

0 6 JAN 2000

TESTING APPARATUS FOR ELECTRONIC DEVICE BOARD**BACKGROUND OF THE INVENTION****1. Field of the Invention**

The present invention relates to a testing apparatus for an electronic device board for testing for example a memory module or other electronic device board.

2. Description of the Related Art

In the process of production of memory modules and other electronic device boards, a testing apparatus is required for testing the finally produced memory modules.

As one type of such a testing apparatus, there is known a testing apparatus for testing memory modules under temperature conditions higher or lower than ordinary temperature. One of the characteristics of the memory modules is the guarantee that the memory modules operate well under even high temperatures or low temperatures.

When conducting a high temperature test or low temperature test by a conventional memory module testing apparatus, the pre-test memory modules are heated or cooled by a preheater or cooler in the testing apparatus, the heated or cooled memory modules are conveyed to the measurer using a pick-and-place mechanism, and the high temperature tests or low temperature tests are conducted by the preheating or cooling given to the memory modules.

Note that this type of testing apparatus applies a predetermined pattern of test signals to the memory modules under test and measures the electrical characteristics of the same. In general, it is called an IC tester. This IC tester, however, usually has connected to it a conveyor-processor which conveys memory modules to a measurer, brings the memory modules into electrical contact with sockets of a test head in the measurer, conveys the tested memory modules from the measurer after the test, and classifies the tested memory modules into good ones and defective ones based on the test results. This type of conveyor-processor is generally called a handler. In this specification, however, a type of tester with a handler integrally connected to it is simply called a testing apparatus for an electronic device board.

In such a testing apparatus for an electronic device board of the related art, however, several memory modules are conveyed at a time from the preheater or cooler to the measurer by a pick-and-place operation, so the throughput of the testing is extremely poor. Further, the temperature applied to the memory modules ends up changing before the memory modules are conveyed to the measurer, the temperature precision at the measurer is poor, and testing is difficult at an accurate temperature.

In particular, in a low temperature test, condensation is liable to form on the surface of the memory modules cooled to

a low temperature. A practical problem remains that it is difficult to conduct low temperature tests with a testing apparatus for the related art. When condensation forms on memory modules, the condensed water deposits on the terminals of the memory modules or the socket terminals and can have an adverse effect on the testing.

To eliminate these inconveniences, it may be considered to cover all of the preheater (or cooler) and measurer with a chamber and maintain the inside of the chamber at a predetermined temperature. Conducting a pick-and-place operation of memory modules inside the chamber, however, makes the pick-and-place mechanism troublesome and requires that the chamber be designed large. This invites an increase of size, complexity, and cost of the testing apparatus and therefore is not preferable.

Further, when conveying large electronic device boards such as memory modules into or out of the testing apparatus, trays of a type where the electronic device boards are arranged standing up are used, but such trays cannot be stacked on each other. Therefore, the loading section and unloading section of a testing apparatus have been provided with pullout shelf type tray magazines for storing one tray at a time. With a pullout shelf type tray magazine, however, there has been the problem that the larger the number of classifications, the larger the testing apparatus becomes.

Further, in such a testing apparatus, the trays are taken out or inserted by elevating the desired pullout shelf type tray magazines themselves to the device loading stage or device unloading stage.

With such a system of elevating the tray magazines themselves, however, there was the problem that an amount of dead space equal to the elevation operation becomes necessary above the tray magazines and the testing apparatus itself becomes large in size. Further, in the system of elevating the tray magazines themselves, the tray magazine for the trays storing the pre-test electronic device boards (hereinafter called supply trays) and the tray magazine for the trays storing the tested electronic device boards (hereinafter called storing trays) are independent in structure. For example, an emptied supply tray cannot be used as a storing tray.

SUMMARY OF THE INVENTION

A first object of the present invention is to provide a testing apparatus for an electronic device board improving the throughput of tests, enabling testing at a precise temperature, and enabling a reduction of the size, simplification, and reduction of the cost of the testing apparatus.

A second object of the present invention is to provide a testing apparatus for an electronic device board having a high compatibility of trays and able to handle a large number of categories of electronic device boards.

A third object of the present invention is to provide an electronic device board test tray for the above testing apparatus.

A fourth object of the present invention is to provide a tray transporter for the above testing apparatus.

According to a first aspect of the present invention, there is provided a testing apparatus for an electronic device board provided with at least a stocker for stocking pre-test and post-test electronic device boards and a measurer for testing the pre-test electronic device boards, the stocker provided with a first tray magazine in which first trays are independently stored in a vertical direction, a second tray magazine in which second trays are independently stored in a vertical direction, a first elevating means provided elevatably between the first tray magazine and the second tray magazine and transferring first trays or second trays between the first tray magazine and the second tray magazine, a horizontal conveying means provided above the first tray magazine, second tray magazine, and first elevating means, made able to be moved in a direction of parallel arrangement of these, and transferring the first trays or second trays with the first elevating means, and a second elevating means made elevatable with respect to a target position and transferring first trays or second trays with the horizontal conveying means; the measurer provided with a test socket to which board terminals of an electronic device board

are detachably inserted and a board pusher by which board terminals of an electronic device board is inserted into the test socket in the state where the electronic device board is attached to a test tray; a test tray provided with an insert formed with a holding groove in which two side ends of the electronic device board are slidably inserted so that the board terminals of the electronic device board are exposed and a tray body holding the insert so that the board terminals of the electronic device board are exposed being conveyed in and conveyed out.

In the testing apparatus for an electronic device board of the present invention, since it is possible to make a plurality of electronic device boards move inside the testing apparatus while held on a test tray and possible to have the measurer test the plurality of electronic device boards simultaneously, the throughput of the tests is tremendously improved. Further, there is no longer a need for a pick-and-place operation of an electronic device board at the measurer, it is possible to simplify the internal structure of the testing apparatus, and it is possible to reduce the size, simplify, and reduce the cost of the testing apparatus as a whole. Further, by holding the inside of the chamber at a constant high or low temperature, the temperature precision at the time of testing the electronic device board is improved and accurate testing becomes possible.

In addition to this, in the testing apparatus for an electronic device board of the present invention, since the tray magazines themselves are not elevated, but the trays are transported by the first elevating means, horizontal conveying means, and second elevating means, there is no longer the problem of dead space occurring above the tray magazines and the testing apparatus can be made smaller overall in at least the height direction.

Further, by providing the first elevating means between the tray magazines, it is possible to access both the tray magazines, the transport of the trays is made more efficient, and the freedom of the transport sequence of the trays is increased. Further, since it is possible to store trays in any of the tray magazines and possible to take out trays stored in any of the tray magazines, it is possible to flexibly deal with an increase in the number of classifications without changing the testing apparatus itself.

In the present invention, preferably there is further provided a first conveying means for reloading an electronic device board from a first or second tray on which a pre-test electronic device board is loaded to the test tray.

Preferably there is further provided a second conveying means for reloading an electronic device board from a test tray on which a post-test electronic device board is loaded to the first or second tray.

Preferably one of the tray magazines is for a tray on which a pre-test electronic device board is loaded and the other is for a tray on which a post-test electronic device board is loaded.

More preferably, at least part of the first tray magazine stores a tray on which a post-test electronic device board is loaded.

Still more preferably, the post-test electronic device board is of a category to be retested.

Preferably, the first tray and the second tray are the same type of tray.

Preferably, the board pusher includes a guide groove, in which two side ends of the electronic device board are inserted, for correcting an inclination of the electronic device board.

Preferably, there is further provided a matching plate for slidably holding the board pusher.

More preferably, there is further provided a driving means for making the matching plate move close to and move away from the test tray.

More preferably, the driving means includes an auxiliary driving means for making the board pusher move with respect to the matching plate so that the board pusher makes the electronic device board move in the test tray and pushes the board terminals of the electronic device board into the socket.

More preferably, there is further provided a tray

conveying base for elastically holding a test tray a predetermined interval above the test socket.

More preferably, the test socket includes inside it a return spring for applying a force in a direction for pulling out the board terminals of the electronic device board from the inside of the test socket.

According to a second aspect of the present invention, there is provided an electronic device board test tray provided with an insert formed with a holding groove in which two side ends of an electronic device board are slidably inserted the board terminals of the electronic device board are exposed and a tray frame for holding the insert so that the board terminals of the electronic device board are exposed.

Preferably, the insert includes a first positioning means for positioning board terminals of the electronic device board with respect to a board pusher for pushing them into the test socket.

Preferably, the insert includes a second positioning means for positioning the board terminals of the electronic device board and the test socket.

Preferably, the tray frame holds a plurality of inserts positioned in it.

According to a third aspect of the present invention, there is provided a testing apparatus for an electronic device board provided with an electronic device board test tray as set

forth in claim 14, a test socket in which board terminals of an electronic device board are detachably inserted, and a board pusher for pushing board terminals of an electronic device board into the test socket in the state with the electronic device board attached inside the electronic device board test tray.

Preferably, the board pusher includes a guide groove, in which two side ends of the electronic device board are inserted, for correcting inclination of the electronic device board. Preferably, there is further provided a matching plate for slidably holding the board pusher.

More preferably, there is further provided a driving means for making the matching plate move close to and move away from the electronic device board test tray.

More preferably, the driving means includes an auxiliary driving means for making the board pusher move with respect to the matching plate so that the board pusher makes the electronic device board move in the test tray and pushes the board terminals of the electronic device board into the socket.

Preferably, there is further provided a tray conveying base for elastically holding the electronic device board test tray a predetermined interval above the test socket.

Preferably, the test socket includes a return spring for applying force in a direction for pulling out the board terminals of the electronic device board from the inside of the test socket.

In the testing apparatus for an electronic device board using an electronic device board test tray according to the present invention, since it is possible to make a plurality of electronic device boards move inside the testing apparatus while held on a test tray and possible to have the measurer test the plurality of electronic device boards simultaneously, the throughput of the tests is tremendously improved. Further, there is no longer a need for a pick-and-place operation of an electronic device board at the measurer, it is possible to simplify the internal structure of the testing apparatus, and it is possible to reduce the size, simplify, and reduce the cost of the testing apparatus as a whole. Further, by placing all or part of the testing apparatus according to the present invention inside a chamber and holding the inside of the chamber at a constant high or low temperature, the temperature precision at the time of testing the electronic device board is improved and accurate testing becomes possible.

According to a fourth aspect of the present invention, there is provided a tray transporter provided with at least a pair of tray magazines in which trays are independently stored in a vertical direction and a first elevating means, provided elevatably between the pair of tray magazines, for transferring trays with the tray magazines.

Preferably, there is further provided a horizontal conveying means provided above the tray magazines and the first

elevating means, made movable in the direction of parallel arrangement of the same, and transferring the trays with the first elevating means.

Preferably, there is further provided a second elevating means made elevatable with respect to a target position and transferring trays with the horizontal conveying means.

While not particularly limited in the present invention, for example one of the tray magazines is for a tray on which a pre-test electronic device board is loaded and the other is for a tray on which the post-test electronic device board is loaded.

According to a fifth aspect of the present invention, there is provided a tray transporter provided with a first tray magazine in which first trays are independently stored in a vertical direction, a second tray magazine in which second trays are independently stored in a vertical direction, a first elevating means, provided elevatably between the first tray magazine and the second tray for transferring first trays or second trays with the first tray magazine and the second tray magazine, a horizontal conveying means provided above the first tray magazine, second tray magazine, and first elevating means, made movable in the direction of parallel arrangement of the same, and transferring first trays or second trays with the first elevating means, and a second elevating means made elevatable with respect to a target position and transferring

first trays or second trays with the horizontal conveying means.

While not particularly limited in the present invention, for example, one of the tray magazines is for a tray on which a pre-test electronic device board is loaded and the other is for a tray on which a post-test electronic device board is loaded. Preferably, at least part of the first tray magazine stores a tray on which a post-test electronic device board is loaded. In this case, more preferably the post-test electronic device board is of a category to be retested.

Preferably, at least part of the second tray magazine stores an empty tray from which a pre-test electronic device board has been transferred.

Preferably, the first tray and the second tray are the same type of tray.

In the tray transporter of the present invention, since the tray magazines themselves are not elevated, but the trays are transported by the first elevating means, horizontal conveying means, and second elevating means, so there is no longer the problem of dead space occurring above the tray magazines and the testing apparatus can be made smaller overall in at least the height direction.

Further, by providing the first elevating means between the tray magazines, it is possible to access both the tray magazines, the transport of the trays is made more efficient,

and the freedom of the transport sequence of the trays is increased. Further, since it is possible to store trays in any of the tray magazines and possible to take out trays stored in any of the tray magazines, it is possible to flexibly deal with an increase in the number of classifications without changing the testing apparatus itself.

The present disclosure relates to subject matter contained in Japanese Patent Applications No. HEI11-3792, HEI11-4276, HEI11-4277, filed on January 11, 1999, the disclosures of which are expressly incorporated herein by reference in their entirety.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will be explained in more detail below with reference to the attaching drawings, wherein:

Fig. 1A is a plan conceptual view of a testing apparatus for an electronic device board according to an embodiment of the present invention;

Fig. 1B is a sectional view along line B-B of Fig. 1A;

Fig. 2 is a side sectional view;

Fig. 3 is a perspective view of an example of a supply or storing tray used in the present embodiment;

Fig. 4A is a perspective view of a memory module stocker of the present embodiment;

Fig. 4B is a perspective view of the part of the tray

magazine and elevator;

Fig. 5 is a perspective view of a memory module gripping mechanism used in an XY conveyor of the present embodiment;

Fig. 6 is a sectional view of a measurer of the present embodiment;

Fig. 7 is a perspective view of a test tray used in the present embodiment;

Fig. 8A is a front view of an insert of a test tray of Fig. 7;

Fig. 8B is a front view of an insert of a test tray of Fig. 7;

Fig. 8C is a side view of an insert of a test tray of Fig. 7;

Fig. 9 is a perspective view of a test head of the present embodiment;

Fig. 10 is a sectional view of a state of contact of a memory module and socket in the test head;

Fig. 11A to Fig. 11E are conceptual views for explaining the method of handling a supply or storing tray of the present invention;

Fig. 12A to Fig. 12G are sectional views of principal parts for explaining the operation at the measurer of Fig. 1;

Fig. 13A is a plan conceptual view of a testing apparatus for an electronic device board of another embodiment of the present invention; and

Fig. 13B is a sectional view along line B-B of Fig. 13A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following embodiments, the present invention will be explained giving as an example of memory module 10 of the shape shown in Fig. 3 as the device under test, but the testing apparatus for the present invention is not limited to just a memory module of the shape illustrated and includes all electronic devices which cannot be stored in a tray magazine with the trays stacked on each other.

First, the overall configuration of the testing apparatus of the present embodiment will be explained with reference to Fig. 1A to Fig. 10. The testing apparatus of the present embodiment, as shown in Fig. 2, is comprised of a handler 1 for handling a memory module 10 under test, a test head TH with which the memory module 10 is brought into electrical contact, and a tester TS for sending a predetermined pattern of test signals to the test head TH for executing a test of the memory module.

Note that the testing apparatus of the present invention can be applied to all sorts of test heads TH and tester TS and all test heads TH and testing apparatus TH are included, so these are shown in only Fig. 2 and are omitted from the other figures.

Among these, the handler 1 is comprised of a chamber 100

in which the test head TH is attached, a memory module stocker 200 stocking the memory modules 10 to be tested from then on or classifying and stocking the tested memory modules 10, a loader section 300 for sending memory modules 10 into the chamber 100, and an unloader section 400 for classifying and taking out the tested memory modules 10 which had been tested at the chamber 100.

The handler 1 is an apparatus which tests (inspects) whether a memory module 10 is suitably operating in a state applying a high temperature or low temperature thermal stress to the memory module 10 and classifies the memory module 10 in accordance with the test results. The operating test in the state with such a thermal stress applied is conducted with the memory module 10 under test reloaded from a supply tray 202 on which a large number of memory modules 10 are loaded to a test tray 20 conveyed inside the handler 1.

The test tray 20 is loaded with memory modules 10 at the loader section 300, then is sent into the chamber 100. The memory modules 10 are tested in a measurer 102 of the chamber 100 in the state loaded on the test tray 20. The tested memory modules 10 are carried out to the unloader section 400, then the memory modules 10 are reloaded on the storing trays 204 in accordance with the test results in the unloader section 400.

The chamber 100 is comprised of a soak chamber 10 for giving a desired high temperature or low temperature thermal

stress to the memory modules 10 loaded on the test tray 20, a measurer 102 for bringing a memory module 10 in a state given a thermal stress in the soak chamber 101 into contact with a socket 50 of the test head TH, and an unsoak chamber 103 for removing the thermal stress given from a memory module 10 tested at the measurer 102.

In the unsoak chamber 103, when a high temperature was applied at the soak chamber 101, the memory module 10 is cooled by blowing air to return it to room temperature or is allowed to naturally cool to return to near room temperature. As opposed to this, when a low temperature of for example about -30°C was applied at the soak chamber 101, the memory module 10 is heated by blowing hot air or a heater etc. to return it to a temperature of an extent where condensation does not occur. Further, the unsoaked memory module 10 is conveyed out to the unloader section 400.

Note that the unsoak chamber 103 preferably is thermally isolated from the soak chamber 101 or measurer 102, so in the present example an unsoak chamber 103 is provided outside the chamber 100, but conceptually it is also possible for the soak chamber 103 to be included in the chamber 100 as well.

The configurations of the areas of the memory module stocker 200, loader section 300, chamber 100, and unloader section 400 will be explained in further detail.

Memory Module Stocker 200

First, the memory modules 10 under test are conveyed loaded on the trays 202 and 204 shown in Fig. 3 in a standing state with the terminals 12 facing down or are conveyed out in the same state. Reference numeral 205 shown in the figure shows projections for holding the memory modules 10 in the standing state.

Note that it has been decided to call a tray for loading pre-test memory modules 10 a supply tray 202 and a tray for loading tested memory modules 10 a storing tray 204, but these trays 202 and 204 may be the same in shape or different. At the very least, however, the supply tray 202 is preferably provided with a positioning function for the memory modules 10 loaded. This is because the memory modules 10 loaded on the supply tray 202 are conveyed into the handler 1 where they are reloaded by a plurality of pickups (later explained XY conveyor 303).

The memory module stocker 200 of the present embodiment is provided with a pair of tray magazines 212 and 214. As shown in Fig. 1A, Fig. 1B, Fig. 2, Fig. 4A, and Fig. 4B, one of the tray magazines 212 holds and stores in it, without stacking, mutually independently in the vertical direction mainly supply trays 202 on which memory modules 10 to be tested from then on are loaded. As opposed to this, the other tray magazine 214 holds and stores in it, without stacking, mutually independently in the vertical direction storing trays 204 on which the tested memory modules 10 are suitably classified. That is, the trays

202 and 204 are stored in for example a pullout shelf manner in these tray magazines 212 and 214.

Note that the number of the trays which can be stored in the tray magazines 212 and 214 is not particularly limited and can be suitably determined with reference to the size of the handler 1, sorting ability, etc. In this example, a maximum of seven trays 202 and 204 can be stored in each of the tray magazines 212 and 214.

Further, while explained later in detail, the tray magazines 212 and 214 are made the same in structure, so it is possible for them to store either of the supply trays 202 and storing trays 204. That is, when a large number of categories of test results are required in addition to good modules and defective modules such as, among good ones, ones with high operating speeds, medium speeds, and low speeds or, among defective ones, ones requiring retesting, this can be handled by making comprehensive use of the two tray magazines 212 and 214.

Between the pair of tray magazines 212 and 214 is provided elevatably an elevator 206. The elevator 206, as shown in Fig. 4A, is controlled to move at least in the vertical direction between the bottommost stage and topmost stage of the tray magazines 212 and 214 by a ball-screw drive 206a.

The elevator 206 transfers the trays 202 and 204 with the tray magazines 212 and 214. This operation, for example, as

shown in Fig. 4B, is performed by hooking a rod of a fluid pressure cylinder 206b on a tray 202 or 204 or a plate carrying the same and driving the fluid pressure cylinder 206b to project or retract so as to remove or insert the tray 202 or 204.

Directly above the tray magazines 212 and 214 and the elevator 206 is provided a transfer arm 208 to be movable in the +X-axial direction shown in Fig. 4A. The transfer arm 208 is controlled to move to a predetermined position in the +X-axial direction by for example a ball-screw drive 208a. The transfer arm 208 picks up the tray 202 or 204 placed on the elevator 206 and places it to a later explained setting plate 210 or conversely picks up a tray 202 or 204 placed on the setting plate 210 and places it at the elevator 206. At this time, a hook mechanism 208b for holding or releasing the tray 202 or 204 (see Fig. 11A) is provided in an openable manner.

Note that in the present embodiment, the direction of movement of the transfer arm 208 is made just the +X-axial direction, but it may also be made elevatable with respect to the +Z-axial direction and the trays elevated in the +Z-axial direction at the time of transfer of the tray 202 or 204. Further, it may be made elevatable with respect to the +Y-axial direction to give a degree of freedom to the range of setting the later explained setting plate 210.

In the present embodiment, three setting plates 210 are provided directly above the transfer arm 208. The setting plates

210 are made independently elevatable in the +Z-axial direction by for example a ball-screw drive 210a and can be elevated at least between a position lower than the transfer arm 208 and a position higher than the transfer arm 208. The lower limit position spoken of here is the position at the time of transfer of the trays 202 and 204, while the upper limit position is the setting position of the trays 202 and 204 (that is, the position of placement of memory modules 10 on the test tray 20 by the XY-conveyor 303 and the position of pickup of memory modules 10 from the test tray 20 by the XY-conveyor 403).

Note that in the present example, three setting plates 210 are provided, with the left one in Fig. 4A being used as the setting plate 210 of the loader section 300 and the right two being used as the setting plates 210, 210 of the unloader section 400. The present invention, however, is not limited to this. Two or four or more may be provided.

Loader section 300

The above-mentioned supply tray 202 is set at a window 306 of the loader section 300 from below. At the loader section 300, the memory modules 10 loaded on the supply tray 202 are reloaded onto a test tray 20 stopped at the loader section 300.

As a conveyor reloading memory modules 10 from a supply tray 202 to a test tray 20, as shown in Fig. 1A, use is made of an XY-conveyor 303 provided with a Y-axial rail 301, an X-axial

rail 302 able to move in the +Y-axial direction between the supply tray 202 and test tray 20 along the Y-axial rail, and a movable head 304 able to move in the +X-axial direction along the X-axial rail 302.

The movable head 304 of the XY-conveyor 303 has attached to it a memory module gripping mechanism 500 shown in Fig. 5 facing downward. The gripping mechanism 500 shown in the figure is comprised of a fluid pressure cylinder 502 for making the gripped memory module 10 move in the +Z-axial direction, a pair of chucks 504 for grasping the two side edges of the memory module 10, and a fluid pressure cylinder 506 making the pair of chucks 504 open or close. By making the chucks 504 open or close by the fluid pressure cylinder 506, it is possible to grasp or release the two side edges of the memory module 10. Further, it is possible to elevate a gripped memory module 10 by the fluid pressure cylinder 502.

By the gripping mechanism 500 gripping and moving a memory module 10 in this way, the memory module 10 is gripped from the supply tray 202 and that memory module 10 reloaded on the test tray 20. For example, in the present example, eight gripping mechanisms 500 are attached to the movable head 303 and can reload eight memory modules at one time on the test tray 20.

Note that in the supply tray 202, since the recess-shaped pockets for carrying the memory modules are formed relatively larger than the shapes of the memory modules 10, the memory

modules stored in the supply tray 202 are positioned with some variation. Therefore, in some cases if gripping a memory module 10 by the gripping mechanism 500 and carrying it directly to the test tray, it is sometimes difficult to accurately drop it into an insert 30 of the test tray 20.

Therefore, in the present embodiment, provision is made of a position correcting means for a memory module 10 called a preciser 305 between the setting position of the supply tray 202 and the test tray 20. This preciser 305 has relatively deep recesses enabling insertion of the memory modules 10 and has rims of the recesses shaped surrounded with inclined surfaces. Therefore, when a memory module 10 is dropped in a recess, the dropping position of the memory module 10 is corrected by the inclined surfaces. Due to this, the mutual positions of the eight memory modules 10 are accurately determined. By picking up the thus correctly positioned memory modules 10 once again by the gripping mechanism 500 and reloading them on the test tray 20, it is possible to accurately reload the memory modules 10 in the inserts 30 of the test tray 20.

Chamber Section 100

As explained above, a test tray 20 is loaded with memory modules 10 at the loader section 300 and carried to the soak chamber 101. While the illustration is omitted, the soak chamber 101 is provided with a vertical conveyor. Using this vertical conveyor, a plurality of test trays 20 are supported and kept in

a standby state until the measurer 102 becomes empty. A high temperature or low temperature thermal stress is applied to the memory modules 10 mainly while they are waiting.

The measurer 102 has a test head TH placed at its center and set so the sockets 50 approach the inside of the measurer 102 from below. A test tray 20 is carried above the thus set test head TH. The plurality of memory modules 10 are simultaneously brought into electrical contact with the plurality of sockets 50 for the testing. The test tray 20 finished being tested is unsoaked at the unsoak chamber 103. The memory modules 10 are returned to room temperature or a temperature corresponding to it, then conveyed out to the unloader section 400.

Further, the test tray 20 conveyed out to the unloader section is sent back again to the loader section 300 and the chamber 100 by a not shown roller conveyor etc.

As shown in detail in Fig. 7, the test tray 20 of the memory modules is provided with an insert 30 in which a memory module 10 is detachably accommodated and a tray body 20a for holding a plurality of inserts 30 in a row along the X-axial direction. The tray body 20a is provided with a rectangular upper frame 22 and a rectangular lower frame 24 of the same size. These frames 22 and 24 are connected substantially in parallel by a plurality of rod-shaped spacers 26.

The upper frame 22 and lower frame 24 are formed at

predetermined intervals along the X-axial direction with holding holes 21 and 23 for holding the inserts 30 passed through them. Near the two ends in the Y-axial direction of each holding hole 21 formed in the upper frame 22 are formed a pair of positioning holes 25 shifted in position in the X-axial direction. These positioning holes 25, as shown in Fig. 8C, engage with positioning pins 42 formed at the insert 30 and position the insert 30 with respect to the tray body 20a. Note that the bottom end of each pin 42 is provided with a cap 43 so that the insert 30 is prevented from being pulled out from the tray body 20a.

As shown in Fig. 7 and Fig. 8A and Fig. 8B, an insert 30 has a pair of side walls 32 formed with inverted frustoconical cutaway portions 31. The side walls 32 are integrally formed with end walls 33a and 33b so that a module space 34 is formed between these side walls 32. The inserts 30 are comprised of for example a synthetic resin.

As shown in Fig. 8B, the end walls 33a and 33b have formed at their inner sides bosses 35 projecting out to the space 34. Each boss 35 has formed at its inner periphery a holding groove 36 and holding bottom wall 37. As shown in Fig. 8A and Fig. 8B, the bottom of the space 34 formed between the pair of side walls 32 becomes the through hole 38 between the facing bosses 35, 35. Board terminals 12 of a memory module 10 held between the holding bottom walls 37 of the holding grooves

36 pass through the through hole 38 and are exposed downward.

The holding grooves 36 enable the two side ends of a memory module 10 to be detachably inserted from above. As shown in Fig. 8A, above the holding grooves 36 are formed tapered guide grooves 42 for guiding the two side ends of the memory module 10 into the holding grooves 36. Inside an insert 30, the interval of the space 34 is formed with a relatively large clearance so that the memory module 10 is held by its own weight positioned by the holding bottom walls 37 of the holding grooves 36 with slight clearances in the X-axial direction and Y-axial direction and does not contact the other portions of the insert 30.

At the top parts of the end walls 33a and 33b are integrally formed flanges 39. The flanges 39, as shown in Fig. 7, are placed on the edges of the holding holes of the upper frame 22 in a state with the insert 30 held passing through the inside of the holding holes 21 and 23 of the tray body 20a and prevent the insert 30 from falling downward from the holding holes 21 and 23. At the bottom surfaces of the flanges 39 are provided projecting out therefrom positioning pins 42 as shown in Fig. 7 and Fig. 8B and Fig. 8C. These positioning pins 42, as shown in Fig. 8C, engage with the positioning holes 25 formed in the upper frame 22.

At the bottom ends of the positioning pins 42 are attached caps 43, whereby the insert 30 is prevented from being

pulled out upward from the tray body 20a. As a result, the insert 30 is held positioned with respect to the tray body 20a. The clearance between the positioning holes 25 and the positioning pins 42 is preferably set large to an extent enabling movement of the insert 30 with respect to the tray body 20a in the X-axial direction and Y-axial direction of about 0.5 to 1.5 mm. As explained later, this is because the inserts 30 have to be positioned with respect to the board pushers 76 and the sockets 50 and have to be able to move with respect to the tray body 20a. Further, the inserts 30 have to be able to move slightly with respect with the tray body 20a in the Z-axial direction as well, so the caps 43 shown in Fig. 8C are attached to the bottom ends of the positioning pins 42 so as to allow relative movement in the Z-axial direction of the inserts 30 and the tray body 20a. Note that the clearance of the outer shape of the bottom end of an insert 30 with respect to a holding hole 23 formed in the bottom frame 24 is substantially the same as the clearance between a positioning hole 25 and positioning pin 42. This prevents the insert 30 from becoming inclined more than necessary with respect to the tray body 20a.

In particular as shown in Fig. 8B, the end walls 33a and 33b are formed with upper positioning holes 40 formed so as to pass through the flanges 39 and lower positioning holes 41 opening to the bottom of the end walls 33a and 33b. The upper positioning holes 40 have inserted into them the positioning

pins 80 formed at a holding plate 78 of a board pusher 76 shown in Fig. 6, whereby the board pusher 76 and the insert 30 are positioned. Further, the lower positioning holes 41 have inserted into them the positioning pins 56 formed at a socket guide 52 of a test socket 50 shown in Fig. 6, whereby the board terminals 12 of a memory module 10 held by the insert 30 is positioned with respect to the test socket 50.

As shown in Fig. 6, a test tray 20 holding inserts 30 is placed on a tray conveying base 44 and can be conveyed in for example the X-axial direction. The tray conveying base 44 is elastically held with respect to a test head base 48 holding the sockets 50 by for example a spring 46 (or pressure cylinder) or other means. As a result, the tray conveying base 44 is given a spring force in a direction in which the test tray 20 moves away from the sockets 50 above the test head base 48.

The structural relationship between a test tray 20 and test head TH in the measurer 102 is as follows:

First, as shown in Fig. 9, a plurality of sockets 50 are arranged along the X-axial direction on the test head base 48 through a common test board 64 and individual test boards 66. The number of sockets 50 shown in Fig. 9 arranged is preferably a whole fraction of the number of inserts 30 held by the test tray 20 shown in Fig. 7. Further, the pitch of arrangement of the sockets 50 shown in Fig. 9 in the X-axial direction is preferably a whole multiple of the pitch of arrangement of the

inserts 30 shown in Fig. 7 in the X-axial direction.

For example, when 16 inserts 30 shown in Fig. 7 are arranged along the X-axial direction, eight sockets 50 shown in Fig. 9 or $\frac{1}{2}$ of 16 are arranged in X-axial direction. Further, the pitch of arrangement of the sockets 50 shown in Fig. 9 in the X-axial direction is made double the pitch of arrangement of the inserts 30 shown in Fig. 7 in the X-axial direction. By arranging sockets 50 in such numbers and at such pitches, it is possible as shown next to test all of the memory modules 10 held by a test tray 20 divided into several batches (for example, two).

That is, first, the board terminals 12 of the odd number (or even number) memory modules 10 in the X-axial direction out of the memory modules 10 held by the inserts 30 of the test tray 20 shown in Fig. 7 are inserted into the socket grooves 51 of the sockets 50 shown in Fig. 9 for testing the modules simultaneously. Next, the test tray 20 shown in Fig. 7 is made to move along the X-axial direction by exactly the same interval as the pitch of arrangement of the inserts 30 in the X-axial direction, then the board terminals 12 of the even number (or odd number) memory modules 10 along the X-axial direction are inserted into the socket grooves 51 of the sockets 50 for testing the modules simultaneously. In this way, it is possible to test all of the memory modules 10 held by the test tray 20.

As shown in Fig. 9, each of the sockets 50 has a socket

body 53 formed with a socket groove 51 along the Y-axial direction and a base 68 holding the socket body 53. The base 68 is connected to the top part of an individual test board 66. Further, on top of the base 68 at the outer circumference of the socket body 53 is attached a socket guide 52 formed with an elongated through hole 54 in the Y-axial direction. Between the two ends of the socket body 53 in the Y-axial direction and the socket guide 52 are formed relief grooves 55 corresponding to the two ends of the through hole 54. As shown in Fig. 6, the bosses 35 formed at the lower ends of the end walls 33a and 33b of an insert 30 enter into these relief grooves 55. The board terminals 12 of the memory module 10 with its two side ends held by the holding grooves 36 of the bosses 35 can be inserted well into the socket groove 51 of the socket 50 as a result.

Further, as shown in Fig. 10, inside the socket groove 51 of a socket 50 are arranged socket terminals 58. The socket terminals 58 are electrically connected with the board terminals 12 formed at the bottom end of the memory module 10 in the state with the board terminals 12 inserted inside the socket groove 51. The socket terminals 58 are connected through the internal wiring of the base 68, individual test board 66, common test board 64, and test head base 58 to the test head TH and the tester TS. The test results can be read for each memory module 10.

Further, in the present embodiment, as shown in Fig. 10,

the socket groove 51 is provided at its bottom with a pad 60 for receiving the bottom end of a module 10 and a return spring 62 for imparting a spring force for pushing the pad 60 upward. Therefore, the bottom end of a memory module 10 is pushed upward from the socket groove 51 in the state with no external force acting on the memory module 10.

As shown in Fig. 6, above the test tray 20 held on the conveying base 44 is arranged a Z-axial drive unit 70 for making the board pushers 76 move in the vertical direction (Z-direction). The Z-axial drive unit 70 has a common drive plate 72, matching plate 74, and holding plates 78 for holding the board pushers 76.

At the bottom surface of each board pusher 76 is formed a pushing surface 71 for finally pushing the top end of a memory module 10. At the positions of the two ends of the pushing surface 71 in the Y-axial direction are integrally formed guide projections 73 projecting downward from the bottom surface of the board pusher 76. Further, the guide projections 73 can be inserted into the inside of the space 34 of the insert 30.

At the inside of the guide projections 73 is formed a guide groove 77 into which the two top side ends of a memory module 10 are inserted for correcting the inclination of the module 10 in the insert 30. At the bottom end of the guide groove 77 is formed a taper 75. The two top side ends of a memory module 10 can be easily inserted into the guide groove 77

as a result.

At the bottom surface of the two ends in the Y-axial direction of a holding plate 78 holding a board pusher 7 are provided positioning pins 80. The positioning pins 80 are inserted into the upper positioning holes 40 of an insert 30 for positioning the board pusher 76 and the memory module 10 when the holding plate 78 moves downward in the Z-axial direction.

A plurality of board pushers 76 and holding plates 78 are arranged along the X-axial direction at intervals and in numbers corresponding to the pitch of arrangement of the sockets 50 in the X-axial direction. The holding plates 78 are secured to the lower ends of a plurality of suspension rods 82. The upper ends of the suspension rods 82 are secured to the lower surfaces of the individual drive plates 84. The individual drive plates 84 are also arranged in the X-axial direction at intervals and in numbers corresponding to the pitch of arrangement of the sockets 50 in the X-axial direction. The individual drive plates 84 are placed movably in the Z-axial direction inside the plurality of holding grooves 86 formed along the X-axial direction in the upper surface of a single matching plate 74. The inside walls of the holding grooves 86 are formed into tapers. The board pushers 76 are held suspended with respect to the matching plate 74 through the holding plates 78, suspension rods 82, and individual drive plates 84. In that state, the individual drive plates 84 are held positioned with respect to the holding

grooves 86.

The matching plate 74 and the common drive plate 72 are linked by a linkage block 92 as shown in Fig. 12A to Fig. 12G. These can move in the Z-axial direction while maintaining the same interval between them. Note that the illustration of the drive mechanism for making the matching plate 74 and common drive plate 72 in the Z-axial direction (pressure cylinder or motor actuator etc.) is omitted.

As shown in Fig. 6, a pair of contact cylinders 88 are attached to the bottom surface of the common drive plate 72 in the Y-axial direction corresponding to the top part of the individual drive plates 84. The contact cylinders 88 are provided with pushing pads 90 able to be driven in the Z-axial direction. As explained later, it is possible to push the individual drive plates 84 floating up from the matching plate 74 downward at predetermined timings.

Unloader Section 400

The unloader section 400 is also provided with an XY conveyor 403 of the same structure as the XY conveyor 303 provided at the loader section 300. This XY conveyor 403 is also provided with a Y-axial rail 401, an X-axial rail 402 able to move in the +Y-axial direction between the storing tray 204 and test tray 20 along the Y-axial rail 401, and a movable head 404 able to move in the +X-axial direction along the X-axial rail 402. The movable head 404 has attached to it a memory module

gripping mechanism 500 shown in Fig. 5 facing downward. The XY conveyor 403 reloads the tested memory modules 10 from the test tray 20 carried to the unloader section 400 to a storing tray 204.

Further, the unloader section 400 has opened in it a pair of windows 406a and 406b arranged so that storing trays 204 carried to the unloader section 400 can approach them from below. As already explained, below the windows 406a and 406b are provided setting plates 210, 210 for elevating the storing trays 204. Here, these descend carrying storing trays 204 becoming full after being loaded with tested memory modules 10 and transfer the full trays 204 to the transfer arm 208.

Note that with the handler 1 of the present embodiment, even if there are a maximum of for example eight types of sortable categories, it is only possible to arrange a maximum of two storing trays 204 at the windows 406a and 406b of the unloader section 400. Therefore, there is a limit of two categories which modules can be sorted into in real time. In general, good modules are sorted into the three categories of high speed response devices, medium speed response devices, and low speed response devices. These plus defective modules gives four categories, which are sufficient. However, sometimes categories arise not belonging to these such as when the test results are unclear and retesting is required.

When memory modules 10 arise which would be classified

into a category other than the categories allocated to the two storing trays 204 arranged at the windows 406a and 406b of the unloader section 400, one storing tray 204 is returned from the unloader section 400 to the stocker 200 and, in its place, a storing tray 204 for storing the memory modules 10 of the newly arising category is transferred to the unloader section 400 so as to store the memory modules 10.

If switching storing trays 204 in the middle of sorting work, however, the sorting work has to be interrupted during that interval and the problem arises of a reduction in the throughput. Therefore, in the handler 1 of the present embodiment, a buffer section 405 is provided between the test trays 20 and windows 406a and 406b of the unloader section 400, and that buffer section 405 is made to temporarily keep the memory modules 10 of an only rarely arising category.

For example, the buffer 405 is given the capacity to store 30 to 50 or so memory modules 10. Further, a memory device for storing the categories of the memory modules 10 stored in the storage positions of the buffer section 405 is provided and stores the categories and positions of the memory modules 10 temporarily kept at the buffer section 405 for each memory module 10. Further, between the sorting work or when the buffer section 405 has become full, a storing tray 204 of a category to which the memory modules 10 kept at the buffer section 405 belong is called up from the stocker 200 and the modules are

stored in the storing tray 204. At this time, in some cases the memory modules 10 temporarily kept at the buffer section 405 extend over several categories. At such a time, it is sufficient to call up a plurality of storing trays 204 at one time to the windows 406a and 406b of the unloader section 400 when calling up the storing trays 204.

Next, the operation will be explained.

First, referring to Fig. 11A to Fig. 11E, an explanation will be given starting from the operation of the memory module stocker 200. In Fig. 11A to Fig. 11E, the operation of storing supply trays 202 filled with pre-tested memory modules 10 in all of the stages of the tray magazine 212 and setting this in the loader section 300 of the handler 1 and the operation of transferring storing trays 204 becoming full with tested memory modules 10 at the unloader section 400 of the handler 1 to the tray magazine 214 will be explained continuously.

For example, if taking out a supply tray 202 from the topmost stage of the tray magazine 212, as shown in Fig. 11A, the elevator 206 is made to move to a position of the height of the topmost stage of the tray magazine 212, then the fluid pressure cylinder 206a shown in Fig. 4B is used to push out the supply tray 202 of the topmost stage of the tray magazine 212 to the elevator 206. Around this time, the transfer arm 208 is made to move directly above the elevator 206.

Next, the elevator carrying the supply tray 202 is made

to rise to a position for transfer with the transfer arm 208 and the hook mechanism 208b of the transfer arm 208 is closed so as to pick up and hold the supply tray 202. Further, the transfer arm 208 is made to move to the target position, that is, the bottom part of the loader section 300. Before this movement, the setting plate 210 of the loader section 300 is made to descend to the lower limit position.

This state is shown in Fig. 11B. Here, however, the setting plate 210 is made to rise slightly (or when the transfer arm 208 is given an additional function of elevation in the +Z-axial direction, the transfer arm 208 side is made to descend slightly) and the hook mechanism 208b of the transfer arm 208 is opened to transfer the supply tray 202 on to the setting plate 210. The transfer arm 208 is then made to retract from that position, then, as shown in Fig. 11C, the setting plate 210 is made to rise to the upper limit position and the supply tray 202 is set at the loader section 300. With the above, the operation for setting a supply tray 202 filled with the pre-test memory modules 10 at the loader section 300 is completed.

In Fig. 11C, the transfer arm 208 which had been positioned at the bottom of the loader section 300 moves to the right side of the unloader section 400 to receive the storing tray 204 filled with the tested memory modules 10. Before this movement, the setting plate 210 at the right side of the unloader section 400 is made to descend to the lower limit

position. Further, the setting plate 210 is made to rise slightly (or when the transfer arm 208 is given an additional function of elevation in the +Z-axial direction, the transfer arm 208 side is made to descend slightly) and the hook mechanism 208b of the transfer arm 208 is closed to receive and hold the supply tray 204 at the transfer arm 208.

Next, as shown in Fig. 11D, the transfer arm 208 is made to move to above the elevator 206 standing by at the elevated position. There, the hook mechanism 208b of the transfer arm 208 is opened to transfer the storing tray 204 to the elevator 206. Further, as shown in Fig. 11E, the elevator 206 is made to descend to a predetermined empty stage of the tray magazine 214 (in this example, the third stage from the top), then the fluid pressure cylinder 206b shown in Fig. 4B is used to pull the storing tray 204 into the tray magazine 214. With the above, the operation for transferring a storing tray 204 filled with the tested memory modules 10 from the unloader section 400 to the tray magazine 214 is completed.

In this way, if using the tray transporter of the present embodiment, since there is no need to elevate the tray magazines 212 and 214 themselves, there is no need to provide space for the elevation operation above the tray magazines 212 and 214. Therefore, the testing apparatus itself can be made smaller in at least the height direction.

Note that the handling sequence of trays shown in Fig.

11A to Fig. 11E is no more than one example of the present invention. According to the present invention, since the elevator 206 is structured to enable access to any of the trays 202 and 204 stored at the pair of tray magazines 212 and 214, it is possible to take out and insert any of the trays 202 and 204 between the loader section 300 and unloader section 400 and the tray magazines 212 and 214.

For example, when the supply tray 202 and the storing tray 204 are the same trays, a supply tray 202 filled with the memory modules 10 is transferred to the loader section 300 by the routine shown in Fig. 11A to Fig. 11C, then when the supply tray 202 of the loader section 300 becomes empty, it can be directly or indirectly transferred by the transfer arm 208 to the unloader section 400 and used as a storing tray 204.

Further, a storing tray becoming full with memory modules 10 at the unloader section 400 is usually stored in the tray magazine 214, but by using empty stages of the tray magazine 212, it is also possible to flexibly deal with increases in the number of categories.

That is, if the supply trays 202 and the storing trays 204 are used independently, when the number of supply trays is A, the number of storing trays is B, and the number of categories is n, continuous operation is not possible unless there are at least $B=A+(n-1)$ number of storing trays 204, but by making common use of these trays 202 and 204, it becomes

possible to perform the storing operation continuously even with $n=B+1$.

Next, the pre-test memory modules 10 filled on a supply tray 202 set at the window 306 of the loader section 300 from the above memory module stocker 200 are transferred to a test tray 20 for memory modules by the XY conveyor 303 shown in Fig. 1A and Fig. 1B, then are conveyed into the chamber 100 in the state loaded on the test tray 20. In the chamber 100, the memory modules 10 are heated or cooled to the temperature for testing (high temperature or low temperature) at the soak chamber 101 and pushed to the test head at the measurer 102. This pushing to the test head is performed in the state carried on the test tray 20. Several memory modules 20 are simultaneously pushed.

The operation at the measurer 102 will be explained in detail with reference to Fig. 12A to Fig. 12G.

First, the test tray 20 on which several memory modules 10 shown in Fig. 7 are held is, as shown in Fig. 6, conveyed by the tray conveying base 44 to a position above the sockets 50 secured on the test head base 8 from another position and is stopped positioned with respect to the sockets 50.

Next, the Z-axial drive unit 70 is made to descend in the Z-axial direction from the position shown in Fig. 12A to the position shown in Fig. 12B. This being done, the positioning pins 80 formed at the bottom surface of the holding plates 78 shown in Fig. 6 enter inside the upper positioning holes 40

formed at the inserts 30 of the test tray 20 for positioning of the board pushers 78 and the memory modules 10 held at the inserts 30.

Simultaneously, the guide projections 73 of the board pushers 76 enter into the spaces 34 of the inserts 30, the two upper side ends of the memory modules 10 are pushed into the guide grooves 77, the inclinations of the memory modules 10 held inside the inserts 30 are corrected, and the memory modules 10 are held substantially vertical with respect to the pushing surfaces 71 of the board pushers 76.

At this time, the holding plates 78 of the board pushers 76 shown in Fig. 6 abut against the top surfaces of the inserts 30 and push the inserts 30 downward together with the tray 20. At this point of time, the pushing surfaces 71 of the board pushers shown in Fig. 6 do not completely contact the top ends of the memory modules 10.

Next, as shown in Fig. 12C, if the drive unit 70 is made to descend further along the Z-axial direction, the bottom end of the linkage block 92 abuts against the top end of the tray conveying base 44. The interval between the matching plate 74 and the common drive plate 72 in the Z-axial direction does not change. Since the test tray 20 is held with respect to the conveying base 44, the board pushers 76 contacting the top surfaces of the inserts 30 are lifted slightly upward relative to the matching plate 74 along with the individual drive plates

84. At this time as well, however, the pushing surfaces 71 of the board pushers 76 shown in Fig. 6 do not completely contact the upper ends of the memory modules 10 held in the inserts 30.

Next, as shown in Fig. 12D, if the drive unit 70 is further made to descend along the Z-axial direction, the linkage block 92 pushes the tray conveying base 44 down against the force of the springs 46 shown in Fig. 6. As a result, the test tray 20 held at the tray conveying base 44 is pushed down along the Z-axial direction, the lower ends of the bosses 35 of the inserts 30 shown in Fig. 6 enter into the relief grooves 55 of the sockets 50, and the lower ends of the memory modules 10 contact the sockets 50. Simultaneously, the positioning pins 56 of the sockets 50 enter into the lower positioning holes 41 of the inserts 30 for positioning of the inserts 30 and the sockets 50.

As shown in Fig. 12E, if the drive unit 70 is made to descend further along the Z-axial direction, the bottom ends of the memory modules 10 shown in Fig. 10 start to enter the socket grooves of the sockets 50. Due to the repulsive force of the socket terminals 58, only the memory modules 10 stop at that position. That is, the memory modules 10 remain stationary with respect to downward movement of the inserts 30 and the tray 20, so are pushed back upward relatively and as a result the upper ends of the memory modules contact the pushing surfaces 71 shown in Fig. 6. The tray 20 including the inserts 30 without the

memory modules 74, the conveying base 44, matching plate 74, and common drive plate 72 continue to descend. By attaching springs or other spring mechanisms at any positions of the sockets 50 shown in Fig. 6, however, it is possible to make the inserts 30 stop temporarily in descending movement along with the memory modules 10.

As shown in Fig. 12F, if the drive unit 70 is made to further descend, the linkage block 44 strikes the mechanical stopper 94 provided on the test head base 48 and the descending movement of the drive unit 70 is stopped. Note that when the drive unit 70 is driven by a motor actuator other than a pressure cylinder etc., it is possible to make the descending movement stop at an accurate position by numerical control without using the mechanical stopper 94.

Next, as shown in Fig. 12G, the contact cylinders 88 shown in Fig. 6 are made to operate to push down the pushing pads 90 and push down the individual drive plates 84 which had been floating above the matching plate 74. As a result, the pushing surfaces 71 of the board pushers 76 push down the memory modules 10. As shown in Fig. 10, the bottom ends of the memory modules 10 completely enter the inside of the socket grooves 51, and the board terminals 12 are electrically connected to the socket terminals. At this time, the contact cylinders 88 shown in Fig. 6 have a pushdown force sufficient for inserting the memory modules 10 inside the socket grooves 51 of the sockets 50

and are designed not to give an excessive force more than necessary. The memory modules 10 strike the mechanical ends (not shown) provided at the sockets 50 and are positioned in the height direction. At this time, the contact cylinders 88 are designed to have a margin in stroke, absorb the error in the height direction of the memory modules 10 (for example, about 0.3 mm), and push the memory modules 10 downward by a predetermined force.

Note that in the state shown in Fig. 12F, when the inserts 30 are configured so as to temporarily stop in descending movement along with the memory modules 10, the inserts 30 are also pushed downward along with the memory modules 10 by the board pushers 76 shown in Fig. 6 in the state shown in Fig. 12G.

In the state shown in Fig. 12G, as shown in Fig. 10, the board terminals 12 of the memory modules 10 are electrically connected with the socket terminals 58 and a plurality of memory modules 10 are simultaneously tested in the state held in the tray 20.

After the end of the testing, the pushing force by the contact cylinders 88 shown in Fig. 6 is released and the drive unit 70 is moved upward. As a result, the tray conveying base 44 holding the tray 20 tries to return to its original tray conveyance height due to the return mechanism of the springs 46 or pressure cylinders. Further, due to the spring force of the

return springs 62 attached to the bottoms of the socket grooves 51 of the sockets 50 shown in Fig. 10, the bottom ends of the memory modules 10 are pulled up from the socket grooves 51. Note that in the present invention, as the sockets, it is possible to use not only sockets having a self-pullout force of return springs 62 etc. shown in Fig. 10, but also sockets with no self-pullout force.

In this case, since the sockets themselves have no pullout force, the memory modules 10 try to remain at the sockets 50. Therefore, a lifting force of the springs 46 or pressure cylinders shown in Fig. 6 is designed so that the tray conveying base 44 shown in Fig. 6 is acted upon by a force for pulling the memory modules 10 out from the sockets 50 and a force for lifting up the tray 20 to the height of tray conveyance together with the inserts 30. Note that the force for pulling out the memory modules 10 from the sockets may be obtained by attaching to the inserts 30 or sockets 50 springs etc. for creating a force for pulling apart the inserts 30 and the sockets 50 when the inserts 30 and sockets 50 are positioned.

By using this structure, the memory modules 10 can be inserted into the sockets 50 and pulled out from the sockets 50 without the action of an excessive force. Further, even in the event the insertion of a memory module 10 into a socket 50 fails, the contact cylinder 88 shown in Fig. 6 does not try to

push down the memory module 10 by a force more than the force for insertion in the socket 50, so there is seldom damage given to the memory module 10 and no excessive load acts on the tray 20.

In a handler 1 using such a test tray 20, a plurality of memory modules 10 may be made to move in the handler 1 while being held on the test tray 20 and a plurality of memory modules 10 tested simultaneously at the measurer 102 side, so the throughput of the testing is tremendously improved. Further, there is no longer a need for performing a pick-and-place operation of the memory modules 10, the internal structure of the handler 1 can be simplified, and the handler as a whole can be made smaller in size, simpler, and lower in cost. Further, in the handler 1 according to the present embodiment, since all or part of the test mechanism is arranged inside the chamber, by holding the inside of the chamber at a constant high temperature or low temperature, the temperature precision at the time of testing memory modules 10 is improved and accurate testing becomes possible.

Note that the present invention is not limited to just the above embodiment. For example, the means for positioning the members are not particularly limited. Other means besides positioning pins and positioning holes may be adopted. Further, the socket body 52 and the socket body 53 may be made integral in structure.

Further, the board pusher 76 is not limited to the embodiment shown in Fig. 6. In the present invention, the guide projections 73, guide grooves 77, and tapers 75 are not necessarily essential. A pusher having just the pushing surface 71 is sufficient. It is preferable however to provide positioning pins 80 as positioning pins.

When the testing is finished by this routine, the test tray 20 is conveyed to the unsoak chamber 103 where the tested memory modules 10 are returned to close to room temperature. This is done for the purpose of preventing condensation mainly when applying a low temperature.

The test tray 20 filled with the memory modules 10 returned to room temperature is conveyed to the unloader section 400. Here, the XY conveyor 403 is used to transfer the tested memory modules 10 to storing trays 204. At this time, the memory modules 10 are transferred to storing trays 204 in accordance with the test results. In the example shown in Fig. 1A, for example, "passing" memory modules 10 are transferred to the two storing trays 204, 204 set at the windows 406a, 406b of the unloader section 400, while "failing" or "retesting" memory modules 10 are successively transferred to the buffer stage 405. Further, when the buffer stage 405 becomes full, the "failing" use storing tray 204 or "retesting" use storing tray 204 is set at the window 406a or 406b of the unloader section 400 and the memory modules 10 placed at the buffer stage 405 are transferred

according to their categories. By the above routine, the memory modules 10 are tested and classified by the test results.

The present invention may be further modified. Figure 13A is a schematic plan view of a handler of another embodiment of the present invention, while Fig. 13B is similarly a schematic sectional view (view along line B-B). First, the structure of the memory module stocker 200 is different.

That is, a tray magazine 212 for storing supply trays 202 and a tray magazine 214 for storing trays 204 are provided, but the first elevating means, that is, the elevators 206A and 206B, are not provided between these but individually for these. Further, the setting position of the supply trays 202 to the loader section 300 is made just a single location (shown by the window 306). It is made possible to manually take out or insert a supply tray 202z at the adjoining position.

The elevator 206A is used to take out from the tray magazine 212 a supply tray 202 full with memory modules 10 and raise the elevator 206A so as to set it at the window 306 of the loader section 300. When all of the memory modules 10 finish being transferred to a test tray 20, the elevator 206A is made to descend as it is and the now empty supply tray 202 is returned to the tray magazine 212.

The pre-test memory modules 10 are charged into the handler 1 by the above operation. While taking out the supply tray 202 from the tray magazine 212 or conversely storing an

empty tray 202 in the tray magazine 212, the XY-conveyor 303 and test tray 20 may end up idling. Therefore, when such idle time arises, the memory modules 10 are transferred from the manually set supply tray 202z to the test tray 20 using the XY-conveyor. Due to this, it is possible to suppress a fall in the throughput of the handler 1.

On the other hand, at the unloader section 400, an empty storing tray 204 is set at only one window (in the example, the right side window 406b), while an empty storing tray 204z is set manually at a position corresponding to the other window 406a. Further, nearby, one empty supply tray 202 (202f) is set manually for failing memory modules and one (202r) is set for retesting memory modules.

Further, passing memory modules 10 are mainly transferred from the test tray 20 finished being tested and conveyed to the unloader section 400 to a storing tray 204 set at the right side window 406b using the XY conveyor 403. When the storing tray 204 becomes full, the elevator 206B is made to descend as it is, the tray is stored in the tray magazine 214, and the next empty storing tray 204 is set in the window 406b. During this interval, the passing memory modules 10 are transferred to the storing tray 204 set manually at the left side.

The memory modules 10 which fail are transferred to the manually set left side supply tray 202f, while the memory modules 10 for retesting are similarly transferred to the right

side supply tray 202r. When the supply trays 202f and 202r become full, the empty supply trays 202f and 202r are replaced by hand. At that time, supply tray 202r becoming full with the memory modules 10 to be retested is set at the tray magazine 212 or the right adjoining position of the window 306 of the loader section 300 as it is.

According to the handler 1 of the present embodiment configured as explained above, while the throughput is poor, the transfer arm 208 or setting plate 210 etc. become unnecessary. It is possible to make the testing apparatus smaller by that amount and reduce the cost.

Note that the embodiment explained above was given for facilitating the understanding of the present invention and was not given to limit the present invention. Therefore, the elements disclosed in the above embodiment include all modifications or equivalents etc. falling under the technical scope of the present invention.

CLAIMS

1. A testing apparatus for an electronic device board provided with at least a stocker for stocking pre-test and post-test electronic device boards and a measurer for testing the pre-test electronic device boards,

(1) the stocker provided with:

a first tray magazine in which first trays are independently stored in a vertical direction,

a second tray magazine in which second trays are independently stored in a vertical direction,

a first elevating means provided elevatably between said first tray magazine and said second tray magazine and transferring said first trays or said second trays between said first tray magazine and said second tray magazine,

a horizontal conveying means provided above said first tray magazine, said second tray magazine, and said first elevating means, made able to be moved in a direction of parallel arrangement of these, and transferring said first trays or said second trays with said first elevating means, and

a second elevating means made elevatable with respect to a target position and transferring said first trays or said second trays with said horizontal conveying means,

(2) said measurer provided with:

a test socket to which board terminals of an electronic device board are detachably inserted and a board pusher by which



board terminals of an electronic device board is inserted into the test socket in the state where the electronic device board is attached to a test tray,

test tray provided with an insert formed with a holding groove in which two side ends of the electronic device board are slidably inserted so that the board terminals of the electronic device board are exposed and a tray body holding said insert so that the board terminals of the electronic device board are exposed being conveyed in and conveyed out.

2. The testing apparatus for an electronic device board as set forth in claim 1, further provided with a first conveying means for reloading an electronic device board from a first or second tray on which a pre-test electronic device board is loaded to the test tray.

3. The testing apparatus for an electronic device board as set forth in claim 1, further provided with a second conveying means for reloading an electronic device board from a test tray on which a post-test electronic device board is loaded to the first or second tray.

4. The testing apparatus for an electronic device board as set forth in claim 1, wherein one of the tray magazines is for a tray on which a pre-test electronic device board is loaded and the other is for a tray on which a post-test electronic device board is loaded.

5. The testing apparatus for an electronic device board



as set forth in claim 4, wherein at least part of the first tray magazine stores a tray on which a post-test electronic device board is loaded.

6. The testing apparatus for an electronic device board as set forth in claim 5, wherein said post-test electronic device board is of a category to be retested.

7. The testing apparatus for an electronic device board as set forth in claim 1, wherein said first tray and said second tray are the same type of tray.

8. The testing apparatus for an electronic device board as set forth in claim 1, wherein said board pusher includes a guide groove, in which two side ends of the electronic device board are inserted, for correcting an inclination of the electronic device board.

9. The testing apparatus for an electronic device board as set forth in claim 1, further provided with a matching plate for slidably holding the board pusher.

10. The testing apparatus for an electronic device board as set forth in claim 9, further provided with a driving means for making said matching plate move close to and move away from said test tray.

11. The testing apparatus for an electronic device board as set forth in claim 9, wherein said driving means includes an auxiliary driving means for making said board pusher move with respect to said matching plate so that said board pusher makes



the electronic device board move in said test tray and pushes the board terminals of the electronic device board into the socket.

12. The testing apparatus for an electronic device board as set forth in claim 8, further provided with a tray conveying base for elastically holding a test tray a predetermined interval above said test socket.

13. The testing apparatus for an electronic device board as set forth in claim 8, wherein said test socket includes inside it a return spring for applying a force in a direction for pulling out the board terminals of the electronic device board from the inside of the test socket.

14. An electronic device board test tray provided with:

an insert formed with a holding groove in which two side ends of an electronic device board are slidably inserted the board terminals of the electronic device board are exposed and

a tray frame for holding said insert so that the board terminals of the electronic device board are exposed.

15. The electronic device board test tray as set forth in claim 14, wherein said insert includes a first positioning means for positioning board terminals of the electronic device board with respect to a board pusher for pushing them into the test socket.

16. The electronic device board test tray as set forth



in claim 14, wherein said insert includes a second positioning means for positioning the board terminals of the electronic device board and the test socket.

17. The electronic device board test tray as set forth in claim 14, wherein said tray frame holds a plurality of inserts positioned in it.

18. A testing apparatus for an electronic device board provided with:

an electronic device board test tray as set forth in claim 14,

a test socket in which board terminals of an electronic device board are detachably inserted, and

a board pusher for pushing board terminals of an electronic device board into the test socket in the state with the electronic device board attached inside the electronic device board test tray.

19. The testing apparatus for an electronic device board as set forth in claim 18, wherein said board pusher includes a guide groove, in which two side ends of said electronic device board are inserted, for correcting inclination of said electronic device board.

20. The testing apparatus for an electronic device board as set forth in claim 18, further provided with a matching plate for slidably holding said board pusher.

21. The testing apparatus for an electronic device board



as set forth in claim 20, further provided with a driving means for making said matching plate move close to and move away from said electronic device board test tray.

22. The testing apparatus for an electronic device board as set forth in claim 20, wherein said driving means includes an auxiliary driving means for making said board pusher move with respect to said matching plate so that said board pusher makes said electronic device board move in said test tray and pushes the board terminals of the electronic device board into the socket.

23. The testing apparatus for an electronic device board as set forth in claim 18, further provided with a tray conveying base for elastically holding said electronic device board test tray a predetermined interval above said test socket.

24. The testing apparatus for an electronic device board as set forth in claim 18, wherein said test socket includes a return spring for applying force in a direction for pulling out the board terminals of the electronic device board from the inside of said test socket.

25. A tray transporter provided with:

at least a pair of tray magazines in which trays are independently stored in a vertical direction and

a first elevating means, provided elevatably between said pair of tray magazines, for transferring trays with said tray magazines.



26. The tray transporter as set forth in claim 25, further provided with a horizontal conveying means provided above the tray magazines and the first elevating means, made movable in the direction of parallel arrangement of the same, and transferring said trays with said first elevating means.

27. The tray transporter as set forth in claim 25, further provided with a second elevating means made elevatable with respect to a target position and transferring trays with said horizontal conveying means.

28. A tray transporter provided with:

a first tray magazine in which first trays are independently stored in a vertical direction,

a second tray magazine in which second trays are independently stored in a vertical direction,

a first elevating means, provided elevatably between the first tray magazine and the second tray for transferring first trays or second trays with said first tray magazine and said second tray magazine,

a horizontal conveying means provided above the first tray magazine, second tray magazine, and first elevating means, made movable in the direction of parallel arrangement of the same, and transferring first trays or second trays with said first elevating means, and

a second elevating means made elevatable with respect to a target position and transferring first trays or second trays



with said horizontal conveying means.

29. The tray transporter as set forth in claim 25, wherein one of the tray magazines is for a tray on which a pre-test electronic device board is loaded and the other is for a tray on which a post-test electronic device board is loaded.

30. The tray transporter as set forth in claim 28, wherein at least part of the first tray magazine stores a tray on which a post-test electronic device board is loaded.

31. The tray transporter as set forth in claim 30, wherein said post-test electronic device board is of a category to be retested.

32. The tray transporter as set forth in claim 28, wherein at least part of the second tray magazine stores an empty tray from which a pre-test electronic device board has been transferred.

33. The tray transporter as set forth in claim 28, wherein said first tray and said second tray are the same type of tray.

