

METHOD AND DEVICE FOR GLUING TWO SUBSTRATES

The invention relates to a method and a device for gluing two substrates to a substrate disc wherein an adhesive is applied to the surface of a first substrate to be glued and a second substrate is placed with its surface to be glued onto the first substrate wherein the substrates are spun about their center axis for removing excess adhesive.

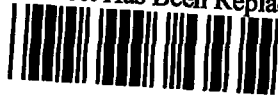
Methods and devices of this kind are known from DE 40 41 199 A1, Derwent abstract 94-246139/30, and EP 0 744 739 A1. In order to manufacture, for example, so-called digital video discs (also known as DVD). Digital video discs are comprised of two substrates or partial substrates on which the digital video information is stored on one surface and which are then glued together with their faces that have no information stored thereon. For connecting the two substrates to a substrate disc, for example, a digital video disc, very precisely operating devices are required because the substrates not only must be precisely stacked above on another, but the adhesive action must be uniform over the entire disc surface, without air inclusions and without having different adhesive layer thickness. Only in this way an error-free substrate disc will be produced. Furthermore, the conventional devices for gluing two substrates are



very complex with regard to their construction and require a large space.

5 It is an object of the invention to provide a method and a device for gluing two substrates which allows for a reliable, uniform gluing of the substrates, results in good substrates discs with minimal reject rate and is still simple to execute and simple in its construction while allowing for high productivity.

10 The aforementioned object is inventively solved by a method of the aforementioned kind in which at least one of the surfaces of the substrate to be glued, preferably the surface of the substrate to be glued onto which the actual adhesive is applied, is provided with a precoating. In this manner, the gliding action for the primary adhesive, respectively, the primary lacquer is substantially improved so that the adhesive distribution over the entire surface is not only
15 faster but also more uniform. The precoating allows to very uniformly distribute the adhesive between the substrates to be glued in a simple manner over the entire surface to be glued and to prevent inclusions such as air bubbles etc. The substrates accordingly adhere over the entire substrate surface fixedly to one
20 another, and the substrate discs have a uniform thickness over the entire surface area.



5 The adhesive is preferably as so-called ultraviolet synthetic
lacquer which can be rapidly cured by radiation treatment with
ultraviolet light and which allows for excellent adhesion between the
two substrates. Preferably, the adhesive is applied as an annular
strip onto the surface of a substrate to be glued which is then
distributed by spinning over the entire substrate surface.

10 Preferably, an adjustable, precise pressure is exerted onto
the second substrate after having been placed onto the first
substrate which improves the uniform distribution of the adhesive
between the substrates. The upper substrate to be placed onto the
lower one is preferably placed by a single arm handling device with
precision drive in a finely adjusted movement precisely centrally
onto the first substrate, and the required pressure is applied.

15 The aforementioned object is inventively also solved in that
at least one of the substrates, upon placement onto the other
substrate, is bent in the edge area away from the other substrate so
that air bubbles or other inclusions in the adhesive layer or in the
adhesive can be reliably and safely removed. When bending the
substrate to be stacked on top, it will first contact at the center, and
20 only after being released completely will be "rolled" from the central
inner area outwardly, so that the adhesive ring is forced and rolled



from the inner area to the outer area toward the substrate edges so that air inclusions and bubbles are removed.

5 A further solution of the aforementioned object is that the edges of the substrates to be glued are cleaned after removal of the adhesive by spinning force. Due to the cleaning process a reliable sealing of the substrate disc edge is, additionally, provided which contributes to an increased quality of the finished product. For cleaning the substrate disc edges it is suggested to provide an adhesive suction device which is pressed spring-elastically onto the
10 edge of the substrate disc. For increasing the productivity, this cleaning of the substrate edge is carried out directly after the centrifugal removal of the adhesive without requiring an additional position change of the substrate disc or the separate cleaning station for the edge cleaning process.

15 The glued substrate discs are preferably dried in an adhesive drier, and, when using UV lacquer, in a UV drier, so that the manufacturing process is substantially shortened. Such an adhesive drier can, for example, be embodied as a device which is disclosed in the patent document DE-A 195 45 843, not published as of the
20 application date and owned by the instant applicant. For avoiding repetition, the disclosure is included by reference into the present



application. The substrate discs can be guided, for example, with rotating movement underneath a UV lamp.

5 One solution of the aforementioned object is especially advantageous when a quartz or glass plate is placed onto the substrate disc during the drying process so that with its own weight during drying it presses onto the substrate disc and keeps it planar. Preferably, after the drying process during which it has been heated, the quartz or glass plate is cooled before it is placed onto the next substrate disc. Cooling of the quartz or glass plate takes place
10 according to one embodiment with ionized air whereby the glass plates are moved by a changing system respectively between the cooling process and the placement step onto the substrate disc. It is also advantageous to perform drying in a nitrogen atmosphere which contributes to a faster and final drying of the substrate discs.

15 After the gluing and drying process, the substrate discs are tested in an inspection station, for example, by a scanner with regard to flaws and, depending on the measured results, are released or separated as rejects.

20 The inventive method is controlled and/or visually represented by a data processing program which is run, for example, on a personal computer.



The aforementioned object is furthermore solved by a device of the aforementioned kind which comprises a coating or predispensing device which, in the direction of movement of the manufacturing process, is arranged upstream of the gluing station, respectively, upstream of the adhesive application device. The precoating device provides at least one of the surfaces of the substrates to be glued, preferably the surface onto which the other substrate is to be placed, with a prelacquering which improves the gliding action of the adhesive or of the primary lacquer and thus results in a more uniform and faster distribution of the primary lacquer during the spinning process. With the corresponding substrate manipulation device, especially when provided with a precision drive, a substrate is precisely centrally positioned and is subjected to a precisely adjustable pressure applied to the substrate to be placed onto the first one so that a precise adjustable pressure is applied to the two substrates to thereby improve or increase the distribution and the speed during the adhesive process. The advantages to be derived from the afore disclosed method can also be achieved with the inventive device, i.e., to apply the adhesive quickly, reliably, and uniformly onto the surfaces of the substrates to be glued without having to content with inclusions, for example,



air bubbles, between the substrates which would result in non-uniform thickness of the substrate discs and in to substrate discs with reduced quality, respectively, in high reject rates.

5 According to a further inventive principle for solving the object, a bending device is suggested for bending at least one of the substrates to be glued at its edges away from the other substrate. In this manner, an even more improved prevention of air bubbles or other inclusions in the adhesive layer is achieved because the two substrates to be glued will contact one another beginning at the
10 inner portion and continuing outwardly so that bubbles or air inclusions will be pressed outwardly and removed during this rolling process.

The bending device has advantageously an inner gripper which engages the inner area of the substrate to be bent and an
15 outer gripper which engages the outer area of the substrate to be bent. The grippers are movable relative to one another in the axial direction of the substrates so that bending of the lower or upper substrates with respect to the other substrate is possible. For the engagement of the inner and/or outer grippers suction cups or
20 suction cup groups are advantageously provided. The outer gripper can have them arranged also over the entire circumference.

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5 A further solution to the aforementioned object is a device
provided with a cleaning device for cleaning the substrate disc
edges. The cleaning device effects at the same time a sealing of the
substrate disc edge and thus a quality improvement of the resulting
product. The cleaning device has preferably an adhesive suction
device which, according to a further embodiment of the invention,
can be pressed spring-elastically onto the substrate disc edge. The
cleaning device is preferably part of an adhesive centrifugation
device so that the substrate discs must not be transported to a
10 corresponding station for the cleaning process but instead can be
cleaned at their edges directly after completion of the spinning
process in a respectively determined position.

15 $\parallel$ The adhesive centrifugation device, respectively, the
substrate disc edge cleaning device is preferably provided
downstream thereof with a drying station which, upon use of
adhesives or lacquer that can be cured or hardened by UV light, is
embodied as an ultraviolet drier.

20 For improving the quality of the glued discs and the
productivity, the drying station preferably has a quartz or glass plate
placement device. The quartz or glass plate can be moved back and
forth by a sliding or changing system between the substrate disc

area and a cooling area.

5 The drying station has preferably UV lamps wherein
advantageously reflective surfaces for the lamp radiation are
provided in the area of the substrate edges. Accordingly, a drying
and curing of the adhesive at the edge and rim area of the substrate
disc is possibly quickly and reliably. The drying station has
arranged downstream thereof, according to a further embodiment
of the inventive device, an inspection station in which, as a function
of the measured results of the testing process, the finished
10 substrates are released or rejected.

 The inventive device is especially very inexpensive and
,because of its compact construction, can be realized with minimal
dimensions and preferably with a protective cabin with doors and
windows. With a corresponding so-called flow box a substantially
15 laminar flow and a clean room-similar environment for the
manufacture of the substrate discs can be produced in the cabin.
The inventive device can be used as an individual machine or can
be integrated into a manufacturing line.

20 Substrate discs in the context of the present invention are not
only digital video discs but also, in general, discs which are formed
by gluing at least two partial discs.

The invention will be disclosed in the following with the aid of preferred embodiments in reference to the figures.

It is shown in:

- Fig. 1 a schematic representation of the inventive device in
5 a plan view, and
Fig. 2 a schematic representation of an embodiment for the
 bending device.

In the embodiment of Fig. 1 for an inventive device, the method sequence is carried out in method steps from the right to the left. In
10 a first supply station 1 the first substrates 3 are provided by a supply table 2. In similar manner, a second supply station 4 with a second supply table 5 delivers second substrates 6 which are to be glued with their surface free of information onto the corresponding surface of the first substrate 3. With an overhead handling device
15 7 the first substrates 3 are removed from the supply station 1, are rotated by 180°, so that the side to be glued free of information faces upwardly and is placed onto a preset location at the receiving turntable 8. The handling device 9 transports the second substrate 6 with the side to be glued facing downwardly, i.e., without rotation
20 of the substrate 6, onto a respective location of the turntable 8. The receiving turntable 8 has a special division, i.e., a two position

division by which confusion in regard to the two substrates 3 and 6 to be glued can be avoided even after power failure.

5 The turntable 8 supplies the first and second substrates 3 or 6 to a gluing station 10 which comprises to adhesive centrifugal devices or process pots 11 and 12 and a respective adhesive applicator or a dispenser 13, 14, a respective substrate disc edge cleaning device 15, 16, as well as a precoating device or predispensing unit 17 and respective handling devices 18, 19.

10 The method at the adhesive station 10 is carried out as follows. Firstly, the first substrates 3 resting on the receiving turntable 8 and having surfaces to be glued facing upwardly, thus representing the lower substrates during the gluing process, are positioned on a table 20 of the precoating device 17 by the handling device 19 in a certain turntable position and are there precoated by
15 the coating device 21 in order to provide the optimal gliding properties for the actual adhesive or the primary lacquer to be applied in a subsequent method step. The precoated first substrates 3 are then returned onto the receiving turntable 8.

20 The single arm handling device 18 with precision drive then places the first substrates 3 taken from the receiving turntable 8 into the two adhesive spinning devices 11 or 12. In a subsequent

method step, an adhesive is applied with the adhesive application device or the main dispensing unit 13, 14, for example, in the form of a UV synthetic lacquer approximately in the shape of a ring. Subsequently, the second upper substrate 6 is removed from the turntable 8 and is placed precisely centrally onto the first lower substrate 3. The plates of the adhesive centrifugal devices 11, 12 are then rotated so that the adhesive between the substrates 3 and 6 is centrifugally removed.

In the following it will be explained in more detail with the aid of Fig. 2 how the upper or lower substrate 3 or 6 can be slightly bent so that the removal of air inclusions or air bubbles occurring during application of the adhesive or adhesive ring is facilitated and the adhesive distribution is additionally improved and accelerated. Via the precision drive of the single arm handling device 18 not only the velocity with which the second upper substrate 6 is placed but also a precise pressure with which the substrate 6 is placed onto the adhesive ring can be controlled as well as the deceleration with which the substrate edge of the bent substrate is released.

After centrifugally removing the adhesive, the substrate edge cleaning device 15 or 16 will be operated by which in the represented embodiment an adhesive suction device is spring

elastically pressed onto the edge of the substrate disc to be glued.
The edge cleaning action that is achieved therewith also achieves additionally a sealing action of the substrate disc edge so that the product quality is improved.

5 The glued substrate discs 23 are then removed by a single arm handling device 24 from the adhesive station 10 and are placed onto a further turntable 25 of a drying station 26 in which the substrate discs 23 are guided underneath a UV drier 27 in a cycled manner and are irradiated with UV lamps so as to be dried. The UV
10 drier 27 is preferably provided with two to four 4 HPA lamps in one or two stations.

 The drying station 26 has furthermore a glass plate handling device 28 in the form of a pusher or changing device with which the quartz or glass plates 29 are placed onto the substrate discs 23 to
15 be dried. The plates 29 rest with their own weight on the substrate discs 23. The glass plates 29 are cooled, after removal from the substrate discs 23 by the glass plate handling device 28, with ionized air in order to be subsequently placed onto further substrate discs 23.

20 The dried substrate discs 23 are supplied by a three-arm handling device 30 from the turntable 25 of the drying station 26 to

a receiving station 31 in which an inspection station 34 is positioned which inspects the finished substrates 23 for quality assurance and, as a function of the result of this control, respectively, of its measured values, will control the three-arm handling device 30 such
5 that the flawless substrate discs 23 are placed onto a further turntable 35 and the flawed substrate discs 23 are placed onto a reject spindle 36.

Due to its compact construction, the inventive device has small dimensions with a length of 2,900 millimeter, a width of 1,250
10 mm, and a height of 1,900 millimeter, which allow for flexible use of the device even in smallest spaces as individual machines as well as integrated in manufacturing lines.

Fig. 2 shows in a schematic and partially cross-sectional representation an embodiment for a bending device 40 for bending
15 one of the substrates to be glued or both of the substrates to be glued at the respective edge areas away from the respective other substrate. The bending device 40 has an inner gripper 41 and an outer gripper 42 which are movable relative to one another by a hydraulic cylinder 43. The inner gripper 41 has a suction cup 43
20 which is connected by a respective vacuum connector 44 to a vacuum source and engages the substrate 3 or 6 in order to

transport it by a lifting and lowering cylinder 45.

The outer gripper 42 has multiple suction cups 46 distributed about the outer gripper circumference which engage the substrates 3 or 6 at their outer areas for bending them.

5 The bending occurs when the outer gripper 42 with the cylinder 43 is lifted relative to the inner gripper 41.

 The invention has been explained with the aid of preferred embodiments. However, to a person skilled in the art further numerous designs and developments are known without deviating
10 from the gist of the invention. The inventive device was described in connection with the manufacture of digital video discs. The principles of the invention however can also be applied to methods and devices for producing other products in which two substrates are to be glued to one another.

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CLAIMS:

1. Method for gluing two substrates (3,6) to form a substrate disc (23) in which an adhesive is applied to a surface to be glued of a first substrate (3), and a second substrate (6) with its surface to be glued is placed onto the first substrate, and in which the substrates (3,6) are rotated about their central axes for centrifugally removing the adhesive, characterized in that the surface of the first substrate (3) to be glued is provided with a precoating before application of the adhesive.
2. Method according to claim 1 characterized in that the adhesive is an ultraviolet synthetic lacquer.
3. Method according to one of the preceding claims, characterized in that the adhesive is applied as an adhesive ring onto the surface of the first substrate (3) to be glued.
4. Method according to one of the preceding claims, characterized in that an adjustable pressure is exerted onto the second substrate (6) after placement onto the adhesive.
5. Method for gluing two substrates (3,6) to form a substrate disc (23) in which an adhesive is applied onto a surface of a first substrate (3) to be glued, and a second substrate (6) is





- 5 placed with its surface to be glued onto the first substrate,
and in which the substrates (3,6) are rotated about their
central axes for centrifugally removing the adhesive,
characterized in that at least one of the substrates (3,6) upon
placement onto the other substrate (6,3) is bent in its edge
area away from the other substrate (6,3).
6. Method for gluing two substrates (3,6) to form a substrate
disc (23) in which an adhesive is applied to a surface of a
first substrate (3) to be glued, and a second substrate (6)
10 with its surface to be glued is placed onto the first substrate,
and in which the substrates (3,6) are rotated about their
central axes for centrifugally removing the adhesive,
characterized in that the edge of the glued substrate discs
(23) are cleaned after centrifugal removal of the adhesive.
- 15 7. Method according to claim 6, characterized in that the edge
cleaning is carried out in the station (10) in which gluing of
the substrates (3,6) is performed.
8. Method according to claim 6 or 7, characterized in that an
adhesive suction device is pressed elastically onto the edges
20 of the glued substrate disc (23).
9. Method for gluing two substrates (3,6) to form a substrate





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- disc (23), in which an adhesive is applied to a surface of a first substrate (3) to be glued, and a second substrate (6) with its surface to be glued is placed onto the first substrate, and in which the substrates (3,6) are rotated about their central axes for centrifugally removing the adhesive, characterized in that a quartz or glass plate (29) is placed onto the substrate disc (23) during drying.
- 10
10. Method according to claim 9, characterized in that the quartz or glass plate (29) after the drying process is cooled before it is placed onto the next substrate disc (23).
11. Method according to claim 9 or 10, characterized in that the quartz or glass plate (29) is cooled with ionized air.
12. Method according to one of the claims 9 through 11, characterized in that drying is carried out in a nitrogen atmosphere.
- 15
13. Method according to one of the preceding claims, characterized in that the glued and dried substrate discs (23) are inspected for flaws.
- 20
14. Method according to one of the preceding claims, characterized in that the method is controlled and/or visually represented by a data processing program.





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15. Device for gluing two substrates (3,6) to form a substrate disc (23), with at least one adhesive station (10), at least one adhesive application device (15,16), and at least one adhesive removal device (11,12), characterized by a precoating device (17).
16. Device according to claim 15, characterized by a pressing device which applies an adjustable pressure onto at least one of the substrate discs (3,6) during the gluing process .
- 10
17. Device for gluing two substrates (3,6) to a substrate disc (23), with at least one gluing station (10), at least one adhesive application device (15,16), and at least one adhesive removing device (11,12), characterized by a bending device (40) for bending at least one of the substrates (3,6) to be glued at its edge area away from the other substrate (6,3).
- 15
18. Device according to claim 17, characterized in that the bending device (40) comprises an inner gripper (41) engaging the inner area of the substrates (3,6) to be bent and an outer gripper (42) engaging the outer area of the substrate (3,6) to be bent.
- 20
19. Device according to claim 17 or 18, characterized in that the





inner gripper (41) and/or the outer gripper (42) can be moved relative to one another in the axial direction of the substrates (3,6).

- 5 20. Device according to one of the claims 17 through 19, characterized in that the inner gripper (41) and/or the outer gripper (42) have suction cups (43, respectively, 46).
- 10 21. Device for gluing substrates (3,6) to a substrate disc (23), with at least one gluing station (10), at least one adhesive application device (15,16), and at least one adhesive removal device (11,12), characterized by a substrate disc edge cleaning device (15,16).
22. Device according to claim 21, characterized in that the substrate disc edge cleaning device (15,16) comprises an adhesive suction device.
- 15 23. Device according to claim 21 or 22, characterized in that the substrate disc edge cleaning device (15,16) is pressed spring-elastically onto the substrate disc edge.
24. Device according to one of the claims 21 through 23, characterized in that the substrate disc edge cleaning device
- 20 (15,16) is part of the adhesive removal device (11,12).
25. Device for gluing two substrates (3,6) to a substrate disc





- (23), with at least one gluing station (10), at least one adhesive application device (15,16), and at least one adhesive removal device (11,12), characterized by a drying station (26) with a quartz or glass plate placing device (28).
- 5 26. Device according to claim 25, characterized in that the drying station (26) comprises a quartz or glass plate cooling device.
27. Device according to claim 26, characterized in that the cooling medium is ionized air.
28. Device according to one of the claims 25 through 27,
10 characterized in that the drying station (26) comprises ultraviolet lamps, and that in the area of the substrate edges reflective surfaces for the lamp radiation are provided.
29. Device according to one of the claims 15 through 28,
15 characterized by an inspection station (34) arranged downstream of the drying station (26).

