DESCRIPTION

# PRINTING SYSTEM FOR PRINTING SUBSTRATES, METHOD FOR OPERATING THE PRINTING SYSTEM

The invention relates to a printing system for printing substrates, in particular circuit boards, wafers, solar cells or the like, comprising a printing device which has a printing table on which the substrates can be positioned, and a print head which is associated with the printing table and is intended for printing the substrates positioned on the printing table, said system comprising a feed device for feeding the substrates to be printed to the printing device, and comprising a discharge device for discharging the printed substrates from the printing device, and comprising a plurality of substrate supports, on each of which a plurality of substrates can be laid, the feed device, printing device and discharge device being designed for conveying the substrate supports together with the substrates located thereon.

The invention furthermore relates to a method for operating a printing system of this kind.

Printing systems of the type mentioned at the outset are known from the prior art. In order to print circuit boards, for example screen printing devices are known, comprising a printing table on which one or more substrates to be printed can be positioned, and comprising a print head which comprises for example a printing screen and a printing squeegee which are designed to print the substrate, positioned on the printing table, with a printing mass or paste which is pushed through the printing screen by means of the squeegee. In order to allow for automation of a printing system of this kind, it is known to connect a feed device upstream and a discharge device downstream of the printing device, by means of which feed and discharge devices the substrates are automatically fed to the printing table and discharged from the printing device. In order to increase the throughput of a printing system of this kind, it is furthermore known that a plurality of substrates can be conveyed and printed simultaneously. In order to simplify this process, it is known to arrange a plurality of substrates on one substrate support, such as a retaining plate, tray or the like, and to feed the substrate support to the printing device. As a result, handling of a plurality of substrates simultaneously is achieved in a simple and cost-effective manner.

The object of the invention is that of improving the above-mentioned printing system in that the handleability is simplified and the throughput is increased yet further.

Summary

According to a first aspect, the present disclosure refers to a printing system for printing substrates, in particular circuit boards, wafers, solar cells, comprising a printing device which has a printing table on which the substrates can be positioned, and a print head which is associated with the printing table and is intended for printing the substrates positioned on the printing table, said system comprising a feed device for feeding the substrates to be printed to the printing device, and comprising a discharge device for discharging the printed substrates from the printing device, and comprising a plurality of substrate supports, on each of which a plurality of substrates can be laid, and the feed device, printing device and discharge device being designed for conveying the substrate supports together with the substrates located thereon, characterized in that the feed device is designed to collect a plurality of substrate supports and to feed said substrate supports to the printing device in a collected manner, the printing device being designed to print the substrates on the collected substrate supports, and in that the discharge device is designed to separate and discharge said collected substrate supports.

According to a second aspect, the present disclosure refers to a method for operating a printing system which is designed according to the first aspect, said method having the following steps: A) collecting a plurality of substrate supports in the feed device, one behind the other when viewed in the conveying direction, B) transporting the collected substrate supports into the printing device, C) printing the collected substrate supports in the printing device, D) transporting the collected substrate supports into the discharge device, E) separating and successively discharging the substrate supports out of the discharge device.

This object is achieved by the invention by a printing system having the features of the first aspect.

This is advantageous in that a plurality of processes can take place simultaneously, such that the downtime, in particular of the printing device, is reduced to a minimum.

The printing system according to the disclosure is characterized in that the feed device is designed to collect a plurality of substrate supports and to feed these to the printing device in a collected manner, the printing device being designed to print the substrates on the collected substrate supports, and in that the discharge device is designed to discharge and to separate the collected substrate supports. Thus, the feed device collects a plurality of substrates which are separated again, following the printing process, by the discharge device. The fact that the substrate supports can be fed to and discharged from the printing device in a collected manner is advantageous in that a printing process can be carried out on the substrates of the collected substrate supports located in the printing device during collection and separation of the substrate supports in said printing device. As a result, it is possible for substrate supports to be collected and separated at the same time as a printing process, as a result of which the overall throughput of the printing system is optimized and downtimes of the printing system are minimized.

According to a preferred example of the disclosure, the feed device comprises a collection device which comprises a displaceable first stop, against which the substrate supports can be conveyed for collection. The first stop makes it particularly simple to collect a plurality of substrate supports. For this purpose, it is merely necessary to convey said substrate supports against the first stop, such that they are grouped together there. In particular if the substrate supports are conveyed against the first stop in succession, a row of substrate supports, one behind the other, results, which substrate supports are supported on the first stop, either directly or indirectly. Only when the first stop is displaced, such that it no longer impedes the movement of the substrate supports, can the substrate supports previously collected at the stop be conveyed, by the feed device, onto the printing table of the printing device. This ensures simple collection and conveying of the substrate supports. In particular, the collection device comprises a plurality of rollers that are mounted so as to be freely rotatable, and on which rollers the substrate supports can be collected. The rollers that are mounted so as to be freely rotatable allow for the substrate supports to be brought together in a frictionless, and thus low-energy, manner.

It is furthermore preferable for the feed device to comprise a conveying device for displacing the collected substrate supports on the printing table. Thus, by means of the conveying device, the substrate supports are collected and are in particular pushed onto the printing table in a collected manner, in particular after the displaceable first stop has been displaced

aligning the substrate supports the printing table optionally comprises a conveying device, as has been described above.

It is furthermore preferable for the discharge device to comprise a plurality of rollers that are mounted so as to be freely rotatable and are intended for receiving and transporting the substrate supports. Following a completed printing process, the printing device itself preferably conveys the collected substrate supports, together with the printed substrates, towards the discharge device. Owing to the rollers that are mounted so as to be freely rotatable, the substrate supports are received there automatically and without further assistance or without further actuators.

The discharge device particularly preferably comprises a separation device for separating and discharging the substrate supports. The separation device is designed to separate the collected substrate supports conveyed out of the printing device, and in particular to discharge them in succession, for example in the direction of a downstream processing facility.

The separation device preferably comprises a third stop, against which the substrate supports can firstly be conveyed, and by means of which separation, or individual or separated further transport, of the substrate supports is made possible. The third stop interacts in particular with a third conveying device of the separation device, which is designed to further convey the substrate supports. In this case, the stop is in particular displaceable such that the substrate supports are transported further from the discharge device only in succession and separated.

According to a preferred example of the disclosure, the discharge device comprises a conveying device which comprises a displaceable driver stop, at least one drivable conveying belt and/or at least one driven conveying roller. The conveying device of the discharge device is preferably designed at least substantially in the manner of the conveying device of the feed device, in order to provide a cost-effective solution by using identical parts. The conveying device preferably comprises driven conveying rollers both at the front, in the conveying direction, and to the rear, which rollers allow for the substrate supports to be conveyed and moved. In addition, the conveying device preferably comprises the displaceable driver stop, which is displaceable in particular between the two mutually parallel and mutually spaced rows or rollers of the discharge device in the conveying device, in particular by means of a spindle drive.

According to a preferred example of the disclosure, the printing device, the feed device and the discharge device are designed to collect the substrate supports and conveying device in succession, and to transport them one behind the other. As already mentioned above, this results in particularly simple collection and separation of the substrate supports. According to an alternative example, the substrate supports are collected and transported, side-by-side, in the conveying direction. For this purpose, for example the substrate supports are conveyed side-by-side, against the first stop of the collection device, and subsequently, after displacement of the stop into a release position, fed to the printing table.

It is furthermore preferable for the feed device, the printing device and the discharge device to each comprise at least one sensor for recording at least one position of at least one substrate support. The sensor allows for monitoring of the collection, separation and printing, such that automatic intervention is possible if an unexpected state occurs, in which for example a substrate support is missed or is not correctly positioned.

The method according to the disclosure for operating the above-described printing system is characterized by the features of the second aspect. The method is characterized by the following steps: In a step a), a plurality of substrates are collected by the feed device so as to be in succession in the conveying device. For this purpose for example the above-mentioned first stop, and the rollers mounted so as to be freely rotatable, are used. In a step b), the substrates thus collected are conveyed into the printing device and in particular onto the printing table, and are there optionally aligned and/or positioned by the printing device, in particular in relation to a printing screen of the print head. In a step c), the collected substrates are printed in the printing device, for example in that the printing paste or mass is pushed, by a squeegee, through the printing screen and onto the substrates positioned therebelow. In a step d), following a printing process the collected substrates are conveyed or transported out of the printing device and into the discharge device. In a step e), the substrate supports are separated in the discharge device and are discharged one after the other. This results in the advantages already mentioned above.

In particular steps a), c) and e) take place at least substantially simultaneously, so as to ensure a particularly high throughput of substrate supports through the printing system, with minimized downtimes. The advantages already mentioned above result.

Further advantages and preferred features and combinations of features emerge in particular from the above description, and from the claims. The invention will be explained in greater detail in the following, with reference to the drawings, in which:

CLAIMS

1. Printing system for printing substrates, in particular circuit boards, wafers, solar cells, comprising a printing device which has a printing table on which the substrates can be positioned, and a print head which is associated with the printing table and is intended for printing the substrates positioned on the printing table, said system comprising a feed device for feeding the substrates to be printed to the printing device, and comprising a discharge device for discharging the printed substrates from the printing device, and comprising a plurality of substrate supports, on each of which a plurality of substrates can be laid, and the feed device, printing device and discharge device being designed for conveying the substrate supports together with the substrates located thereon, **characterized in that** the feed device is designed to collect a plurality of substrate supports and to feed said substrate supports to the printing device in a collected manner, the printing device being designed to print the substrates on the collected substrate supports, and in that the discharge device is designed to separate and discharge said collected substrate supports.

2. Printing system according to claim 1, **characterized in that** the feed device comprises a collection device which comprises a displaceable first stop, against which the substrate supports can be conveyed for collection.

3. Printing system according to either of the preceding claims, **characterized in that** the collection device comprises a plurality of rollers which are mounted so as to be freely rotatable and on which the substrate supports can be collected.

4. Printing system according to any of the preceding claims, **characterized in that** the feed device comprises a conveying device for conveying the in particular collected substrate supports into the printing device.

5. Printing system according to claim 4, **characterized in that** the conveying device comprises a displaceable driver stop, at least one drivable conveying belt and/or at least one driven conveying roller.

6. Printing system according to any of the preceding claims, **characterized in that** the printing table comprises means for transporting and aligning the substrate supports.

7. Printing system according to any one of claims 2-6, **characterized in that** the printing table comprises at least one second displaceable stop, against which the substrate

supports can be conveyed.

8. Printing system according to any of the preceding claims, **characterized in that** the discharge device comprises a plurality of rollers which are mounted so as to be freely rotatable and which are intended for receiving the substrate supports from the printing device and for transporting the substrate supports.

9. Printing system according to any of the preceding claims, **characterized in that** the discharge device comprises a separation device for separating and discharging the substrate supports.

10. Printing system according to any one of claims 7-9, **characterized in that** the separation device comprises a displaceable third stop, against which the substrate supports can be conveyed.

11. Printing system according to any of the preceding claims, **characterized in that** the discharge device comprises a conveying device which comprises at least one displaceable driver stop, at least one drivable conveying belt and/or at least one driven conveying roller.

12. Printing system according to any of the preceding claims, **characterized in that** the printing device, the feed device and the discharge device are designed for collecting the substrate supports in succession in the conveying direction, and for transporting them in succession as a substrate support unit.

13. Printing system according to any of the preceding claims, **characterized in that** the feed device, the printing device and the discharge device each comprise at least one sensor for recording at least one substrate support.

14. Method for operating a printing system which is designed according to any of claims 1 to 13, said method having the following steps:

A) collecting a plurality of substrate supports in the feed device, one behind the other when viewed in the conveying direction,

B) transporting the collected substrate supports into the printing device,

C) printing the collected substrate supports in the printing device,

D) transporting the collected substrate supports into the discharge device,

E) separating and successively discharging the substrate supports out of the discharge

device.

15. Method according to claim 14, **characterized in that** steps A), C) and E) are carried out simultaneously.