The storage disc shown in Fig. 1 comprises a transparent substrate 11 on which a recording layer 12 has been deposited, which layer can be modified by a radiation beam. A cover 13 is secured to the substrate 11 at some distance from the recording layer by annular means 14 and 15, so that a sealed space 16 is enclosed between the substrate and the cover disc. The cover 13 is identical to the transparent substrate 11 and has also been

provided with a recording layer, not shown. Thus, a two-sided storage disc is obtained, one substrate forming a cover for the other substrate. The annular means 14 and 15 comprise concentric annular spacers as disclosed in the afore-mentioned United States Patent Specification 4,074,282. The annular spacer 14 comprises a portion 17 which projects from the circumference of the two substrates 11 and 13 and which serves as protective circumferential means for protecting the edges of the substrates against impact. Assuming the mass centre of the storage disc is located eccentrically of the disc, according to the present invention the portion 17 is also utilised in the correction of the eccentricity. For this purpose holes 18 are formed locally in the portion 17, so that material is removed locally. In many cases the mass of the portion 17 is low in comparison with the total mass of the storage disc, so that the local removal of portions of the protective circumferential means has a comparatively small influence on the location of the mass centre of the storage disc. In such a case the embodiment shown in Fig. 1 may be modified slightly by securing balancing mass, for example lead, to the portion 17, if desired by use of the holes 18. The holes 18 may then be used for anchoring the balancing mass to the portion 17.

The storage disc shown in Fig. 2 is a modification of the storage disc shown in Fig. 1. The difference is that the protective circumferential means 27 are provided with a circumferential outer edge portion 27A which extends perpendicularly to the flat annular edge portion at some radial distance from the substrates 21 and 23, as known per se in a different version from the above-mentioned Japanese Patent Application 57-172541. The balancing means comprise balancing mass in the form of separate balancing portions 28 arranged on the inner side against the outer circumferential portion 27A. The circumferential outer edge portion constitutes an uninterrupted cylindrical wall which extends equal distances from both sides of the annular edge portion. In this way the storage disc has a symmetrical construction and balancing mass may be arranged on both

sides of the storage disc. In practice this will often be necessary in the case of a storage disc which, like the storage disc shown in Fig. 2, comprises two separate substrates if the substrates are made of a comparatively heavy material such as glass. Balancing is effected on a balancing machine by first providing one side of the storage disc with balancing portions 28 during this balancing operation. Subsequently, the storage disc is placed on the balancing machine in an inverted position. The storage disc is always centred in the centre hole of the relevant substrate, so that after the storage disc has been turned over, it must be possible to correct the balancing already performed. This may be effected by mounting further balancing portions on the second side of the storage disc.

In principle many modifications of the storage disc shown in Figs. 1 and 2 are possible. Fig. 3 shows an example of such a modification. The circumferential outer edge portion 37 now has a different shape. In cross-section the assembly comprising the annular means 34 and the outer edge portion 37 has the shape of a fork. The balancing mass may be arranged between the flanges 37A and 37B.

Fig. 4 shows a substrate 41 made of glass or a transparent plastics provided with a recording layer 42. A hat-shaped cover 43 made of thin aluminium sheet or another suitable material is secured to the substrate 41 so as to enclose a sealed space 46 between the substrate and the cover. The brim 44 of the hat-shaped cover 43 constitutes an annular means and is secured to the substrate 41 by means of an adhesive. On its circumference the brim 44 has protective circumferential means in the form of an annular edge portion 47 which is employed in balancing the storage disc. It comprises a crimped portion of the cover disc 43, which adjoins a portion 49 which is sprung over the edge of the substrate 41. For the purpose of balancing the storage disc recesses 48 may be formed in the outer rim 47 by means of a suitable operation such as, for example, grinding or nibbling.

In the modification shown in Fig. 5 the protective

circumferential means 57 is provided with a circumferential cylindrical outer rim 57A. Between this outer rim and the substrate, balancing mass in the form of balancing portions 58 may be arranged in the same way as with the storage disc shown in Figure 2.

The modification shown in Figure 6 uses annular means which are separate from the cover disc 63 and which clamp the substrate 61 and the cover disc 63 onto each other at their peripheries. There are provided circumferential means 67 with a cylindrical outer rim 67A, so that in the same way as with the storage disc shown in Figure 2 balancing mass in the form of balancing portions 68 may be arranged on the inner side of the outer rim.

Within the scope of the invention many modifications are possible in which the protective circumferential means which are present anyway for securing the cover to the substrate may be used in balancing the storage disc.

In order to avoid thermal stresses in the substrate or substrates or damage as a result of shocks or falling, it may often be desirable to construct the protective circumferential means in a manner as described in Applicants' Patent Application No. 8503678, of even date with the present application, now published as GB-A-2155684. According to GB-A-2155684, in a storage disc comprising two identical substrates, between the circular outer rim of each substrate and the periphery of the protective circumferential means a space exists which is substantially free of intermediate means which in the event of deformation of the periphery of the protective circumferential means could transmit to the circular outer rim of the respective substrate a force which is directed towards the centre of the substrate and which has a magnitude such that it could damage the substrate.

The presence of the balancing portions 28, 58 and 68 will generally be acceptable in this respect, because only over a very small part of the circumference of the storage disc can these portions give rise to forces which act on the periphery of the substrate. However, as is shown in Figure 2, it is even better to

provide some space between the balancing portions and the periphery of the substrate. The embodiment shown in Fig. 3 is also favourable in this respect.

* C L M S *

Claims

1. A method of balancing an interchangeable optically readable storage disc of the kind described whose mass centre is situated eccentrically of the disc, the method comprising correcting the eccentricity of the mass centre by locally and selectively removing portions from the protective circumferential means or by securing balancing mass thereto.

2. An interchangeable optically readable storage disc balanced by the method claimed in Claim 1.

3. An interchangeable optically readable storage disc as claimed in Claim 2, in which said annular means and the protective circumferential means are together constituted by a flat ring which has portions removed from it or balancing mass secured to it to correct the eccentricity of the mass centre of the disc.

4. An interchangeable optically readable storage disc as claimed in Claim 2, in which the annular means are provided with an outer circumferential edge portion which extends perpendicularly to a flat annular edge portion at some radial distance from the periphery of the substrate, and balancing mass is mounted against the outer edge portion to correct the eccentricity of the mass centre of the disc.

5. An interchangeable optically readable storage disc as claimed in Claim 4, characterized in that balancing mass is mounted on that side of the outer edge portion which faces the centre of the storage disc.

6. An interchangeable optically readable storage disc as claimed in Claim 2, in which the cover is made of a material other than that of the substrate and has a larger external diametral dimension than the substrate, and the portion of the cover which extends beyond the substrate serves as the protective circumferential means and has portions removed from it or balancing mass secured to it to correct the eccentricity of the mass centre of the disc.

7. An interchangeable optically readable storage disc as claimed in Claim 2 and substantially as described with reference to any of Figures 1 to 6 inclusive of the accompanying drawings.