Description

The invention relates to a method of providing a substrate of an optically readable information disc with an optically detectable structure, which disc can be rotated by means of a drive apparatus comprising a drive spindle and optical read means, which method employs a mould having a base provided with a mould structure which is covered with a reproduction layer, which in a deformable phase adapts itself to the mould structure is subsequently solidified and, while attached to the substrate, is separated from the mould in such way that the structure is maintained.

Such a method is described in the Applicant's previous United States Patent Specification No. 4,312,823. The method described therein relates to the manufacture of a video long-play disc by means of a reproduction layer made of a moulding resin. The substrate is transparent and is made of a suitable synthetic material. The moulding resin may be a radiation-curable moulding resin, which is exposed through the transparent substrate. The method described therein may also be employed for the manufacture of information discs for computer memories and similar uses, on which information can be recorded by means of a suitable light source, such as a laser.

A method of optical information-recording is described in the Applicant's previous United States Patent Specification No. 4,363,116. The information disc is provided with an optically detectable servo track which extends over the entire area of that part of the information disc which is available for recording. The servo track is generally a spiral track, but in principle it may alternatively comprise a multitude of concentric sub-tracks. By means of a servo track it is possible to control the radial position of the radiation spot formed on the information layer by the radiation beam. The servo track may already contain information before the user records information on the information disc. This pre-recorded information in the servo track may comprise, for example, sector addresses in each of which the address of the associated continuous portion of the servo track is encoded in address areas. The servo track contains a multitude of sector addresses per turn of the servo track. In addition to the track number or the number of the turn of the spiral servo track, the sector addresses may, for example, also contain the number of the relevant sector in this track or in this turn. In addition, a plurality of synchronizing areas may be present at the beginning of each sector address, which when read yield a clock regeneration signal which dictates the clock frequency of the electronic clock which determines the frequency with which the information to be recorded is supplied. The layer on which recording is possible by optical means is deposited on the transparent layer provided with the servo track and may be a thin metal layer, for example one containing tellurium.

Generally, optically readable information discs should comply with very stringent requirements as regards the eccentricity of the structure, for example the servo track, relative to the axis of rotation of the information disc. In a known information disc on which recording can be made by optical means, the information disc comprises two glass substrates which are hermetically affixed to each other by means of interposed annular spacers, see for example United States Patent Specification No. 4,074,282. Such a disc, which has a diameter of approximately 30 cm, contains 32,000 spiral grooves with a pitch of 1.6 micron. The eccentricity of the servo track relative to the axis of rotation of the information disc should not exceed 20 microns. It will be evident that when the servo track and the sector addresses are formed on the substrate the method of forming the structure on the substrate should comply with very stringent requirements in view of the extremely small permissible eccentricity.

The method in accordance with the invention provides a solution to this problem and is suitable for forming a structure on a substrate of an information disc with a very small eccentricity, smaller than the required 20 microns, and to this end the invention is characterized in that:

the base of the mould is provided with a base-centring means in the centre;

the mould structure is arranged on the base in a position which is centred relative to the base-centring means;

a disc hub provided with central disc-centring means, intended for centring the finished information disc on the drive spindle of a drive apparatus, is mounted in the centre of the substrate and is permanently attached to the substrate to form an intermediate product;

the intermediate product is centred on the mould through cooperation between the base-centring means and the disc-centring means; and

in the centred position thus obtained the intermediate product is fixed on the mould until the reproduction layer has solidified and adheres to the substrate.

The small eccentricity of the structure on the substrate obtained by means of the method of the invention is due to the fact that the accuracy with which the mould structure is centred relative to the base is transferred to the intermediate product through the cooperation between the disc-centring means and the base-centring means and is subsequently maintained because prior to the transfer step the hub has been attached permanently to the substrate. During use the finished information disc cooperates with the drive spindle of a drive apparatus using the same disc-centring means that were employed during manufacture for centring the information disc on the mould. Thus, the high accuracy of the centring on the mould is not lost at a later stage, which would happen if the disc-centring means would have been mounted at a later stage. A substantial advantage of the invention is that the method can be carried out with a short cycle time. This is

because the method does not require any measurements and/or alignments. The optical information disc is manufactured by means of expensive equipment in clean rooms so that a very short cycle time is very desirable in order to reduce the cost price of the product.

Usually the mould structure is formed on a carrier obtained by an electroplating method and is secured to the base as a thin metal disc, generally referred to a "shell". A method of manufacturing a mould suitable for the invention will be described hereinafter.

Although the invention is primarily intended for use with transparent glass or plastics substrates and with a reproduction layer made of a transparent radiation-curable moulding resin, the invention may in principle also be applied to methods using non-transparent substrates and reproduction layers of a different type. This layer may be for example a plastics foil which adapts itself to the mould structure under the influence of heat. It is also conceivable that a reproduction layer is formed by softening the surface of the substrate itself.

A suitable embodiment of the invention is characterized in that the base-centring means comprise a central recess in the base of the mould and the disc-centring means comprise a central through-hole in the disc hub, and the intermediate product is centred by means of an auxiliary-centring means which is inserted into the through-hole in the hub and makes contact both with the wall of the central recess in the base and with the wall of the through-hole in the hub.

An important aspect of this embodiment is that the base-centring means have a very simple shape and can be manufactured easily. Damaging of the base-centring means is practically impossible, because these means do not project from the base. The auxiliary centring means have a simple shape and yet contribute to a high centring accuracy. Preferably, the construction is such that the auxiliary centring means cooperate with the two said walls without clearance.

In this respect an embodiment is preferred, which is characterized in that the disc hub is axially deformable to a limited extent and when the auxiliary centring means are inserted they first abut against the wall of the through-hole in the disc hub and, subsequently, after an axial displacement, also abut against the wall of the central recess in the base of the mould. Since the auxiliary centring means abut both against the wall of the through-hole in the hub and against the wall of the central recess in the base of the mould, this ensures that for auxiliary centring means cooperate with the two other centring means without any clearance. As a result of the axial deformability of the hub the cooperation with these two centring means is independent of any tolerances in the axial distance between the base-centring means and the disc-centring means of an intermediate product which is mounted on the mould. These variations can only give rise to variations in the axial deformation of the hub relative to the mould.

A slight axial deformation of the hub is a centring principle which is also suitable for centring a finished information disc on a drive apparatus. United States Patent Specification No. 4,224,748 describes such a centring principle for a magnetic information disc. Since an axial deformation of the hub may lead to small displacements in a radial direction of the substrate relative to the mould a further embodiment of the invention is important, which is characterized in that said axial deformation of the disc hub on the mould has a predetermined value equal to the axial deformation to which the hub is subjected when the finished information is mounted on the spindle of a drive apparatus. By means of this embodiment it is achieved that centring errors as a result of axial deformation of the hub when the finished information disc is mounted on a drive spindle have no, or at least a very small, influence on the eccentricity. This is because allowance is made for such errors when the substrate is provided with the structure.

Satisfactory results have been obtained with a method which is characterized in that the auxiliary centring means comprise a centring face which is situated on a spherical surface and which engages with said walls of the disc hub and the mould along circular lines of contact. This embodiment is particularly suitable in combination with a further embodiment, which is characterized in that the wall of the central recess in the base of the mould is situated on a conical surface and the wall of the through-hole in the disc hub is situated on a spherical surface of a diameter substantially equal to that on which the centring face of the auxiliary centring means is situated.

In order to enable the auxiliary centring means to be handled more conveniently, they may comprise a ball mounted on a stem. Balls having radii with very small tolerances are commercially available. A similar ball may be used on the spindle of the drive apparatus for which the information disc is intended.

The invention also relates to a method according to Claim 1, which comprises the manufacture of a mould which is eminently suitable for providing a substrate with a structure by means of the method defined in the foregoing. This method comprises the steps of:

detachably connecting a separate structure carrier provided with the mould structure to an auxiliary substrate identical to the substrate defined in Claim 1,

using an auxiliary tool provided with tool-centring means identical to the base-centring means defined in Claim 1,

centring the mould structure relative to the tool-centring means using suitable auxiliary equipment,

centring in this centred relationship a disc hub, as defined in Claim 1, relatively to the auxiliary substrate by a cooperation between the tool-centring means and the disc-centring means in the same way as defined in Claim 1,

fixedly connecting the disc hub thus centred to

the auxiliary substrate,

placing and centring the assembly comprising the structure carrier, the auxiliary substrate and the disc hub on the base of the mould in the same way as the intermediate product is centred on the mould as defined in Claim 1, and

in the position thus centred fixedly connecting the structure carrier to the base and detaching the auxiliary substrate together with the disc hub from the mould.

The above method is cheap because of the use of a disc hub which is also employed for the manufacture of the information discs and which is therefore available anyway. The auxiliary substrate may be a substrate of the kind which is also employed in the manufacture of the information disc. Consequently, the intermediate product is cheap and may be disposed of after use. Since the structure carrier is centred on the mould by exactly the same means by which the substrates are subsequently centred on the mould, a previously unattainable degree of centring accuracy is obtained. It is found that in this way the eccentricity of the servo track of an information disc can be reduced to less than 5 microns. The auxiliary substrate can be connected to the structure carrier in a readily detachable manner without applying any external forces by using an embodiment, wherein the auxiliary substrate is transparent and the auxiliary substrate is detachably connected to the structure carrier by means of a substance which in a liquid phase is applied between the structure carrier and the auxiliary substrate and which is cured under the influence of radiation to which it is exposed through the substrate.

For handling the intermediate product—the assembly comprising the substrate to which the disc hub is secured—in the various stages of manufacturing the information disc it is found to be advantageous to use a method wherein the disc hub is formed with a plurality of recesses or openings at a distance from the centre for receiving portions of an auxiliary tool for manipulating the intermediate product. In this way it is possible to preclude damage to the disc-centring means during manufacture, which might subsequently lead to an undesired increase in the eccentricity of the structure relative to the axis of rotation of the information disc.

A favourable embodiment of the invention may be used, wherein the disc hub is made of one piece of a resilient metal sheet material which is locally formed with apertures to increase its axial flexibility. In this embodiment the disc hub may be a single part which is suitable for being connected to the substrate and in which the disc-centring means are formed directly by means of suitable metal-deformation methods. Moreover, this embodiment in particularly suitable for use in an information disc of the type in which a cover disc, which may be constituted by a second substrate, is mounted coaxially with and at a distance from the substrate by spacer means near the centre of the information disc. Such an information disc may be manufactured by a method, wherein the disc hub forms part of the spacer means.

In known information discs comprising spacer means, see for example the aforementioned United States Patent Specification No. 4,074,282, the spacer means comprise annular spacers made of a metal, because metal is not permeable to oxygen or water vapour from the surrounding atmosphere. This is important because oxygen and water vapour may affect the properties of the metal recording layer. With an information disc manufactured in accordance with the invention it is not necessary to use additional annular spacers near the centre. Moreover, each disc hub has already been secured to a substrate in an earlier stage, so that only the other substrate has to be secured, as the case may be *via* another disc hub. If two substrates are secured to each other, the presence of said recesses or openings for the insertion of an auxiliary tool is advantageous for centring the two substrates relative to each other, specifically in order to preclude an unbalance. When the information disc is mounted on a drive apparatus each substrate is centred on the drive spindle by means of its own disc hub, so that an information disc having two sides on which recordings can be made is centred relative to the drive spindle of the drive apparatus in the same way as two separate information discs each having separate centring means.

Some embodiments of the invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view across the centre of a part of a mould with a superimposed substrate and a view of a part of an auxiliary tool used in the method in accordance with the invention,

Fig. 2 is a full-scale plane view of a disc hub mounted on a substrate, and

Fig. 3 is a substantially full-scale sectional view of a part of an information disc accommodated in an associated enclosure and situated at some distance from a spindle of a drive apparatus.

Fig. 1 shows a mould having a base 1A to which a structure carrier 18 is fixedly connected. The upper side of this carrier has a mould structure 2, which is the negative of a structure to be formed on the substrate 3. In the present embodiment the substrate is transparent and is made of, for example, glass or a polycarbonate. Between the mould structure 2 and the substrate a reproduction layer 4 is applied in a liquid condition. In the present embodiment this layer is a layer of a radiation-curable substance applied by means of a method as described in the Applicant's previously mentioned United States Patent Specification No. 4,312,823 (PHN 8712). In accordance with this known method a ring of a liquid moulding resin is applied to the mould near the centre of the mould structure and a substrate which has been preformed to give it a vaulted spherosymmetrical shape is first placed on the resin near the centre, after which by gradually eliminating the vaulted

shape the ring of resin is spread uniformly in a radial direction to form a thin layer. The resin is cured by exposing the reproduction layer to radiation 5 produced by a suitable radiation source. The radiation traverses the transparent substrate 3 and causes polymerization of the resin, so that the reproduction layer changes from the deformable phase to a solid phase. The reproduction layer then adheres to the substrate, so that after curing the substrate with the reproduction layer can be taken from the mould whilst maintaining the structure reproduced in the reproduction layer.

In Fig. 1 the centre of the mould 1 is marked by the central axis 6. The object of the method in accordance with the invention is to guarantee that the axis of rotation of the finished information disc, of which eventually the substrate 3 will form a part, coincides as far as possible with the central axis 6. Prior to this the mould structure is centred very accurately relative to the central axis 6. As will be described hereinafter, the mould structure 2 is formed on the base 1A in a position which is centred relative to and with the aid of the base-centring means 7. Therefore, it is essential to centre the substrate 3 very accurately relative to the mould. For this purpose the base 1A of the mould carries base-centring means 7 in its centre. A disc hub 8 is secured to the centre of the substrate 3 by any suitable means, for example by means of a suitable adhesive layer, such as an epoxy resin. Once the hub has been mounted it remains connected to the substrate, even upon completion of the method described here, and forms part of the information disc to be manufactured. The disc hub comprises disc-centring means 9 which are intended for centring the finished information disc on the drive spindle of a drive apparatus. In this way an intermediate product is obtained, which comprises the substrate 3 and the disc hub 8. A stock of such intermediate products can be manufactured in advance by separate manufacturing means and in a later stage they may be provided with the desired structure. An essential aspect of the invention is that the intermediate product is centred on the mould by the cooperation between the base-centring means 7 and the disc-centring means 9, thus providing the required high centring accuracy of the mould structure 2 relative to the axis of rotation of the information disc to be manufactured. After the substrate has thus been centred on the mould the reproduction layer is cured in this centred position and thereby also adheres to the substrate.

In the present embodiment the base-centring means 7 comprise a central recess 10 in the base. The disc-centring means 9 comprise a central through-hole 11 in the disc hub 8. The intermediate product is centred on the mould with the aid of separate auxiliary centring means 12 which are inserted through the hole 11 in the drive hub 8 and which are in contact both with the wall 13 of the central recess 10 in the base 1A and with the wall 14 of the through-hole 11 in the disc hub 8. Fig. 1 shows the auxiliary centring means 12 in a position at some distance above the disc hub 8. For an accurate centring of the disc hub hence of the substrate, these auxiliary centring means are axially lowered as indicated by the arrow 15.

The end of the auxiliary centring means 12 comprise a spherical portion 12A of accurately defined diameter formed on a stem 12B. The centring face of the auxiliary centring means is situated on the surface of the ball 12A and engages against walls 13 and 14 of the disc hub and the mould respectively along circular lines of contact. In the present embodiment the wall 13 is situated on a conical surface whose axis coincides with the central axis 6. The wall 14 of the through-hole 11 in the disc hub 8 is situated on the surface of a sphere 16 represented by a broken line. The diameter of this sphere is substantially equal to that of the sphere 12A on which the centring face of the auxiliary means 12 is situated.

Centring of the intermediate product comprising the substrate 3 and the disc hub 8 on the mould 1 is effected as follows. After a ring of moulding resin has been deposited on the mould in the manner described in the foregoing and the substrate has been lowered onto the mould, thereby forming the reproduction layer, the intermediate product and the mould are in the pre-centred position relative to each other as shown in Fig. 1. The auxiliary centring means 12 are brought into contact with the wall 14 of the central hole 11 in the hub 8, which may be effected manually. By exerting some axial force the disc hub 8 is axially distorted to a limited extent. The ball 12A projects slightly from the hub 8 and the projecting portion engages against the wall 13 of the central recess 10 in the base 1A of the mould. In this situation the ball 12A is in contact with the wall 14 of the hub 8 and with the wall 13 of the base 1A along circular lines of contact, without the hub 8 and the base 1A locally being in contact with each other. The ball 12A is in contact with both the mould and the hub 8 without any clearance. This guarantees an excellent centring. It is very important that in the present method the centring of the intermediate product and the mould relative to each other does not depend on the clearance between the various parts. An advantage is that the direction in which the auxiliary centring means 12 are moved from the position shown in Fig. 1 need not be perfectly axial, because this direction is in principle irrelevant as a result of the spherical shape of the ball 12. In the auxiliary centring means are applied by means of a mechanically actuated mechanism, possible loss motion in the mechanism used will not affect the centring of the intermediate product on the mould. The excellent centring cannot be disturbed after this, because the hub is fixedly connected to the substrate and can no longer be moved relative to this substrate.

When the disc hub 8 is axially deformed for centring the intermediate product on the mould a minimal axial displacement of the substrate relative to the mould is possible as a result of a radial

compo of the axial deformation of the disc hub. In order to minimize the effect of this displacement on the centring of the information disc on the drive spindle of a drive apparatus, steps are taken to ensure that the axial deformation of the hub on the mould has a predetermined value equal to the values of the axial deformation to which the hub is subjected when the finished information disc is mounted on the spindle of a drive apapratus. Thus, the above effect is reproduced every time that the information disc is placed on a drive spindle. Therefore, no undesired eccentricity results, because allowance is made for this effect when the substrate is provided with the structure.

The mould in Fig. 1 is manufactured as follows. A negative is made from a "mother disc", provided with a structure which eventually should be formed on the information disc to be manufactured, using known, for example electroforming, techniques, which negative may be connected to a metal backing plate, which in the present Application is referred to as a "structure carrier" 1B. This carrier is detachably connected to an auxiliary substrate, for example identical to the substrate 3. This may be effected, for example, by applying a liation-curable reproducing layer between the ucture carrier and the auxiliary substrate in the manner described. The auxiliary substrate need only be centred enough relative to the structure carrier. The adhesion of the reproduction layer is adequate temporarily connecting auxiliary substrate and the structure carrier to each other.

An auxiliary tool comprises tool-centring means which are identical to the base-centring means 7 of the base 1A and which thus also comprise a conical recess 10 with a wall 13 which is disposed on conical surface. By suitable means, for example optical measuring equipment, the assembly comprising the auxiliary substrate and the separate structure carrier is centred relative to the tool-centring means. For this purpose it should be possible to detect the mould structure, which in the present embodiment is simple when a transparent auxiliary substrate and a transparent reproduction layer are used.

After the mould structure has thus been centred accurately relative to the tool-centring means a hub 8 is placed on the auxiliary substrate and is centred relative to the tool-centring means using auxiliary centring means identical to the auxiliary centring means 12. In the centred relationship thus obtained, the disc hub 8 is fixedly connected to the auxiliary substrate, for example by means of a suitable type of cold-curing adhesive.

The assembly comprising the interconnected structure carrier, the auxiliary substrate and the disc hub is now placed on and centred relative to the base of the mould in accordance with the method described with reference to Fig. 1. Subsequently, the structure carrier 1B is affixed to the base 1A, for example by vacuum suction, and the substrate 3 carrying the reproduction layer is detached from the structure carrier 1B.

By means of the above-described methods of manufacturing the mould and forming the structure on the substrate of the information disc excellent results have been achieved, the eccentricity of the structure of the finished information disc thus manufactured being less than 5 microns. In this respect, it should be borne in mind that accurate measuring equipment is necessary only in the manufacture of the mould. An important variant of the method of manufacturing the mould is the method employing a radiation-curable resin for temporarily connecting the auxiliary substrate to the structure carrier. Thus, the temporarily connection is obtained without the auxiliary substrate and the separate structure carrier being subjected to any stresses. This precludes the occurrence of deformations which may affect the attainable accuracy.

Fig. 3 shows an information disc 17 comprising two substrates 3 each having a separate disc hub 8. The information disc is accommodated in an enclosure 18 comprising two parts 18A and 18B. The design of the enclosure falls beyond the scope of the present invention and is therefore not described. It is to be noted merely that when placed in a drive apparatus the two parts 18A and 18B are axially moved relative to each other to provide room for the rotation of the information disc. The two disc hubs are identical to each other and identical to the disc hub shown in Figs. 1 and 2. As is shown in Fig. 2, the hub 8 is formed with three through-holes 19 at some distance from the centre. These holes serve for inserting parts of an auxiliary tool (not shown), which during the manufacture is employed for manipulating the intermediate product comprising the substrate and the hub which is secured thereto. In this way it is not necessary to use the central hole 11 of the hub for manipulating the intermediate product. This is important because the wall 14 of the central hole is liable to be damaged. Any damage to this wall, even the slightest damage, contributes to the eccentricity of the structure on the substrate relative to the axis of rotation of the finished information disc. As is shown clearly in Fig. 2, the disc hub is made of one piece of a resilient metal sheet material, which is locally formed with openings to increase its axial flexibility. In the present embodiment, in particular the openings 20 and 21, are important in this respect. In this way the radial disc hub is formed with radial blade springs 22, whose radial ends are connected to tangential blade springs 23, thereby guaranteeing the desired axial flexibility.

The two substrates 3 of the information disc shown in Fig. 3 are coaxially spaced from each other by first circumferential spacer means 24 and second spacer means 25 near the centre of the information disc. The outer spacer means 24 comprise a metal annular spacer of T-shaped cross-section. In this way an annular guard ring is formed around the information disc. The second spacer means 25 nearer the centre of the information disc comprise the interconnected annular outer portions 26 of the two hubs 8. In this way the disc hubs have a double function. They serve not

only for centring the information disc on the drive spindle 27 (see Fig. 3), but they also function as the spacer between the substrate and a cover plate, which may be formed by a second substrate. Although the information disc 17 in Fig. 3 comprises two substrates, it is important that the structure on each substrate is centred relative to the axis of rotation 28 of the drive spindle 27 by means of an associated separate hub 8. Therefore, the two substrates need not be centred perfectly relative to each other. Moreover, this is practically impossible, at least very difficult, in practice.

In order to be driven the information disc 17 comprises a hub in its centre, which hub comprises two identical plastic shells 28 in which a soft-iron ring 29 is glued. The two shells are circumferentially supported by the two substrates and are interconnected by three bolts 30 and nuts 31 inserted through holes 19 in the hubs. The drive spindle 27 comprises a flange 32, which carries a magnetic ring 33 and a central centring pin 34 having a spherical end portion 35. The radius of the spherical surface of the drive spindle is exactly equal to the radius of the ball 12A of the auxiliary centring means in Fig. 1. The information disc is mounted on the drive spindle 27 in such a way that the spherical end portion 35 of the centring pin 34 engages the central opening 11 in the hub. The metal ring 29 is drawn against the permanent magnet 33, so that the spherical end portion 35 of the centring pin abuts against the wall 14 of the central hole 11. As already stated, this gives rise to a small predetermined axial deformation of the hub.

Within the scope of the invention many variants are possible. The substrate need not be transparent, the reproduction layer need not be made of a radiation-curable resin, the disc hub need not be made in one piece and need not be made of a metal or entirely of a metal, the base-centring means and the disc-centring means may comprise centring means other than a central recess and a central hole respectively, for example means which are pin-shaped, for example similar to the centring pin 34 of the drive spindle 27 shown in Fig. 3.

Claims

1. A method of providing a substrate of an optically readable information disc with an optically detectable structure, which disc can be rotated by means of a drive apparatus comprising a drive spindle and optical read means, which method employs a mould having a base provided with a mould structure which is covered with a reproduction layer, which in a deformable phase adapts itself to the mould structure, is subsequently solidified and, while attached to the substrate, is separated from the mould in such a way that the structure is maintained, characterized in that:

the base (1A) of the mould is provided with base-centring means (7) in its centre,

the mould structure (2) is arranged on the base (1A) in a position which is centred relative to the base-centring means (7),

a disc hub (8) provided with central disc-centring means (9), intended for centring the finished information disc on the drive spindle of a drive apparatus, is mounted in the centre of the substrate (3) and is permanently attached to the substrate to form an intermediate product,

the intermediate product is centred on the mould (1) through cooperation between the base-centring means (7) and the disc-centring means (9), and

in the centred position thus obtained the intermediate product is fixed on the mould (1) until the reproduction layer (4) has solidified and adheres to the substrate (3).

2. A method as claimed in Claim 1, characterized in that the base-centring means comprise a central recess (10) in the base (1A) of the mould (1) and the disc-centring means (9) comprise a central through-hole (11) in the hub (8), and the intermediate product is centred by means of an auxiliary centring means (12) which is inserted into the through-hole (11) in the hub (8) and makes contact both with the wall (13) of the central recess (10) in the base (1A) and with the wall (14) of the through-hole (11) in the hub (8).

3. A method as claimed in Claim 2, characterized in that the disc hub (8) is axially deformable to a limited extent and when the auxiliary centring means (12) are inserted they first abut against the wall (14) of the through-hole (11) in the disc hub (8) and subsequently, after an axial displacement, also abut against the wall (13) of the central recess (10) in the base (1A) of the mould (1).

4. A method as claimed in Claim 3, characterized in that said axial deformation of the disc hub (8) on the mould (1) has a predetermined value equal to the axial deformation to which the hub is subjected when the finished information disc is mounted on the spindle of a drive apparatus.

5. A method as claimed in Claim 3, characterized in that the auxiliary centring means (12) comprise a centring face which is situated on a spherical surface (12A) and which engages with said walls (13, 14) of the disc hub (8) and the mould (1) along circular lines of contact.

6. A method as claimed in Claim 5, characterized in that the wall (13) of the central recess (10) in the base (1A) of the mould (1) is situated on a conical surface and the wall (14) of the through-hole (11) in the disc hub (8) is situated on a spherical surface (16) of a diameter substantially equal to that on which the centring face of the auxiliary centring means (12) is situated.

7. A method according to Claim 1, which method comprises manufacture of the mould employed, which manufacture comprises the steps of:

detachably connecting a separate structure carrier provided with the mould structure to an

only for centring the information disc on the drive spindle 27 (see Fig. 3), but they also function as the spacer between the substrate and a cover plate, which may be formed by a second substrate. Although the information disc 17 in Fig. 3 comprises two substrates, it is important that the structure on each substrate is centred relative to the axis of rotation 28 of the drive spindle 27 by means of an associated separate hub 8. Therefore, the two substrates need not be centred perfectly relative to each other. Moreover, this is practically impossible, at least very difficult, in practice.

In order to be driven the information disc 17 comprises a hub in its centre, which hub comprises two identical plastic shells 28 in which a soft-iron ring 29 is glued. The two shells are circumferentially supported by the two substrates and are interconnected by three bolts 30 and nuts 31 inserted through holes 19 in the hubs. The drive spindle 27 comprises a flange 32, which carries a magnetic ring 33 and a central centring pin 34 having a spherical end portion 35. The radius of the spherical surface of the drive spindle is exactly equal to the radius of the ball 12A of the auxiliary centring means in Fig. 1. The information disc is mounted on the drive spindle 27 in such a way that the spherical end portion 35 of the centring pin 34 engages the central opening 11 in the hub. The metal ring 29 is drawn against the permanent magnet 33, so that the spherical end portion 35 of the centring pin abuts against the wall 14 of the central hole 11. As already stated, this gives rise to a small predetermined axial deformation of the hub.

Within the scope of the invention many variants are possible. The substrate need not be transparent, the reproduction layer need not be made of a radiation-curable resin, the disc hub need not be made in one piece and need not be made of a metal or entirely of a metal, the base-centring means and the disc-centring means may comprise centring means other than a central recess and a central hole respectively, for example means which are pin-shaped, for example similar to the centring pin 34 of the drive spindle 27 shown in Fig. 3.

Claims

1. A method of providing a substrate of an optically readable information disc with an optically detectable structure, which disc can be rotated by means of a drive apparatus comprising a drive spindle and optical read means, which method employs a mould having a base provided with a mould structure which is covered with a reproduction layer, which in a deformable phase adapts itself to the mould structure, is subsequently solidified and, while attached to the substrate, is separated from the mould in such a way that the structure is maintained, characterized in that:

the base (1A) of the mould is provided with base-centring means (7) in its centre,

the mould structure (2) is arranged on the base (1A) in a position which is centred relative to the base-centring means (7),

a disc hub (8) provided with central disc-centring means (9), intended for centring the finished information disc on the drive spindle of a drive apparatus, is mounted in the centre of the substrate (3) and is permanently attached to the substrate to form an intermediate product,

the intermediate product is centred on the mould (1) through cooperation between the base-centring means (7) and the disc-centring means (9), and

in the centred position thus obtained the intermediate product is fixed on the mould (1) until the reproduction layer (4) has solidified and adheres to the substrate (3).

2. A method as claimed in Claim 1, characterized in that the base-centring means comprise a central recess (10) in the base (1A) of the mould (1) and the disc-centring means (9) comprise a central through-hole (11) in the hub (8), and the intermediate product is centred by means of an auxiliary centring means (12) which is inserted into the through-hole (11) in the hub (8) and makes contact both with the wall (13) of the central recess (10) in the base (1A) and with the wall (14) of the through-hole (11) in the hub (8).

3. A method as claimed in Claim 2, characterized in that the disc hub (8) is axially deformable to a limited extent and when the auxiliary centring means (12) are inserted they first abut against the wall (14) of the through-hole (11) in the disc hub (8) and subsequently, after an axial displacement, also abut against the wall (13) of the central recess (10) in the base (1A) of the mould (1).

4. A method as claimed in Claim 3, characterized in that said axial deformation of the disc hub (8) on the mould (1) has a predetermined value equal to the axial deformation to which the hub is subjected when the finished information disc is mounted on the spindle of a drive apparatus.

5. A method as claimed in Claim 3, characterized in that the auxiliary centring means (12) comprise a centring face which is situated on a spherical surface (12A) and which engages with said walls (13, 14) of the disc hub (8) and the mould (1) along circular lines of contact.

6. A method as claimed in Claim 5, characterized in that the wall (13) of the central recess (10) in the base (1A) of the mould (1) is situated on a conical surface and the wall (14) of the through-hole (11) in the disc hub (8) is situated on a spherical surface (16) of a diameter substantially equal to that on which the centring face of the auxiliary centring means (12) is situated.

7. A method according to Claim 1, which method comprises manufacture of the mould employed, which manufacture comprises the steps of:

detachably connecting a separate structure carrier provided with the mould structure to an

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auxiliary substrate identical to the substrate defined in Claim 1,

using an auxiliary tool provided with tool-centring means identical to the base-centring means defined in Claim 1,

centring the mould structure relative to the tool-centring means using suitable auxiliary equipment,

centring in this centred relationship a disc hub, as defined in Claim 1, relatively to the auxiliary substrate by a cooperation between the tool-centring means and the disc-centring means in the same way as defined in Claim 1,

fixedly connecting the disc hub thus centred to the auxiliary substrate,

placing and centring the assembly comprising the structure carrier, the auxiliary substrate and the disc hub on the base of the mould in the same way as the intermediate product is centred on the mould as defined in Claim 1, and

in the position thus centred fixedly connecting the structure carrier to the base and detaching the auxiliary substrate together with the disc hub from the mould.

8. A method as claimed in Claim 7, wherein the auxiliary substrate is transparent and the auxiliary substrate is detachably connected to the structure carrier by means of a substance which in a liquid phase is applied between the structure carrier and the auxiliary substrate and which is cured under the influence of radiation to which it is exposed through the substrate.

9. A method as claimed in Claim 1 and wherein the disc hub (8) is formed with a plurality of recesses or openings (19) at a distance from the centre for receiving portions of an auxiliary tool for manipulating the intermediate product.

10. A method according to Claim 3, and wherein the disc hub (8) is made of one piece of a resilient metal sheet material which is locally formed with apertures (20, 21) to increase its axial flexibility.

11. A method according to Claim 1, the disc being of the type in which a cover plate, which may be constituted by a second substrate, is mounted coaxially with and at a distance from the substrate (3) by spacer means (25) near the centre of the information disc, wherein the disc hub (8) forms part of the spacer means (25).

Patentansprüche

1. Verfahren um ein Substrat einer optisch lesbaren Informationsplatte mit einer optisch detektierbaren Struktur zu versehen, wobei diese Platte mittels eines Antriebsapparats mit einer Antriebsspindel und mit optischen Lesemitteln in Drehung versetzt werden kann, wobei bei diesem Verfahren eine Form verwendet wird, deren Boden mit einer Formstruktur mit einer diese bedeckenden Reproduktionsschicht versehen ist, die sich in einer verformbaren Phase an die Formstruktur anpaßt, danach ausgehärtet wird und, weil sie sich an das Substrat heftet, derart aus der Form entfernt wird, daß die Struktur beibehalten wird, dadurch gekennzeichnet, daß:

der Boden (1A) der Form in der Mitte mit Bodenzentriermitteln (7) versehen ist,

die Formstruktur (2) auf dem Boden (1A) vorgesehen ist und zwar in einer gegenüber den Bodenzentriermitteln (7) zentrierten Lage,

in der Mitte des Substrats (3) eine Plattennabe (8) mit zentralen Plattenzentriermitteln (9) zum Zentrieren der fertigen Informationsplatte auf der Antriebsspindel eines Antriebsapparates angeordnet und mit dem Substrat ortsfest verbunden ist zum Bilden eines Zwischenerzeugnisses,

das Zwischenerzeugnis durch Zusammenarbeit zwischen den Bodenzentriermitteln (7) und den Plattenzentriermitteln (9) in der Form (1) zentriert ist, und

in der auf diese Weise erhaltenen zentrierten Lage das Zwischenerzeugnis in der Form (1) befestigt ist bis die Reproduktionsschicht ausgehärtet ist und an dem Substrat (3) haftet.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Bodenzentriermittel eine zentrale Ausnehmung (10) in dem Boden (1A) der Form (1) aufweisen und die Plattenzentriermittel (9) eine zentrale hindurchgehende Öffnung (11) in der Nabe (8) aufweisen, und das Zwischenerzeugnis mittels eines Hilfzentriermittels (12) zentriert wird, das in die hindurchgehende Öffnung (11) in der Nabe (8) eingeführt wird und die Wand (13) der zentralen Ausnehmung (10) in dem Boden (1A) sowie die Wand (14) der hindurchgehenden Öffnung (11) in der Nabe (8) berührt.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß die Plattennabe (8) in der axialen Richtung in beschränktem Masse verformbar ist und wenn die Hilfszentriermittel (12) eingeführt werden, diese zunächst die Wand (14) der hindurchgehenden Öffnung (11) in der Plattennabe (8) berühren und danach, nach einer axialen Verschiebung, ebenfalls die Wand (13) der zentralen Ausnehmung (10) in dem Boden (1A) der Form (1) berühren.

4. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die axiale Verformung der Plattennabe (8) auf der Form (1) einen vorbestimmten Wert hat, der der axialen Verformung, der die Nabe ausgesetzt ist, wenn die fertige Informationsplatte auf der Spindel eines Antriebsapparates angeordnet wird, entspricht.

5. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die Hilfszentriermittel (12) eine Zentrierfläche aufweisen, die auf einer sphärischen Fläche (12A) liegt und mit den genannten Wänden (13, 14) der Plattennabe (8) und der Form (1) längs kreisförmiger Kontaktlinien zusammenarbeiten.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß die Wand (13) der zentralen Ausnehmung (10) in dem Boden (1A) der Form (1) auf einer kegelförmigen Fläche liegt und die Wand (14) der hindurchgehenden Öffnung (11) in der Plattennabe (8) auf einer sphärischen Fläche (16) mit einem Durchmesser im wesentlichen entsprechend dem, auf dem die Zentrierfläche der Hilfszentriermittel (12) liegt.

7. Verfahren nach Anspruch 1, das die Herstellung der verwendeten Form umfasst, wobei die-

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ses Herstellungsverfahren die nachfolgenden Verfahrensschritte aufweist:

die entfernbare Befestigung eines einzelnen mit der Formstruktur versehenen Strukturträgers an einem dem in Anspruch 1 beschriebenen Substrat entsprechenden Hilfssubstrat,

die Verwendung eines mit Werkzeugzentriermitteln versehenen Hilfswerkzeugs, wobei diese Mittel den in Anspruch 1 beschriebenen Bodenzentrierungsmitteln entsprechen,

die Zentrierung der Formstruktur gegenüber den Werkzeugzentriermitteln unter Verwendung einer geeigneten Hilfsausrüstung,

die Zentrierung, in diesem zentrierten Verhältnis, einer Plattennabe, wie in Anspruch 1 erwähnt, gegenüber dem Hilfssubstrat durch Zusammenarbeit zwischen den Werkzeugzentriermitteln und den Plattenzentriermitteln auf dieselbe Art und Weise wie in Anspruch 1 beschrieben,

die ortsfeste Verbindung der auf diese Weise zentrierten Plattennabe mit dem Hilfssubstrat,

das Anbringen und Zentrieren des Gefüges mit dem Strukturträger, dem Hilfssubstrat und der Plattennabe auf dem Boden der Form, auf dieselbe Art und Weise wie das Zwischenerzeugnis in der Form zentriert wird, wie in Anspruch 1 beschrieben, und

in der auf diese Weise zentrierten Lage, die Verbindung des Strukturträgers mit dem Boden und die Entfernung des Hilfssubstrats zusammen mit der Plattennabe aus der Form.

8. Verfahren nach Anspruch 7, wobei das Hilfssubstrat transparent und entfernbar mit dem Strukturträger verbunden ist, und zwar mittels einer Substanz, die in flüssiger Phase zwischen den Strukturträger und dem Hilfssubstrat angebracht und unter dem Einfluss von Strahlung, der diese Flüssigkeit durch das Substrat hindurch ausgesetzt wird, ausgehärtet wird.

9. Verfahren nach Anspruch 1 und wobei die Plattennabe (8) mit einer Vielzahl von Ausnehmungen oder Öffnungen (19) in einem Abstand von der Mitte ausgebildet ist zum Erhalten von Teilen eines Hilfswerkzeugs zum Handhaben des Zwischenerzeugnisses.

10. Verfahren nach Anspruch 3 und wobei die Plattennabe (8) aus einem einzigen Teil aus federndem Metallblech hergestellt ist, das zur Steigerung der axialen Biegsamkeit örtlich mit Öffnungen (20, 21) versehen ist.

11. Verfahren nach Anspruch 1, wobei die Platte von dem Typ ist, bei dem eine ggf. durch ein zweites Substrat gebildete Abdeckplatte koaxial zu und durch Distanzmittel (25) in der Nähe der Mitte der Informationsplatte in einem Abstand von dem Substrat (3) angeordnet ist, wobei die Plattennabe (8) einen Teil der Distanzmittel (25) bildet.

Revendications

1. Procédé pour pourvoir un substrat d'un disque d'information optiquement lisible d'une structure optiquement détectable, lequel disque peut être tourné au moyen d'un appareil d'entraînement comportant un arbre d'entraînement et des moyens de lecture optiques, lequel procédé utilise une matrice ayant une base pourvue d'une structure de matrice recouverte d'une couche de reproduction, qui, dans une phase déformable s'adapte à la structure de matrice, est solidifiée ensuite et, tout en étant fixée au substrat, est séparée de la matrice de telle sorte que la structure est maintenue, caractérisée en ce que:

la base (1A) de la matrice est pourvue de moyens de centrage de base (7) dans son centre,

la structure de matrice (2) est disposée sur la base (1A) dans une position centrée par rapport aux moyens de centrage de base (7),

un moyeu de disque (8) pourvu de moyens de centrage de disque centraux (9) destinés au centrage du disque d'information fini sur l'arbre d'entraînement d'un appareil d'entraînement, est monté dans le centre du substrat (3) et est fixé de façon permanente au substrat pour former un produit intermédiaire,

le produit intermédiaire est centré sur la matrice (1) par coopération entre les moyens de centrage de base (7) et les moyens de centrage de disque (9) et

dans la position centrée ainsi obtenue, le produit intermédiaire est fixé sur la matrice (1) jusqu'à ce que la couche de reproduction (4) soit solidifiée et adhère au substrat (3).

2. Procédé selon la revendication 1, caractérisé en ce que les moyens de centrage de base comportent un évidement central (10) dans la base (1A) de la matrice (1) et en ce que les moyens de centrage de disque (9) comportent un trou traversant central (11) dans le moyeu (8), et en ce que le produit intermédiaire est centré par des moyens de centrage auxiliaires (12) qui sont introduits dans le trou traversant (11) dans le moyeu (8) et font contact tant avec la paroi (13) de l'évidement central (10) dans la base (1A) qu'avec la paroi (14) du trou traversant (11) dans le moyeu (8).

3. Procédé selon la revendication 2, caractérisé en ce que le moyeu de disque (8) est axialement déformable à un degré limité et en ce que, lorsque les moyens de centrage auxiliaires (12) sont introduits, ceux-ci butent d'abord contre la paroi (14) du trou traversant (11) dans le moyeu de disque (8) et en ce que, ensuite, après un déplacement axial, ils butent également contre la paroi (13) de l'évidement central (10) dans la base (1A) de la matrice (1).

4. Procédé selon la revendication 3, caractérisé en ce que ladite déformation axiale du moyeu de disque (8) sur la matrice (1) présente une valeur prédéterminée égale à la déformation axiale à laquelle le moyeu est soumis lorsque le disque d'information fini est monté sur l'arbre d'un appareil d'entraînement.

5. Procédé selon la revendication 3, caractérisé en ce que les moyens de centrage auxiliaires (12) comportent une surface de centrage située sur une surface sphérique (12A) et qui bute contre lesdites parois (13, 14) du moyeu de disque (8) et de la matrice (1) suivant des lignes de contact circulaires.

6. Procédé selon la revendication 5, caractérisé

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en ce que la paroi (13) de l'évidement central (10) dans la base (1A) de la matrice (1) est située sur une surface conique et en ce que la paroi (14) du trou traversant (11) dans le moyeu de disque (8) est située sur une surface sphérique (16) d'un diamètre sensiblement égal à celui sur lequel est située la surface de centrage des moyens de centrage auxiliaires (12).

7. Procédé selon la revendication 1, comportant la fabrication de la matrice utilisée, laquelle fabrication comporte les étapes suivantes de:

liaison détachable d'un porteur de structure séparé, pourvu de la structure de matrice, à un substrat auxiliaire identique au substrat défini dans la revendication 1,

utilisation d'un outil auxiliaire pourvu de moyens de centrage d'outil identiques aux moyens de centrage de base définis dans la revendication 1,

centrage de la structure de matrice par rapport aux moyens de centrage d'outil au moyen d'appareils auxiliaires appropriés,

centrage, dans cette relation centrée, d'un moyeu de disque, tel que défini dans la revendication 1, par rapport au substrat auxiliaire par opération entre les moyens de centrage d'outil et les moyens de centrage de disque de la manière définie dans la revendication 1,

fixation du moyeu de disque ainsi centré au substrat auxiliaire,

mise en place et centrage de l'ensemble comportant le porteur de structure, le substrat auxiliaire et le moyeu de disque sur la base de la matrice, de la même manière que celle utilisée pour le centrage du produit intermédiaire sur la matrice telle que définie dans la revendication 1, et

fixation du porteur de structure à la base dans la position ainsi centrée et détachement du substrat auxiliaire simultanement avec le moyeu de disque de la matrice.

8. Procédé selon la revendication 7, dans lequel le substrat auxiliaire est transparent et le substrat auxiliaire est relié de façon détachable au porteur de structure au moyen d'une substance qui, dans une phase liquide, est appliquée entre le porteur de structure et le substrat auxiliaire et qui est durcie sous l'influence d'un rayonnement auquel elle est exposée à travers le substrat.

9. Procédé selon la revendication 1, dans lequel le moyeu de disque (8) présente une pluralité d'évidements ou ouvertures (19) à une certaine distance du centre pour recevoir des parties d'un outil auxiliaire pour la manipulation du produit intermédiaire.

10. Procédé selon la revendication 3, dans lequel le moyeu de disque (8) est réalisé d'une seule pièce à partir d'une tôle métallique élastique dans laquelle sont pratiquées localement des ouvertures (20, 21) pour augmenter sa flexibilité axiale.

11. Procédé selon la revendication 1, le disque étant du type dans lequel une plaque de recouvrement, qui peut être constituée d'un second substrat, est monté coaxialement par rapport au substrat (3) et à distance de celui-ci à l'aide de moyens d'écartement (25) à proximité du centre du disque d'information, dans lequel le moyeu de disque (8) fait partie des moyens d'écartement (25).

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