Description

Transport system

The present invention relates to a transport system, in particular a transport system for the production of integrated semiconductor products. The present invention relates, furthermore, to an apparatus for the intermediate storage and transport of products to be machined.

Modern industrial production is generally marked by a high degree of automation. This refers both to the actual machining of the products to be machined and to the transport of the products to be machined from one machining device to another. In the semiconductor industry in particular, a high degree of automation is indispensable so that it is possible to be competitive on an international scale.

During the production of an integrated semiconductor product, the product passes through up to 600 process steps which can largely be carried out only by means of highly specialized machining plants in a clean room environment. In this case, a plurality of identical machining plants are often combined to form a machining zone ("bay"), normally a plurality of machining zones being accommodated together on one story of a factory building.

In order, then, to transport the semiconductor wafers to be machined to the individual machining zones or machining plants, transport systems are provided on the same story of the factory building as that on which the machining plants are also accommodated. In this case, transport between two machining zones may take place, for example, via railborn vehicles on the ceiling of the story ("monorails").

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Intermediate stores, so-called "stockers", are often provided in the individual machining zones and are capable of briefly storing the semiconductor wafers intended for the machining zone.

The semiconductor wafers may then be transported from an intermediate store to the actual machining plants via robots, railborn robots, railborn vehicles on the floor of the story or via driverless vehicles ("Automated Guided Vehicles" AGV) on the floor of the story.

However, a transport system of this type has some disadvantages. On the one hand, the transport speed is low. Transport from one machining plant to another may take 10 minutes or more. On the other hand, the transport control software is highly complex. Thus, obstacles, in particular the machining plants, have to be bypassed and transport priorities conferred. Overtaking actions occur. Intersections and branches have to be taken into account. Furthermore, the intermediate stores in the machining zones require large standing areas which could be used more appropriately for actual production.

The object of the present invention is, therefore, to provide a transport system and an apparatus for the intermediate storage and transport of products to be machined, said transport system and said apparatus avoiding or reducing the abovementioned disadvantages of previous systems.

This object is achieved by the transport system as claimed in patent claim 1 and by an apparatus for the intermediate storage and transport of products to be machined, as claimed in patent claim 10. Further advantageous embodiments, refinements and aspects of the present invention emerge

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from the sub-claims, the description and the accompanying drawings.

According to the invention, a transport system is provided for transporting products to be machined, in particular integrated semiconductor products, to machining plants arranged in a building, for carrying out machining steps on the products to be machined. The transport system according to the invention is defined in that the transport system and the machining plants are separated by a building ceiling and feeds from the transport system to the machining plants through orifices in the building ceiling are provided.

The advantage of the transport system according to the invention is that it is separated from the machining plants by virtue of construction. A markedly higher transport speed can thereby be achieved. Each position on the level of the transport system can be reached in a freely selectable way and is accessible at any time, should a fault occur. The complexity of the control software can be markedly reduced. On the level or story of the machining plants, the rails often used on the ceiling can be dispensed with. The room height on the level of the machining plants can be reduced by up to one meter. The design of the transport system is simplified, since, now, less stringent clean room conditions have to be adhered to. The transport system can be erected and maintained without the machining plants being involved. Furthermore, the transport system according to the invention can easily be adapted to any desired arrangement of the machining plants. It is usually necessary only to adapt the control software for this purpose.

The transport system is preferably arranged above the machining plants. In semiconductor factories which are conventional at the present time,

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the story above the story in which the machining plants are accommodated is used only for the supply of clean air by means of so-called "filter fan units", so that sufficient space is available here.

It is preferable, furthermore, if the feeds from the transport system to the machining plants through the orifices in the building ceiling are designed as elevators. These elevators may additionally serve as easily accessible short term intermediate stores.

According to a further preferred embodiment of the present transport system according to the invention, at least one storage zone for the intermediate storage of the products to be machined is provided in the transport system. The intermediate stores in the machining zones on the level or story of the machining plants may thereby be dispensed with. Thus, each machining zone can receive one or two additional machining plants.

Preferably, in this case, the storage zone is designed as a level horizontal surface. Thus, rapid, freely selectable access to the products to be machined can be brought about in a simple way.

The transport system is preferably subdivided according to machining zones, the subdivisions each having at least one intrazonal transport system and being connected to one another by at least one interzonal transport system. In this case, it is particularly preferred if the storage zone is also subdivided according to the machining zones or a corresponding number of storage zones are provided in the transport system according to the invention. Accordingly, it is also preferred if the feeds from the transport system to the

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machining plants can be reached by means of the intrazonal transport systems.

It is preferable, furthermore, if the intrazonal transport system comprises a transport crane with a grab and if the interzonal transport system is designed as a conveyor system or as a railborn system.

Furthermore, according to the invention, an apparatus is provided for the intermediate storage and transport of products to be machined, in particular for a transport system according to the invention. The apparatus possesses a storage zone for the intermediate storage of the products to be machined and a transport device for transporting the products to be machined. The apparatus is defined in that the storage zone is designed as a level horizontal surface. Thus, rapid, freely selectable access to the products to be machined can be brought about in a simple way.

The transport device is preferably designed in such a way that the products to be machined can be transported back and forth between a first entry/exit zone, the storage zone and at least one second entry/exit zone. The products to be machined can thus be guided, for example, by the interzonal transport system via the respective storage zone to the feeds to the machining plants.

In this case, it is preferable if the transport device of the apparatus according to the invention comprises a transport crane with a grab.

The invention is illustrated in more detail below with reference to figures of the drawing in which:

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Figure 1 shows a diagrammatic illustration of a transport system according to the invention,

Figure 2 shows a further diagrammatic illustration of the transport system according to the invention, and

Figure 3 shows a diagrammatic illustration of an apparatus according to the invention for the intermediate storage and transport of products to be machined.

Figure 1 shows a diagrammatic illustration of a transport system 1 according to the invention. The transport system 1 according to the invention is separated by a building ceiling 7 from the machining plants 5 which are accommodated on a story below the transport system 1. Feeds 4, which are designed as elevators, connect the transport system 1 to the machining plants 5 through orifices 8 (see Fig. 2) in the building ceiling 7.

The machining plants 5 are combined to form machining zones 6. The transport system 1 is accordingly also divided into a plurality of subdivisions 2. In this case, the subdivisions 2 each comprise an apparatus 10 according to the invention for the intermediate storage and transport of products to be machined, as is explained with reference to Fig. 3. The subdivisions 2 are connected by means of the interzonal transport system 3 which comprises railborn vehicles (not shown) at floor level.

Figure 2 shows a further diagrammatic illustration of the transport system 1 according to the invention. As in Fig. 1, the transport system 1 according to the invention is separated by the building ceiling 7 from the machining plants 5 which are accommodated on a story below the transport system 1. Feeds

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4, which are designed as elevators, connect the transport system 1 to the machining plants 5 through the orifices 8 in the building ceiling 7.

A further story 9, which receives further backup plants, is provided below the story of the machining plants.

A markedly higher transport speed can be achieved by separating the transport system 1 and the machining plants 5 by virtue of construction. Each position on the level of the transport system 1 can be reached in a freely selectable way and is accessible at any time, should a fault ever occur. As already explained, the transport system 1 can be erected and maintained without the machining plants 5 being involved. Furthermore, the transport system 1 according to the invention can easily be adapted to any desired arrangement of the machining plants 5. It is usually necessary only to adapt the control software for this purpose.

Figure 3 shows a diagrammatic illustration of an apparatus 10 according to the invention for the intermediate storage and transport of products 20 to be machined. In this case, the apparatus 10 according to the invention forms part of the transport system 1 according to the invention. The apparatus 10 according to the invention forms in each case an intrazonal transport system in the subdivisions 2 (see Fig. 1).

The apparatus 10 according to the invention comprises, as a transport device, a transport crane 14 which has a truck 15 running on rails 18 and having a telescopic arm 16. A grab 17 is mounted on the end of the telescopic arm 16. The transport crane 14 is arranged above a storage zone 11 which is designed as a level horizontal surface. In this case, the

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products 20 to be machined are arranged in three rows in the storage zone 11. In this case, the products 20 to be machined consist of semiconductor wafers which are combined in so-called batches.

Furthermore, the apparatus 10 possesses two entry/exit zones 12 and 13. In this case, the entry/exit zone 12 serves for taking over semiconductor wafers from the interzonal transport system 3 (see Fig. 1) and the entry/exit zone 13 serves for taking over semiconductor wafers from the elevator 4 which leads to the machining plants 5 (see Fig. 1 or 2).

The hitherto conventional intermediate stores in machining zones 6 may be dispensed with on account of the storage zone 11. Thus, each machining zone 6 may receive one or two additional machining plants 5.

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Patent claims

1. A transport system (1) for transporting products (20) to be machined, in particular integrated semiconductor products, to machining plants (5) arranged in a building, for carrying out machining steps on the products (20) to be machined, wherein the transport system (1) and the machining plants (5) are separated by a building ceiling (7) and feeds (4) from the transport system (1) to the machining plants (5) through orifices (8) in the building ceiling (7) are provided.

2. The transport system (1) as claimed in claim 1, wherein the transport system (1) is arranged above the machining plants (5).

3. The transport system (1) as claimed in claim 1 or 2, wherein the feeds (4) from the transport system (1) to the machining plants (5) through the orifices (8) in the building ceiling (7) are designed as elevators.

4. The transport system (1) as claimed in one of claims 1 to 3, wherein at least one storage zone (11) for the intermediate storage of the products (20) to be machined is provided.

5. The transport system (1) as claimed in claim 4, wherein the storage zone (11) is designed as a level horizontal surface.

6. The transport system (1) as claimed in one of claims 1 to 5, wherein the transport system (1)

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is subdivided according to machining zones (6), the subdivisions (2) each having at least one intrazonal transport system (10) and being connected to one another by at least one interzonal transport system (3).

7. The transport system (1) as claimed in claim 6, wherein the feeds (4) from the transport system (1) to the machining plants (5) can be reached by means of the intrazonal transport systems (10).

8. The transport system as claimed in claim 6 or 7, wherein the intrazonal transport system (10) comprises a transport crane (14) with a grab (17).

9. The transport system as claimed in one of claims 6 to 8, wherein the interzonal transport system (3) is designed as a conveyor system or as a railborn system.

10. An apparatus (10) for the intermediate storage and transport of products to be machined, in particular for a transport system (1) as claimed in one of claims 1 to 9, with a storage zone (11) for the intermediate storage of the products (20) to be machined and with a transport device (14) for transporting the products to be machined, wherein the storage zone (11) is designed as a level horizontal surface.

11. The apparatus (10) as claimed in claim 10, wherein the transport device (14) is designed in such a way that the products (20) to be machined

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can be transported back and forth between a first entry/exit zone (12), the storage zone (11) and at least one second entry/exit zone (13).

12. The apparatus (10) as claimed in claim 10 or 11, wherein the transport device (14) is designed as a transport crane with a grab (17).

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