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D E C I S I O N
of 27 November 2002

Case Number: T 0566/00 - 3.4.3

Application Number: 91307625.3

Publication Number: 0475604

IPC: H01L 21/00

Language of the proceedings: EN

Title of invention:
Vacuum processing apparatus and cleaning method therefor

Patentee:
Hitachi, Ltd.

Opponent:
Institute of Technological Information, Inc.

Headword:
-

Relevant legal provisions:
EPC Art. 56, 102(3)

Keyword:
"Inventive step (yes - after amendments)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0566/00 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 27 November 2002

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 16 May 2000 concerning maintenance of European patent No. 0 475 604 in amended form.**

Composition of the Board:

Chairman: R. K. Shukla
Members: M. Chomentowski
M. J. Vogel

Summary of Facts and Submissions

I. The European patent No. 0 475 604 was granted with 11 claims on the basis of the European patent application No. 91 307 625.3.

II. An opposition against the patent was lodged on the grounds that, having regard to documents E1 to E5, the subject-matter of the claims was not new or did not involve an inventive step. For the present proceedings, reference is to be made to documents

E1: JP-A-2 065 252;

E3: JP-U-2 026 229; and

E5: JP-U-63 127 125.

III. The patent was maintained in amended form by the interlocutory decision of the opposition division dated 16 May 2000 on the basis of the patentee's second auxiliary request.

Claim 1 as maintained by the decision under appeal read as follows:

"1. A method of operating a vacuum processing apparatus having at least two vacuum processing chambers (11a, 11b, 11c), separate first and second substrate stores (1a, 1b, 1c) which are located in air adjacent said vacuum processing chambers, a vacuum transfer chamber (16) communicating with said vacuum processing chambers, at least one load lock chamber (5, 6) communicating between said transfer chamber (16) and the air, a single first conveyor device (13) located in

air and arranged to access both said first store (1a, 1b) and said second store (1c) and a second conveyor device (14) located in said transfer chamber, said method comprising the steps of :

(i) transferring substrates (20) to be processed between said first store (1a, 1b) and said vacuum processing chambers (11a, 11b, 11c) sequentially by means of said first conveyor (13) which is maintained in air and transfers the substrates between said first store and said at least one load lock chamber (5, 6) and said second conveyor (14) which transfers the substrates between said at least one load lock chamber (5, 6) and said vacuum processing chambers and also between said vacuum processing chambers;

(ii) vacuum processing said substrates (20) in said vacuum processing chambers (11a, 11b, 11c);

(iii) transferring at least one dummy substrate (30) from said second store to said vacuum processing chambers (11a, 11b, 11c) by means of said first conveyor (13) which is maintained in air and transfers the dummy substrate between said second store and said at least one load-lock chamber (5, 6) and said second conveyor (14) which transfers the dummy substrate between said at least one load lock chamber (5, 6) and said vacuum processing chambers;

(iv) dry cleaning said vacuum processing chambers (11a, 11b, 11c) with said at least one dummy substrate (30) therein; and

(v) returning said at least one dummy substrate to said second store."

Claims 2 to 4 were dependent method claims.

Independent claim 6 concerned a vacuum processing apparatus adapted to carry out the method of claim 1. Claims 7 and 8 were dependent from claim 6.

IV. The reasoning of the opposition division with respect to inventive step was mostly directed at the independent apparatus claim, the method claim being objected by the opponent only in general terms, e.g. by referring to "corresponding process steps". It was found that documents E1 and E3 only show apparatuses having a single vacuum processing chamber and that none of the apparatuses of documents E1, E3 or E5 has a vacuum transfer chamber.

In the appeal proceedings, the only independent claim of the respondent's request relates to a method of operating a vacuum processing apparatus, and the claim has been substantially amended with respect to the method claim as maintained by the opposition division. Moreover, in response to the amendments, the appellant has filed new prior art documents (see items V and VI below). Consequently, the reasoning of the opposition division in the decision under appeal is not relevant to the present decision and is accordingly not discussed in detail.

V. The opponent lodged an appeal against the decision on 29 May 2000, paying the appeal fee on the same day. A statement setting out the grounds of the appeal was filed on 12 September 2000 citing a new prior art document

E6: JP-A-63 153 270.

VI. With his letter dated 25 October 2002 the respondent (patent proprietor) filed a main request and several auxiliary requests. Claim 1 of the auxiliary request II reads as follows:

"1. A method of operating a vacuum processing apparatus having a plurality of vacuum processing chambers (11a, 11b, 11c), separate first and second substrate stores (1a, 1b, 1c) which are located in air adjacent said vacuum processing chambers, a vacuum transfer chamber (16) communicating with said vacuum processing chambers through respective gate valves (15a, 15b, 15c), a load lock chamber (5) and an unload lock chamber (6) for transferring substrates between said vacuum transfer chamber (16) and the air, a single first conveyor (13) located in air and arranged to access both said first store (1a, 1b) and said second store (1c) and a second conveyor (14) located in said transfer chamber, said method comprising the steps of:

(i) transferring substrates (20) to be processed from said first store (1a, 1b) to said vacuum processing chambers (11a, 11b, 11c) sequentially by means of said first conveyor (13) which is maintained in air and transfers the substrates between said first store and said load lock chamber (5), and said second conveyor (14) which transfers the substrates between said load lock chamber (5) and said vacuum processing chambers and also between said vacuum processing chambers;

(ii) vacuum processing said substrates (20) in said vacuum processing chambers (11a, 11b, 11c);

(iii) after vacuum processing of the substrates (20), transferring the substrates (20) from said vacuum

processing chambers (11a, 11b, 11c) sequentially by means of said second conveyor (14), said unload lock chamber (6) and said first conveyor to their original positions in said first store (1a, 1b);

(iv) transferring at least one dummy substrate (30) from said second store to said vacuum processing chambers (11a, 11b, 11c) by means of said first conveyor (13) which is maintained in air and transfers the dummy substrate between said second store and said load-lock chamber (5) and said second conveyor (14) which transfers the dummy substrate between said load lock chamber (5) and said vacuum processing chambers;

(v) dry cleaning said vacuum processing chambers (11a, 11b, 11c) with said at least one dummy substrate (30) therein; and

(vi) returning said at least one dummy substrate to said second store, by means of said second conveyor (14) which transfers said at least one dummy substrate between said vacuum processing chambers (11a, 11b, 11c) and said unload lock chamber (6) and said first conveyor which transfers said at least one dummy substrate between said unload lock chamber (6) and said second store (1c)."

Claims 2 to 5 of the Auxiliary request II are dependent method claims.

Moreover, a new prior art document

E7: EP-A-0 367 423

was filed with the same letter.

VII. During the oral proceedings of 27 November 2002, the respondent requested that the decision under appeal be set aside and the patent be maintained in amended form on the basis of the following patent documents:

Claims: Nos 1 to 5 of the auxiliary request II filed with letter dated 25 October 2002;

Description: columns 1 to 7 filed during the oral proceedings; and

Drawings: Figures 1 and 2 as granted.

VIII. The respondent argued as follows in support of his requests:

Claim 1 and the further claims, which are dependent claims, concern a method. As a result of the amendments, the vacuum processing apparatus used in the claimed method has a plurality of vacuum processing chambers (11a, 11b, 11c), a vacuum transfer chamber (16) communicating with said vacuum processing chambers through respective gate valves (15a, 15b, 15c); a load lock chamber (5) and an unload lock chamber (6) for transferring substrates between the vacuum transfer chamber (16) and the air, inwardly and outwardly respectively. Moreover, in method step (iii), it is specified that the processed substrates are returned sequentially to their original position in the first store (1a, 1b). With these amendments, the claimed method corresponds to the embodiment disclosed in the application as filed and in the patent as granted, so that the amendments are admissible.

The inventive concept in the claimed method is based on

the provision of dummy substrates stored in air and the use of the same conveyor located in air to transfer both the substrates to be processed and the dummy substrates from air to the vacuum transfer chamber and to return the processed substrates to their original position in the first stores and the dummy substrates to the second stores, in air. The invention thus solves the problem of achieving a high productivity combined with low contamination risk in processing of substrates in a multi-vacuum chamber apparatus.

The prior art is silent on this subject and document E6 adopts a different approach of separate stores for unprocessed and processed substrates. Since in the claimed method as a result of steps (iii) and (iv) there is no co-existence of substrates being processed and dummy substrates in the same vacuum processing chamber, the risk of contamination which exists in the prior art teaching according to documents E1 and E5 is avoided.

It is also to be noted that documents E1, E5 and E3 indeed relate to cleaning of a vacuum processing apparatus, whereby only the two first documents teach about the use of dummy substrates; however, these apparatuses do not comprise a plurality of vacuum processing chambers. Documents E6 and E7 relate to vacuum processing apparatuses having a plurality of vacuum processing chambers; however, there is no information about cleaning, in particular using dummy substrates, and the operation and movement of the substrates is different from that of claim 1.

Therefore, the subject-matter of claim 1 involves an inventive step.

IX. The appellant (opponent) requested that the decision under appeal be set aside and the patent be revoked, and submitted the following arguments in support of his requests:

The problems to be solved by the method of claim 1 are the cleaning of the vacuum processing apparatus while achieving low contamination in processing of substrates in a multi-vacuum chamber apparatus, in particular by avoiding cross-contamination between the substrates to be processed or already processed and the dummy substrates used for cleaning the apparatus.

Since there are two aspects in the object of the invention, it is justified to combine, if necessary, three prior art documents.

Starting from document E7, disclosing a vacuum processing apparatus comprising a vacuum transfer chamber (14) communicating with a plurality of vacuum processing chambers (16-19), and a load and unload lock chambers (22) for transferring substrates between this vacuum transfer chamber and the air, it is obvious that reaction chambers used for vacuum processing must be cleaned, and this can be done by performing plasma cleaning of these chambers, as known e.g. from documents E3; document E5 specifies that such a procedure is done using dummy substrates, and it is directly and unambiguously derivable from document E1 (cf. Figure 3 and the corresponding text) that the procedure of "maintenance" of the apparatus using dummy substrates is a cleaning procedure.

Alternatively, starting from the method known from document E1 (cf. Figure 3 and the corresponding text),

wherein dummy wafers are used for the above-mentioned "maintenance" of the apparatus, it is obvious to use the plasma cleaning method of document E3 and to apply this to an apparatus comprising a plurality of vacuum processing chambers in communication with a vacuum transfer chamber, as known for instance from document E6.

Starting from document E7 or E1, the skilled person would be aware that there can be a problem of cross-contamination between the dummy substrates, the substrates to be processed and the substrates already processed, in particular in the vacuum processing chambers, and that, for this reason, the operations must be sequential with the processed substrates being transferred back to their original position in the first store. Any other way of carrying out the method would not avoid cross-contamination.

Therefore, the method of claim 1 lacks an inventive step in the sense of Article 56 EPC.

Reasons for the Decision

1. The appeal is admissible.

2. There were no objections of the appellant about the admissibility of the amendments and the Board is also satisfied that the patent specification as amended complies with the formal requirements of the Convention.

3. *Inventive step*

The only issue is that of inventive step.

A method of operating a vacuum processing apparatus having a plurality of vacuum processing chambers (16 - 19) is known from document E7 (see Figure 1 and the corresponding text; see also column 17, line 34 to column 19, line 29) ; the apparatus has separate substrate stores (28) which are located in air adjacent the vacuum processing chambers, a vacuum transfer chamber (14) communicating with the vacuum processing chambers, load lock chambers (22) for transferring substrates between the vacuum transfer chamber (14) and the air, a single first conveyor (34) located in air and arranged to access the stores (28) and a second conveyor (24) located in the vacuum transfer chamber (14).

The respondent has convincingly argued as follows:

Document E7 contains no discussion of cleaning of the vacuum processing chambers and in particular of using dummy substrates for such a cleaning. The same remark applies to the method of document E6, from which the problem of dry cleaning using dummy substrates is not derivable. Taking into consideration the respective English abstracts filed by the opponent, the use of dummy substrates for cleaning processing chambers using a plasma is known from document E5. Also, from document E1, it is derivable that references to maintenance of a vacuum processing chamber using a dummy wafer means cleaning of the vacuum processing chamber. Document E3 (see the English abstract filed by the opponent) concerns the technique for deciding when to dry clean a vacuum processing chamber. However, none of the documents E5, E1 and E3 concerns vacuum processing

apparatus with a plurality of vacuum processing chambers. Thus, a combination of these two groups of prior art documents is necessary in relation to the first aspect of the claimed method, i.e., the particular technique using dummy substrates for cleaning to be applied to an apparatus with multiple processing chambers.

The claimed method has a further advantage, important for an apparatus with a plurality of vacuum processing chambers, in that it allows to process substrates and to dry clean the vacuum processing chambers using dummy substrates in such a way that contamination between the substrates to be processed, the processed substrates and the dummy substrates is avoided. The corresponding problem is not addressed by the related prior art documents: in document E7 (see column 17, lines 37 to 42), both load lock chambers (22) can be used for loading the vacuum transfer chamber (14) so that there are no separate load lock chambers and unload-lock chambers as in the claimed method, and there is no indication about transferring back the processed wafers to their original location in the first store. In document E6 (see Figure 1 and the corresponding text in the English translation filed by the appellant), a different approach is adopted, with a mechanism having separate stores (13, 15) for unprocessed and processed substrates. In the claimed method, returning the substrates to their original positions indeed simplifies the apparatus as compared to that of document E6 and minimises the risk of confusion.

Concerning the cross-contamination aspect of the problem, the appellant has argued that the skilled person would regard the measures provided in the method

of claim 1 as obvious.

However, the following is to be noted with respect to the disclosure in the above prior art documents:

In the documents showing an apparatus comprising a plurality of vacuum processing chambers, for the movement of the substrates, other method steps or arrangements in the apparatus are disclosed. For instance, in document E6, different stores are used for unprocessed substrates and processed substrates. In document E7, with no indication about wafers to be processed and dummy wafers, no information can be derived about the respective movements thereof. Thus, the prior art documents do not provide a solution to the above problem of cross-contamination as set out in the claimed method, wherein, as a result of the sequential arrangement of the steps, there is no co-existence of substrates being processed and dummy substrates in the same vacuum processing chambers.

Therefore, in the Board's judgment, having regard to the state of the art, the subject-matter of claim 1 is not obvious to a person skilled in the art and thus involves an inventive step in the sense of Article 56 EPC.

Consequently, claim 1 is patentable in the sense of Article 52(1) EPC. The same applies to the claims 2 to 5, which are dependent claims.

Since following the amendments provided by the respondent the respondent's request is allowable, the European patent can be maintained on this basis (Article 102(3) EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent with the following documents:

Claims: Nos. 1 to 5, filed as auxiliary request II on 25 October 2002;

Description: columns 1 to 7, filed during the oral proceedings; and

Drawings: Figures 1 and 2, as granted.

The Registrar: The Chairman:

M. Zawadzka R. K. Shukla