



AUTOMATIC HANDLER FOR IC TEST SYSTEM, TEST TRAY
STOPPING MECHANISM AND TEST TRAY TRANSFERRING
METHOD FOR AUTOMATIC HANDLER OF IC TEST SYSTEM

5 FIELD OF THE INVENTION

The present invention relates to an automatic handler of an IC test system that transfers IC devices to be tested, from a supply area to a test head area, then to a discharge area, which is capable of minimizing time for switching a
10 test tray to a next test tray (referred to as an index time) to start the device test for the latter test tray after the device test for the former test tray is completed, more particularly to a test tray positioning stopper mechanism for automatic handler to increase flexibility and a choice
15 of the number of IC devices to be tested simultaneously, and to a method for transferring the test trays to a test head area and for discharging them therefrom.

BACKGROUND OF THE INVENTION

20 In general, an IC test system performs an IC device test by electrically contacting IC devices to be tested with test contactors in pin electronics or pin cards provided in a test head area to supply test signals to the IC devices and receive the resulted outputs from the IC devices. The
25 resulted signals are compared with expected signals to determine whether the outputs from the IC devices are acceptable or not.

Hence, an automatic handler transfers IC devices to be tested from a supply area to a test head area. After the
30 test, IC devices that have been tested are transferred from test the head area to a discharge area and are sorted according to the test results. During these times required for transferring the IC devices, the test cannot be

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performed since IC devices to be tested cannot determine their position with respect to contactors in the test head and thus they cannot be electrically contacted. Reducing this transfer time, i.e., an index time, is desirable since the index time is useless for the IC device testing. Hence, there is a need to minimize the index time in an automatic handler.

Figure 7 shows a conventional automatic handler for an IC test system. As shown, test trays 20 are used as means of transferring IC devices 16 to be tested in the IC test system. A plurality of carrier modules 30 are maintained in a floating state in each test tray 20. An IC device 16 is mounted on each carrier module 30. The test trays 20 having the IC devices 16 are arranged at the supply area SU. IC devices 16 are then transferred to the test head area TH while being maintained on the test tray 20. At the test head area TH, the test tray 20 is carried on a belt conveyer 18 by a driving power of a motor 17 until the test tray is stopped by a projection of a stopper 11.

At the test head area TH, the test tray 20 is positioned and fixed by the stopper 11. Then, the IC devices 16 are pushed downward, for example, for the electric connection with the test contactors of the pin electronics (not shown) provided at the test head in the IC test system. The IC devices 16 keep electronic contact with the pin electronics in the IC test system during the testing. Recently, a plurality of test head areas are provided for performing simultaneous testing of IC devices mounted on a plurality of test trays. The test tray 20 is then transferred to the discharge area DI where the IC devices 16 are classified depending on the test results.

Figure 8 is a schematic diagram showing an example of test process in a conventional automatic handler. In the



example shown in Figure 8A, there are four (4) IC devices 16 seated in the test tray 20. In recent years, smaller devices are widely used and thus a larger number of IC devices, such as eight (8) IC devices can be arranged in the test tray 20 according to the actual density of IC devices as shown in Figure.8A. However, the minimum distance between the device contactors along the moving direction of the test tray in the test head is limited to x in Figure 8A because of the limitation in a packaging density of pin electronics in the test heads. Therefore, as shown in Figure 8A, since the test contactors in the pin electronics of the IC test system consist of mechanical and electronics parts and thus require a certain size and space which determine the distance x.

Hence, in the example of Figure 8A, four IC devices 16 are arranged in a length L of the test tray 20. The test tray 20 is shifted from the supply area SU to the test head area TH. After the test tray 20 is transferred to the stopper 11 in the test head area TH, each IC device 16 is electrically contacted by the pin electronics (not shown) as shown in Figure 8B and the test is initiated. After the test, the projection of the stopper 11 withdraws so that the test tray 20 transfers to the discharge area DI. As a result, the test for the IC devices in the next test tray can be ready. An index time is defined as time required for discharging a test tray in a test head area and placing a next test tray to the test head area. In short, the index time is approximately equal to time required for moving a test tray by its length L along the moving direction. Thus, the index time t_1 is given as $t_1 = L/s$, where s is the moving speed of a test tray 20. The index time per device t_1' is given as $t_1' = (L/s)/4$.

Figure 9 is a schematic diagram showing an example of



test process of IC device testing in another conventional automatic handler. In the example of Figure 9, the IC test system includes two test heads TH1 and TH2. As shown in Figure 9, eight (8) IC devices 16 are arranged in the test tray 20. The spacings between the IC devices to be tested are y where it is assumed that $x/2 < y < x$. The IC devices 16 to be tested are arranged in the way that the spacing y between the IC devices 16 to be tested are minimized to the limit of the packaging density of the IC devices 16 in the length L of the test tray 20. In contrast, as discussed above with reference to Figure 8, the distance x is determined by the density of the test contactors in the pin electronics which is larger than that of the IC devices.

As shown in Figure 9A, the test tray 20 is transferred from the supply area SU to the first test head TH1 by the transfer system such as shown in Figure 7. The position of the test tray is determined by the stopper 11, provided at the first test head TH1 by the transfer system. Then, the IC devices 16 on the test tray are electrically contacted with the pin electronics in the test head area so that the test is initiated. Since there is a limitation in the density such as in the pin electronics or pin cards in the test heads, and thus the plurality of test contactors in the pin electronics have a greater spacing x than the spacing y of the IC devices 16 to be tested, not all IC devices 16 in the test tray 20 can be simultaneously tested. Therefore, for example, at the first test head TH1, only the IC devices 16 of odd lines in the test tray 20 are electrically contacted and tested. This is shown in Figure 9B by the shades of the corresponding IC devices 16 in the test tray 20.

After finishing the test for the IC devices 16 in the



odd lines, the projection of the stopper 11₁ at the test head TH1 is detracted and the test tray 20 is transferred to the second test head TH2 as shown in Figure 9C. The test tray 20 is positioned accurately at the second test head TH2 by the stopper 11₂. At the test head area TH2, this time, only the IC devices 16 of even lines in the test tray 20 are electrically contacted by the pin electronics in the second test head TH2 as shown by the shaded lines in Figure 9C.

Since there are two (2) test heads TH1 and TH2 are provided in this example and both test heads can perform the test simultaneously, it is possible for the second test head TH2 to test the IC devices in the even lines in the test tray 20 while the first test head TH1 simultaneously tests IC devices in the odd lines in the next test tray. Thus, all eight (8) IC devices 16 to be tested in the test tray 20 can be tested in the manner described above by allocating the IC devices to the first test head TH1 and the second test head TH2. After the test, the projection of the stopper 11₂ at the second test head TH2 pulls back, and the test tray 20 is transferred to the discharge area DI as shown in Figure 9D.

In this situation, when the transfer speed of the test tray 29 is expressed as s , the index time in the simultaneous testing performed continuously as above is:

$$t_2 = 2L/s.$$

In this case, although more devices can be arranged on a test tray by making the device spacing y small, the index time becomes larger. The index time per device t_2' can be calculated as

$$t_2' = (2L/s)/8 = (L/s)/4,$$

and this is the same as in Figure 8A.

As described above, in the prior art, the number of devices arranged on a test tray cannot be increased without



increasing the index time, and thus index time per device cannot be decreased.

SUMMARY OF THE INVENTION

5 Therefore, it is an object of the present invention to provide an automatic handler for an IC test system which is capable of minimizing the index time required for transferring the test trays having IC devices to be tested by uniquely arranging a plurality of stoppers for
10 positioning the test trays.

 It is another object of the present invention to provide an automatic handler for an IC test system which is capable of minimizing the index time for transferring the test trays by providing a plurality of stoppers
15 corresponding to a single test head of the IC test system to determine a plurality of positions in the test head area.

 It is another object of the present invention to provide an automatic handler which is capable of increasing
20 the number of test positions for the test tray by providing a groove on the test tray which receives and engages with projections of the stoppers.

 It is a further object of the present invention to provide an automatic handler for an IC test system which is
25 capable of minimizing the index time without increasing mechanical parts or spacing in the handler.

 It is yet further object of the present invention to provide a test tray transferring method for an automatic handler of an IC test system which is capable of reducing
30 the index time per device by employing shorter device spacing y than device contactor spacing x without increasing the index time. This could be achieved according to the present invention characterized in that the test tray is



stopped a plurality of times at an interval of an integer multiple of the array spacing along the transfer direction of the devices to be tested on the test tray in the test head area, and at each stop position of the test tray, a
5 different device on the test tray is tested.

According to the first aspect of the present invention, IC devices to be tested are arranged in the length of the test tray to a limit of their density. After being transferred to a test head area by a transfer system, the
10 test tray is positioned by a first positioning stopper. The IC devices in a predetermined line in the test tray are electrically contacted with contactors in pin electronics of the test head area and the IC test is performed. At this point, only the IC devices of odd lines, for example, are
15 electrically contacted and tested at this first step since the spacing of the contactors in the test head is larger than that of the IC devices in the test tray.

After the test for the IC devices in the odd lines, a projection of the first positioning stopper is retracted so
20 that the test tray is transferred to the next position where it is positioned by a second stopper. At this second step, only IC devices of even lines in the test tray are electrically contacted with the contactors in the pin electronics to proceed the IC test. Thus, when the test
25 tray transfers from the first step to the second step, the test tray transfers the distance D which is the distance between the first stopper and the second stopper. This distance D is also identical to the spacing between the IC devices in the test tray.

30 After the test, a projection of the second stopper at the test head area is retracted and the test tray advances to a discharge area. In this case, the transfer distance of the test tray is $(L-D)$. Thus, the transfer distance of



the test tray is reduced compared to the conventional arrangement, which contributes to a reduction of the index time.

5 According to the second aspect of the present invention, a groove is provided on the test tray to receive the positioning stoppers therein. The groove has a predetermined length including an end surface the distance of which is an integer multiple, for example, twice as long as the distance between the positioning stoppers.

10 There can be several grooves on the test tray and at least one stopper is needed. Consequently, the number of possible test positions for the test tray is increased to the number of grooves multiplied by the number of stoppers.

15 Thus, by setting the distance between a flat surface in the front of the test tray and the end surface of the groove as twice as long as the distances between two stoppers, the total test positions for the test becomes four.

In the test tray transferring method of the present invention, there are several view points as described below:

20 The first view point is characterized in that the stop position interval of the test tray is equal to the array spacing, each of the intervals of device contactors of the test head area along the transfer direction is n times (n is an integer equal to or greater than 2) of the device array spacing, and the number of positions where the test tray stops is n .

25 The second view point is characterized in that each of the stop position intervals of the test tray is p times (p is an integer equal to or greater than 2) of the device array spacing, the number of test head areas provided along a moving direction of the test tray is p , and at each
30 initial stop position of the each test head area, different one of first p lines of devices along the moving direction



of the test tray from the initial stop position are tested respectively.

5 The third view point is, in the second view point above, characterized in that the interval of the device contactors along the moving direction of the test tray is $p \cdot n$ times (n is an integer equal to or greater than 2) of the device array spacing and the number of stop positions of the test tray is n .

10 The fourth view point is characterized in that test tray stoppers are provided corresponding to the respective stop positions so that each of the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, and said test tray is stopped at each of the stop positions by controlling those stoppers.

15 The fifth view point is characterized in that a test tray stopper is provided corresponding to the first stop position so that the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with
20 the stopper in the state that the stopper is projected on the test tray path are provided on the test tray at the stop position intervals along the moving direction of the test tray, the number of the engaging parts is equal to the number of the stop positions, and the test tray is stopped
25 at each of the stop positions by controlling the stopper.

30 The sixth view point is characterized in that two test tray stoppers are provided at the stop position intervals along the moving direction of the test tray corresponding to the first and the second stop positions respectively so that each of the two stoppers can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with one of the two stoppers in the state that one of the two stoppers is



projected on the test path are provided on the test tray at the two time interval of the distance between the stoppers along the moving direction of the test tray, the number of the engaging parts is one second of said number of stop
5 positions, and the test tray is stopped at each of the stop positions by alternately controlling the stoppers to be positioned on the test tray path.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a schematic view showing the second embodiment of the automatic handler in accordance with the present invention.

Figure 2 is a schematic view of an automatic handler for explaining a situation where test trays stop at four (4)
15 positions in a test head area in the second embodiment of the present invention of Figure 1.

Figure 3 is a schematic view of the first embodiment of the automatic handler in accordance with the present invention showing a situation where test trays stop at two
20 (2) positions in a test head area.

Figure 4 is a schematic diagram showing a test procedure of IC devices in accordance with the automatic handler of the first embodiment of Figure 3.

25 Figure 5 is a plain view showing the first embodiment of the present invention.

Figure 6 is a perspective view for explaining the relationship between the test tray and the positioning stopper in the first embodiment of the present invention.

30 Figure 7 is a diagram showing an example of conventional automatic handler for an IC test system.

Figure 8 is a schematic view showing a test process for IC devices in the conventional automatic handler of Figure 7.

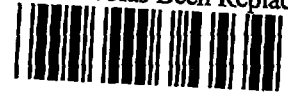


Figure 9 is a schematic view showing a test process for IC devices in another example of conventional automatic handler.

5 DETAILED DESCRIPTION OF THE INVENTION

Preferred embodiments of the present invention will be described with reference to the drawings. Figure 5 shows the first embodiment of the present invention. Figure 5 is a plan view showing an automatic handler corresponding to a
10 test head area TH of an IC test system. The test tray 20 having the IC devices 16 to be tested is placed on the belt conveyer 18 which is driven by the motor 17 as in the same manner shown in Figure 7. In Figure 5, in addition to the conventional stopper 11, the second stopper 12 is also
15 provided in the test head TH along a moving direction of the test tray 20. The distance D between the second stopper 12 and the first stopper 11 is adjusted to be equal to the distance y between the adjacent IC devices 16 to be tested in the test tray 20. The IC devices 16 to be tested in the
20 test tray 20 is arranged in a manner discussed with respect to Figure 9 where the spacing y between the IC devices is decreased to the minimum possible value. An operation of extension and withdrawal of the projection in each stopper is controlled independently.

25 Figure 4 is a schematic diagram showing a test process of the IC devices 16 to be tested according to the automatic handler of the present invention. In the example of Figure 4, eight (8) IC devices 16 to be tested are arranged in the test tray 20. Namely, the IC devices 16 to be tested are
30 aligned in the test tray 20 such that the spacing between the adjacent devices is reduced to the minimum in terms of packaging density of the IC devices 16 to be tested. Thus, the IC devices 16 to be tested are aligned with the spacing



y in the test tray 20 whose length is L.

The test tray 20 is moved from the supply area SU to the test head area TH until it is stopped by the stopper 11 provided in the test head area TH as shown in Figure 4A.

5 Then the test tray 20 is pressed downward, for example, for accomplishing the electrical contact between the test contactors in the pin electronics of the IC test system and the IC devices 16 to be tested as shown in Figure 4B. AT this time, only the IC devices of the odd lines in the test
10 tray 20 are electrically connected and tested as shown by the shaded lines of Figure 4B. This is because the test contactors in the pin electronics in the test head TH have the minimum distance x which is different from the minimum distance y of IC devices in the test tray 20. Usually, the
15 distance x between the adjacent test contactors is greater than the distance y between the adjacent IC devices 16 aligned in the test tray 20. Therefore, in this example, the distance x in the test head is adjusted to be $x=2y$ to that the IC devices in the every other lines in the test
20 tray 20 can be electrically connected with the test head.

After finishing the test for the IC devices in the odd lines, the protrusion of the first stopper 11 is pulled in and the test tray 20 is transferred to the right hand side until it is stopped by the second stopper 12 as shown in
25 Figure 4C. The test tray 20 is then fixed by the projection of the second stopper 12 in the appropriate position in the test head area TH. As stated above, the spacing between the first stopper 11 and the second stopper 12 is D which is the same as distance y between the IC devices 16 in the test
30 trays 20. Thus, when the test tray 20 transfers from the first step (Figure 4B) to the second step (Figure 4C), the IC devices in the even lines are positioned to contact with the contactors in the test head TH.



At this position, the IC devices in the even lines in the test tray 20 are electrically connected with the test contactors of the pin electronics in the IC test system and tested thereby. Therefore, in the first position which is
 5 determined by the first stopper 11, the IC devices 16 in the odd lines in the test tray 20 are tested and in the second position which is determined by the second stopper 12, the IC devices 16 in the even lines in the test tray 20 are tested. As a result, all of the eight (8) IC devices in
 10 the test tray 20 can be tested after the process of Figure 4C. Then, the projection of the second stopper 12 is withdrawn and the test tray 20 is transferred to the discharge area DI.

In this process, the transfer distance of the test tray
 15 20 between the second position and the discharge area DI is (L-D) as shown in Figure 4D. When the transfer speed of the test tray 20 is s, the index time is:

$$t_3 = (D/s + (L-D)/s) = L/s$$

The index time per device per is

20
$$t'_3 = (L/s)/8$$

Hence, the index time per device in this example can be reduced to a half of that in the conventional automatic handler of Figures 7 or 9 in which the index time is L/4s.

In the above example, the IC test is performed in two
 25 steps, i.e., by dividing the IC devices in the odd lines and in the even lines in the test tray 20. However, based on the inventive features of the present invention, the test can be divided into three steps when even smaller IC devices to be tested are arranged in the test tray. In such a
 30 situation, the number of stoppers to be provided will be increased to three each of which is apart from one another by the distance the same as that of the IC devices in the test tray.



Further, the number of steps or the stoppers can be increased arbitrarily according to the relationship between the spacing in the IC devices in the tray and the spacing of the pin electronics in the test head. Even if the number of stoppers and thus the steps for testing the IC devices to be tested is altered, the index time can be increased in the same manner as describe in the foregoing. The only limitation in increasing the number of the stoppers is that the stoppers have to be aligned in the direction to which the test tray is transferred.

Figure 6 shows an example of the test tray 20 and the positioning stoppers 11 and 12. In this example, the stopper 11 and the stopper 12 are distanced by a pitch D and are arranged on a stopper body 13. The projections P_{11} and P_{12} on the end of the stoppers 11 and 12, respectively, are driven independently from each other.

The test tray 20 is provided with, for example, 64 carrier modules 30 so that 64 IC devices to be tested can be loaded in the seats of the carrier modules 30. The test tray 20 has a flat surface 14 and is transferred to the moving direction Q in Figure 6. In the test area, the flat surface 14 meets with the projection P_{11} of the stopper 11 or the projection P_{12} of the stopper 12 so that the appropriate positions of the IC devices to be tested is determined with respect to the pin electronics in the test head.

Thus, the test tray 20 can be stopped at two positions distanced by the pitch D on the test head area. The first positioning can be accomplished when the projection P_{11} of the stopper 11 touches the flat surface 14. Then, after testing the predetermined lines of IC devices on the test tray 20, the projection P_{11} is retracted in the stopper 11 so that the test tray 20 can further advances to the



direction Q. The flat surface 14 of the test tray 20 then meets with the projection P₁₂ of the stopper 12, which determined the second position of the test tray 20 on the test head area.

5 Figure 3 shows an arrangement of an automatic handler for use with an IC test system having two test heads (test chambers) TH1 and TH2 for testing the IC devices. In this arrangement, the automatic handler includes stoppers 11₁ and 12₁ for the first test head TH1, and stoppers 11₂ and 12₂ 10 for the second test head TH2. In each pair of the stoppers, one stopper is separated by a distance D from the other. A pair of plural position sensors 15₁ and 15₂ are also provided in each test head for monitoring the movement of the test trays 20. In this example, although not shown, the 15 test contactors of the pin electronics in each of the test heads TH1 and TH2 have a spacing with respect to the adjacent contactors by a distance which is four times larger than the distance D between the IC devices 16.

20 Thus, in the first test head TH1, four lines (A, C, A, C) of IC devices in the test tray 20 are first tested at the position determined by the stopper 11₁ as shown in Figure 3a. Then, also in the test head TH1, another four lines (B, D, B, D) of IC devices in the test tray 20 are tested at the position determined by the stopper 12₁ as shown in Figure 25 3b, which is shifted by the distance D from the previous position. Namely, in this example, 32 IC devices are tested in the first test head TH1.

30 The test tray 20 is then transferred to the second test head TH2 as shown in Figures 3c and 3d. In the second test head TH2, four lines (E, G, E, G) of IC devices in the test tray 20 are first tested at the position determined by the stopper 11₂ as shown in Figure 3c. Then, also in the second test head TH2, another four lines (F, H, F, H) of IC devices



in the test tray 20 are tested at the position determined by the stopper 12, as shown in Figure 3d, which is shifted by the distance D from the previous position. Thus, in this example, a total of 64 IC devices are tested in the first
5 and second test heads TH1 and TH2.

In the example of Figures 3 or 5, when more devices are attempted to be tested in each test head or when the spacing difference between the IC devices to be tested and the pin electronics is greater than the example of Figure 3, the IC
10 test can be carried out in a similar manner by increasing the number of stop positions in each test head. Such an increase of stop positions is possible by providing the corresponding number of stoppers in the direction where the test tray advances. However, the following problem occurs
15 in such modification. Namely, the number of stop positions may be limited since the number of stoppers have to be increased accordingly. One of the reasons is that the increase in the number of stoppers causes an increase of corresponding mechanical parts and drive mechanism which
20 will increase the overall size of the automatic handler.

Figure 1 shows the second embodiment of the present invention which is able to increase the number of stop positions without increasing the number of stoppers. Figure 1 shows an example in which four (4) stop positions are
25 established for each test head. In this example, the positioning stoppers 11 and 12 are the same as the one used in the first embodiment and may be mounted on the stopper body 13 as discussed with reference to Figure 6. The major difference between the first embodiment and the second
30 embodiment is that, in this embodiment, it is provided with a groove 21 on the test tray 20 to receive the stoppers 11 and 12 therein. The groove 21 is positioned on the side of the test tray 20 which is in parallel to the tray moving



direction. The end surface 22 of the groove 21 has an accurate distance D from the flat surface 14 of the test tray 20, which is, for example, two time as long as the distance between D the stoppers 11 and 12.

5 With further reference to Figure 1, the operation of positioning the test tray at the 4 positions is explained. In the following, the state where the projections of the stopper 11 or 12 expands to stop the test tray 20 is regarded as ON, while the state where the projection of the
10 stopper 11 or the stopper 12 retracts to allow the test tray 20 go forward is regarded as OFF.

Position A

The stopper 11 and the stopper 12 are both turned ON as shown in Figure 1a. The projection of the stopper 11
15 contacts the flat surface 14 of the test tray so as to fix the position A of the test tray 20.

Position B

The projection of the stopper 11 is turned OFF at the position A so that the test tray 20 advances in the right
20 hand direction until the flat surface 14 contacts with the projection of the stopper 12. The test tray 20 then stops at the position B which is a distance D from the position A.

Position C

At the position B, the stopper 11 is turned ON while
25 the stopper 12 is turned OFF. Thus, the projection of the stopper 11 is in the groove 21 of the test tray 20. The test tray 20 moves in the transfer direction until the end surface 22 of the groove 21 meets with the projection of the stopper 11. The test tray 20 then stops at the position C
30 which is a distance D from the position B.

Position D

At the position C, the stopper 12 is turned ON while the stopper 11 is turned OFF. Thus, the projection of the

stopper 12 is in the groove 21 of the test tray 20 while the projection of the stopper 11 withdraws from the groove 21. The test tray 20 moves in the transfer direction until the end surface 22 of the groove 21 contacts the projection of the stopper 12. The test tray 20 then stops at the position D which is a distance D from the position C.

Therefore, in the example of Figure 1, the four test positions each of which is apart from the other by the distance D are realized by the two stoppers 11 and 12. The IC devices in the corresponding positions in the test tray 20 will be tested in each position. After the test, the stopper 11 and the stopper 12 are turned OFF in order to transfer the test tray 20 to the next test head or the discharge area of the automatic handler.

Figure 2 shows an example of automatic handler where the stoppers and the groove in test tray shown in Figure 1 are used in the IC test system having two test heads (test chambers) TH1 and TH2 for testing the IC devices. In this arrangement, similar to the example of Figure 3, the automatic handler includes stoppers 11₁ and 12₁ for the first test head TH1 and stoppers 11₂ and 12₂ for the second test head TH2. In each pair of the stoppers, one stopper is separated by a distance D from the other. The IC devices to be tested in the test tray 20 are also apart from one another by the distance D.

The test tray 20 is provided with a groove 21 and a end surface 22 of the groove as shown in Figure 1. The end surface is distanced from the flat surface 14 of the test tray 20 by 2D. A pair of plural position sensors 15₁ and 15₂ are also provided in each test head for monitoring the movement of the test trays 20. Although not shown, the pin electronics in each of the test heads TH1 and TH2 has a spacing with respect to the adjacent pin electronics by a

distance which is eight times larger than the distance D between the IC devices.

Thus, in the first test head TH1, the IC devices in the two lines (A, A) in the test tray 20 are first tested at the position A determined by the stopper 11, as shown in Figure 2a. Then, also in the test head TH1, another two lines (B, B) of IC devices are tested at the position B determined by the stopper 12, as shown in Figure 2b, which is shifted by the distance D from the previous position. Further, the IC devices in two lines (C, C) are tested at the position C which is determined by the stopper 11, and the groove 21. Moreover, the IC devices in two lines (D, d) are tested at the position D which is determined by the stopper 11₂ and the groove 21. Namely, in this example, 32 IC devices are tested in the first test head TH1.

The test tray 20 is then transferred to the second test head TH2 wherein the IC devices in each two lines in the test tray 20 are tested in the same manner in the first test head TH1 as described above as shown in Figures 2e-2h. Thus, in the test head TH2, the test tray 20 is positioned in the four positions by the pair of stoppers 12₁ and 12₂ in each position of which the IC devices of each two lines in the test tray are tested. Therefore, in this arrangement of Figure 2, a total of 64 IC devices are tested in the first and second test heads TH1 and TH2.

In the above example, it is disclosed that a single groove is provided on the test tray to increase the number of test positions. However, the present invention can be applied to a situation where two or more grooves are provided on the test tray 20 to further increase the number of test positions without increasing the number of stoppers.

Namely, the number of positions for the test tray 20 can be increased by the numbers of grooves multiplied by the



numbers of stoppers.

The distance E that is from the flat surface 14 of the test tray 20 to the end surface 22 of the groove 21 in Figure 1 can be made twice as long as D which is the distance between the stopper 11 and the stopper 12. Then, the test tray 20 can stop at each position spaced by the distance D. Also, the test tray 20 can be stopped at different intervals by changing the distances D and E.

In the example shown in Figure 1, a groove 21 is provided on the test tray 14 and the stopper 11 or 12 is engaged with one end of the groove 21. However, as an alternative way, a convex part provided on the test tray 14 may be engaged with the stopper. Moreover, such a groove or convex part can be formed not only on the side of the test tray 14 but also on the upper or bottom surface of the test tray 14. The number of test head areas can be more than three. Further, as apparent from the previous explanation, the index time per device could be reduced if the test tray is stopped a plurality of times at an interval of an integer multiple of the device array spacing y along the transfer direction of the devices to be tested on the test tray in the test head area, and at each stop position of the test tray, a different device on the test tray is tested. In this case, the test tray could be stopped by controlling the test tray transferring drive rather than controlling the stopper.

According to the present invention, when the first embodiment is performed, the following advantages are obtained. The index time is decreased to a half of the conventional ones since an automatic handler for an IC test system is comprised of a plurality of stoppers 11 and 12 provided along the moving direction of the test tray 20 in a test head area. Thus, the present invention provides an



automatic handler for an IC test device which is able to
reducing the index time required when devices to be tested
are transferred from the supply area to the test head area
or from the test head area to the discharge area in the IC
5 test system.

When the second embodiment is implemented, the number
of test positions for the test tray per test head can be
increased without increasing mechanical components or
spaces in the automatic handler. Consequently, IC devices
10 to be tested at one position can be reduced and the number
of stops can be the same as conventional ones. Hence,
an automatic handler of the present invention allows
flexibility of IC test where the number of devices to be
tested at a time is increased and freely selectable.

15

CLAIMS:

1. An automatic handler for an IC test system to test IC devices by transferring the IC devices from a supply area to a test head area which has a plurality of test contactors and further transferring the tested IC devices from the test head area to a discharge area, comprising:

a test tray for loading said IC devices to be tested, said IC devices to be tested are aligned in said test tray with a distance between one another which is shorter than a distance between said test contactors in said test head area;

a pair of positioning stoppers provided in said test head area along a moving direction of said test tray, said positioning stoppers are spaced by the distance equal to the distance of said IC devices to be tested in said test tray;

wherein said distance of said contactors is adjusted to an integer multiple of said distance of said IC devices to be tested in said test tray, one of said positioning stoppers contacts said test tray to determine a first position for testing said IC devices in a first line in said test tray, and then said test tray is transferred until other positioning stoppers contacts said test tray in a second position for testing said IC devices in a second line in said test tray, said test tray being transferred to said discharge area after said testing.

2. An automatic handler as defined in Claim 1, further includes an additional pair of said positioning stoppers corresponding to an increase in a number of said test head area in said IC test system.

3. An automatic handler as defined in Claim 1, wherein



said positioning stopper includes a projection which expands or retracts to positioning said first and second positions of said test tray.

4. An automatic handler as defined in Claim 1, wherein said test tray includes a flat surface to meet with said projection of said positioning stopper, said first position and second position are determined when said flat surface contacts said projections of said pair of positioning stoppers.

5. A mechanism in an automatic handler for positioning a test tray having a large number of IC devices to be tested aligned therein, comprising:

a stopper which determines a first position of said test tray when said stopper contacts with an outer surface of said test tray and a second position of said test tray when said stopper contacts with a wall of a groove provided on said test tray;

wherein a distance from said outer surface and said wall is equal to or an integer multiple of a distance between adjacent said IC devices in said test tray.

6. A mechanism for positioning a test tray as defined in Claim 5, wherein:

said stopper is comprised of two stopper mechanism independently operable from one another, said two stopper mechanism is separated by a distance equal to said distance of said IC devices in said test tray;

said distance from said outer surface of said test tray and said wall of said groove is equal to two times of said distance of said two stopper mechanism;

whereby said test tray is adjusted in four positions



each of which is apart by the distance between said two stop per mechanism.

7. A mechanism for positioning a test tray as defined in Claim 6, wherein said stopper is comprised of three or more stopper mechanism, and said test tray includes two or more grooves, thereby realizes more than five test positions for said IC devices to be tested.

8. A method for transferring a test tray of an automatic handler for an IC test system wherein said test tray on which devices to be tested are aligned in an array is transferred to a test head area to test said devices to be tested thereat, and is transferred to a discharge area characterized in that comprising steps of:

said test tray is stopped a plurality of times at an interval of an integer multiple of the array spacing along the transfer direction of the devices to be tested on the test tray in said test head area; and

at each stop position of said test tray, a different device on said test tray is tested.

9. The method as defined in Claim 8 characterized in that the stop position interval of the test tray is equal to the array spacing, each of the intervals of device contactors of said test head area along said transfer direction is n times (n is an integer equal to or greater than 2) of said device array spacing, and the number of positions where said test tray stops is n .

10. The method as defined in Claim 8 characterized in that each of the stop position intervals of the test tray is p times (p is an integer equal to or greater than 2) of said



device array spacing, the number of test head areas provided along a moving direction of said test tray is p , and at each initial stop position of said each test head area, different one of first p lines of devices along the moving direction of the test tray from the initial stop position are tested respectively.

11. The method as defined in Claim 10 characterized in that the interval of the device contactors along the moving direction of the test tray is $p \cdot n$ times (n is an integer equal to or greater than 2) of said device array spacing and the number of stop positions of said test tray is n .

12. The method as defined in either one of Claims 8-11 characterized in that test tray stoppers are provided corresponding to said respective stop positions so that each of the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, and said test tray is stopped at each of said stop positions by controlling those stoppers.

13. The method as defined in either one of Claims 8-11 characterized in that a test tray stopper is provided corresponding to the first stop position so that the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with the stopper in the state that the stopper is projected on the test tray path are provided on the test tray at said stop position intervals along the moving direction of the test tray, the number of said engaging parts is equal to the number of the stop positions, and said test tray is stopped at each of said stop positions by controlling said stopper.



14. The method as defined in either one of Claims 8-11 characterized in that two test tray stoppers are provided at said stop position intervals along the moving direction of the test tray corresponding to the first and the second stop positions respectively so that each of said two stoppers can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with one of the two stoppers in the state that one of the two stoppers is projected on the test path are provided on the test tray at the two time interval of the distance between said stoppers along the moving direction of the test tray, the number of said engaging parts is one second of said number of stop positions, and said test tray is stopped at each of said stop positions by alternately controlling said stoppers to be positioned on the test tray path.

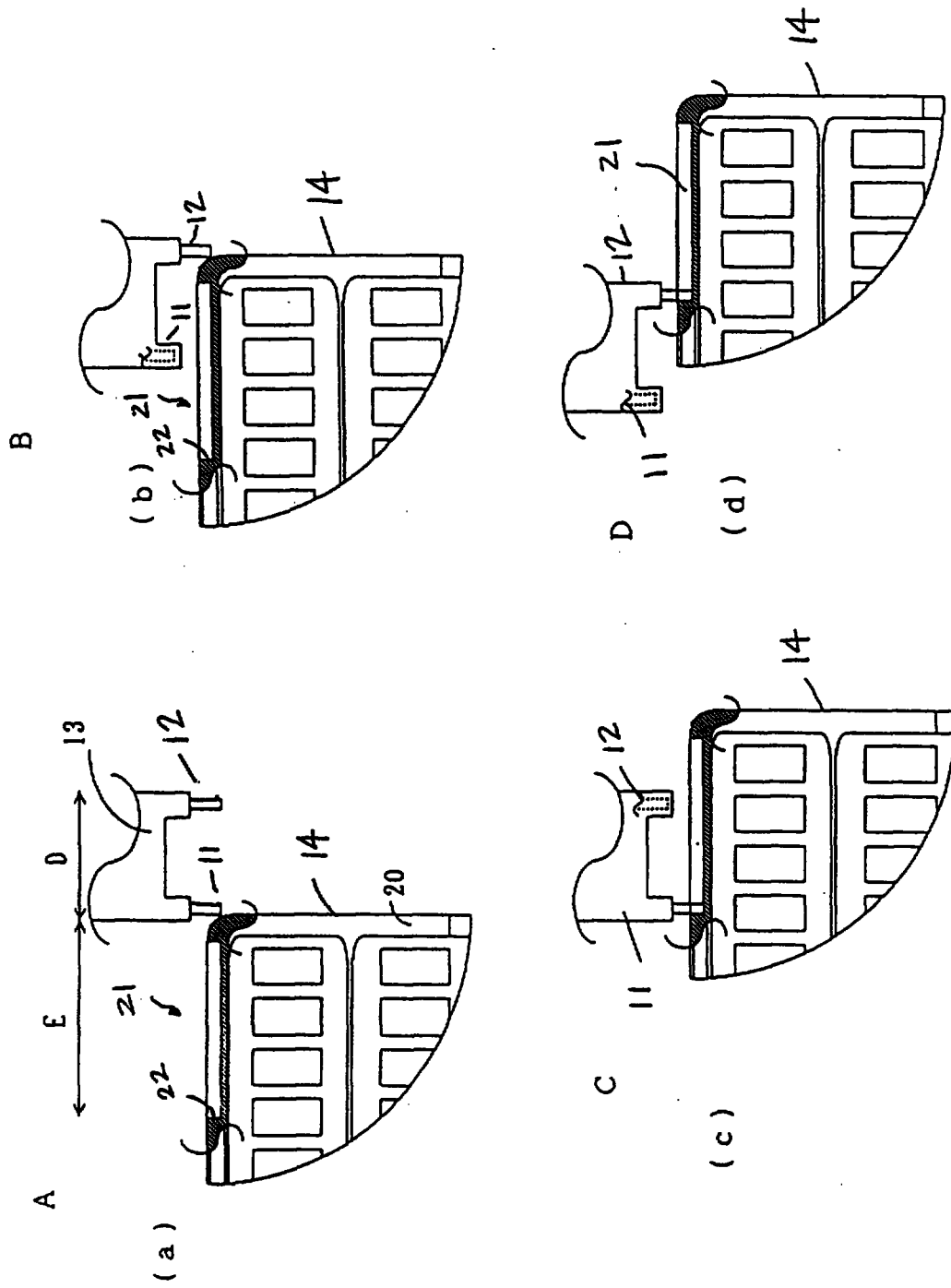


ABSTRACT

An automatic handler for an IC test system is disclosed which is capable of reducing a time for transferring IC devices to be tested from a supply area to a test head area and from the test head area to a discharge area. The automatic handler includes a test tray for loading the IC devices to be tested in which the IC devices to be tested are aligned in the test tray with a shorter distance with one another than a distance between test contactors in the test head area, a pair of positioning stoppers provided in the test head area along a moving direction of the test tray in which the positioning stoppers are spaced by the distance equal to the distance of the IC devices to be tested in the test tray. In the automatic handler, the distance of the contactors is adjusted to an integer multiple of the distance of the IC devices to be tested in the test tray. One of the positioning stoppers contacts the test tray to determine a first position for testing the IC devices in a first line in the test tray, and then the test tray is transferred until other positioning stoppers contacts the test tray in a second position for testing the IC devices in a second line in the test tray. The test tray is then transferred to the discharge area. Another aspect of the automatic handler is provided with a groove on the test tray to increase a number of test position for the test tray. The groove includes an end surface which engages with the positioning stoppers.



Fig. 1



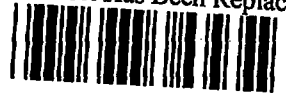


Fig. 2

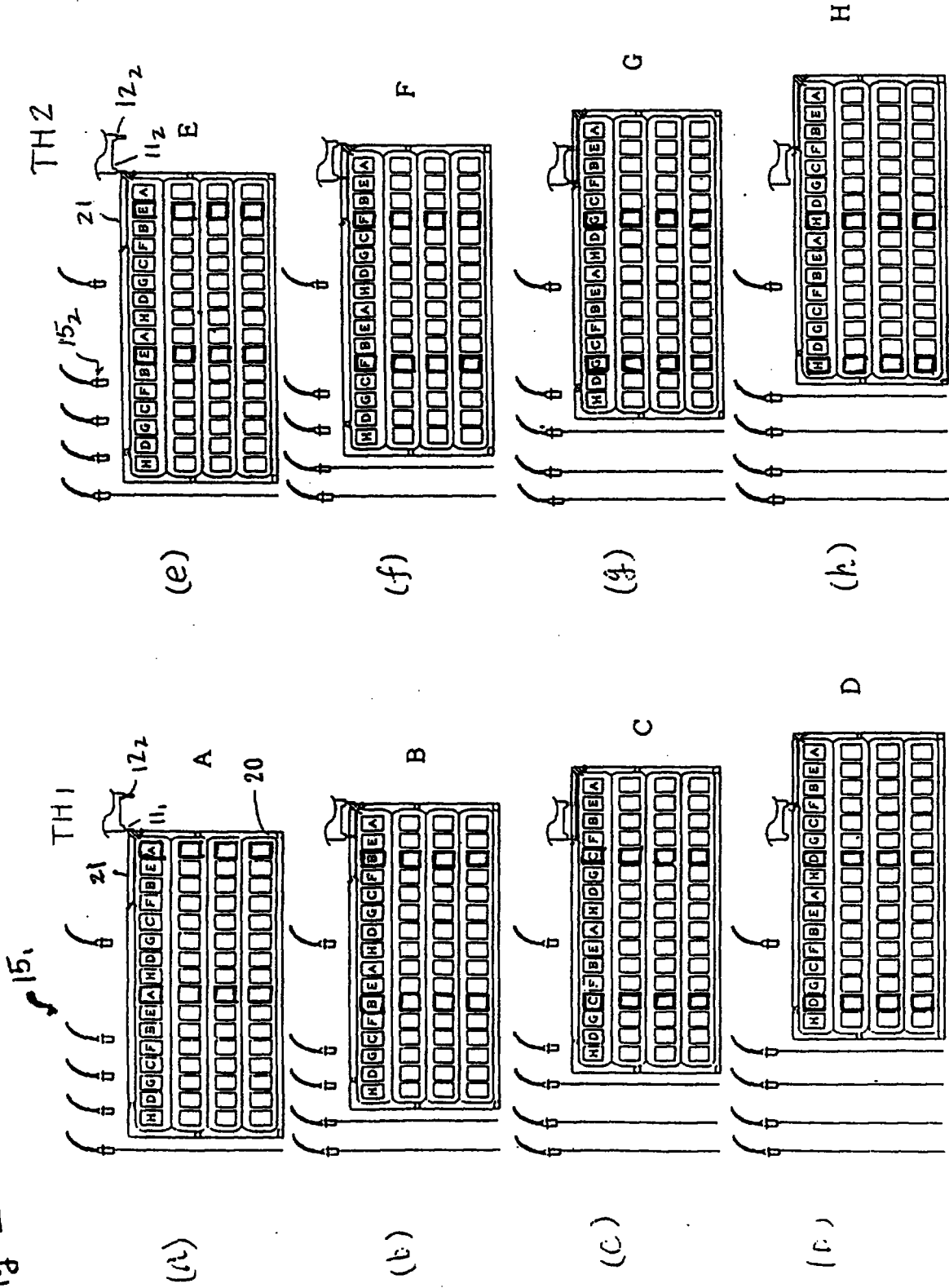
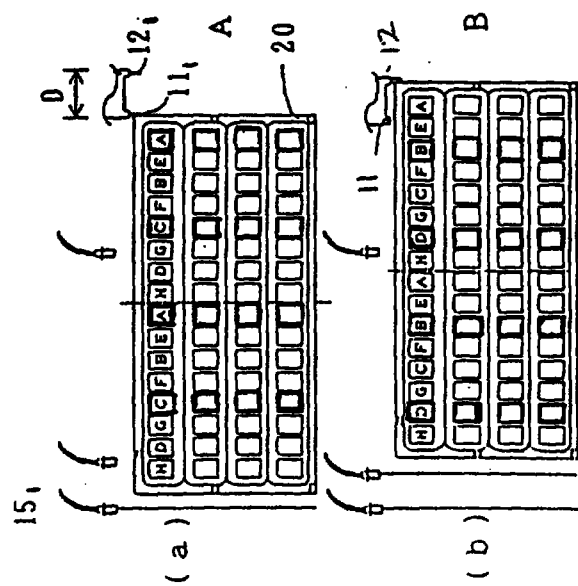


Fig. 3

TH1



TH2

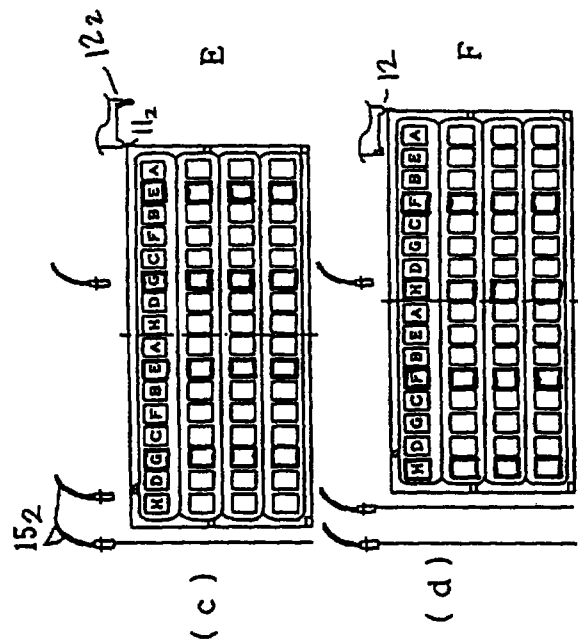




Fig. 4

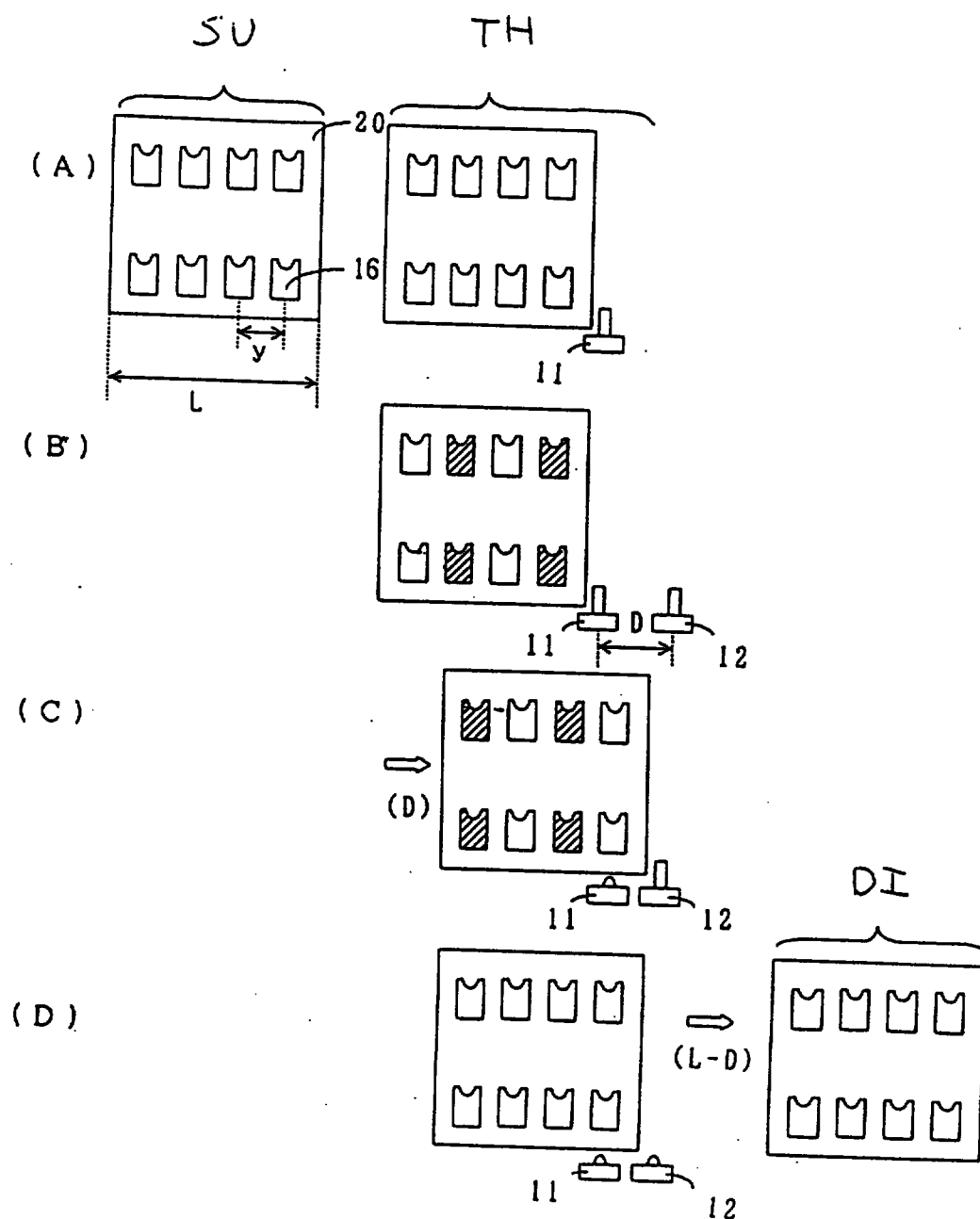




Fig. 5

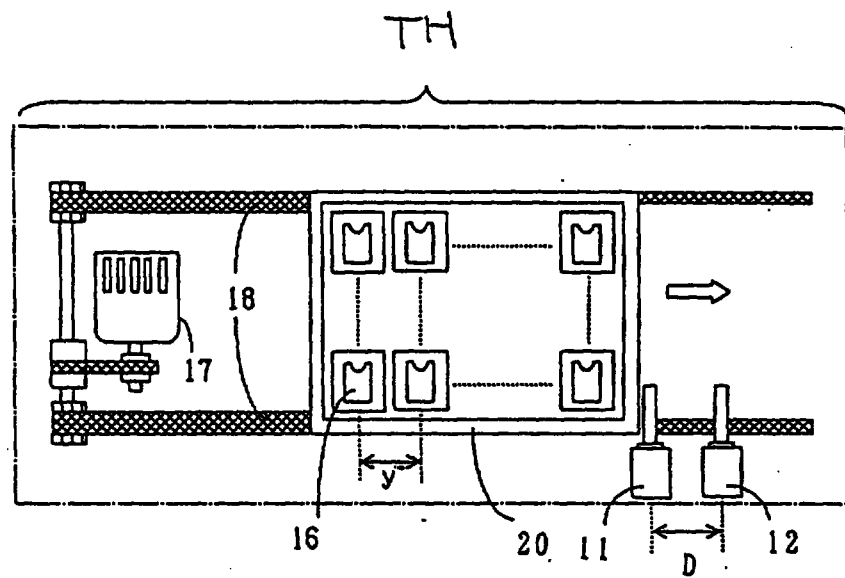


Fig. 6

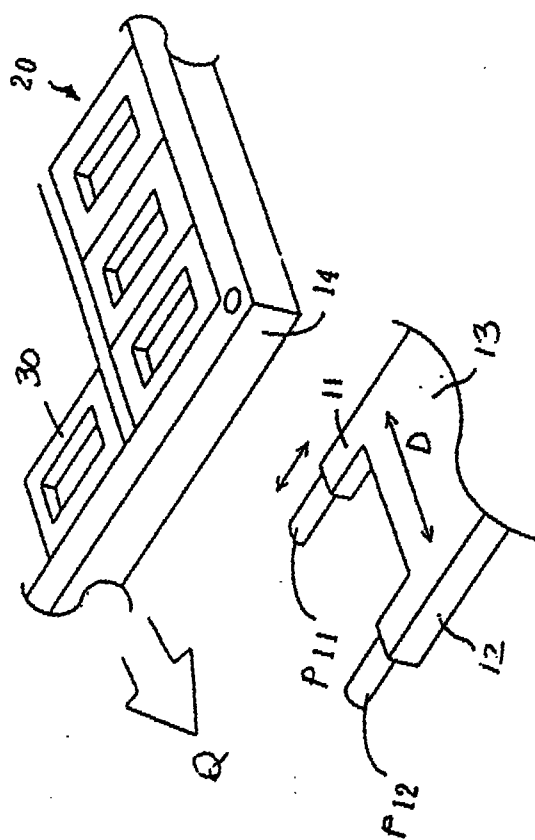
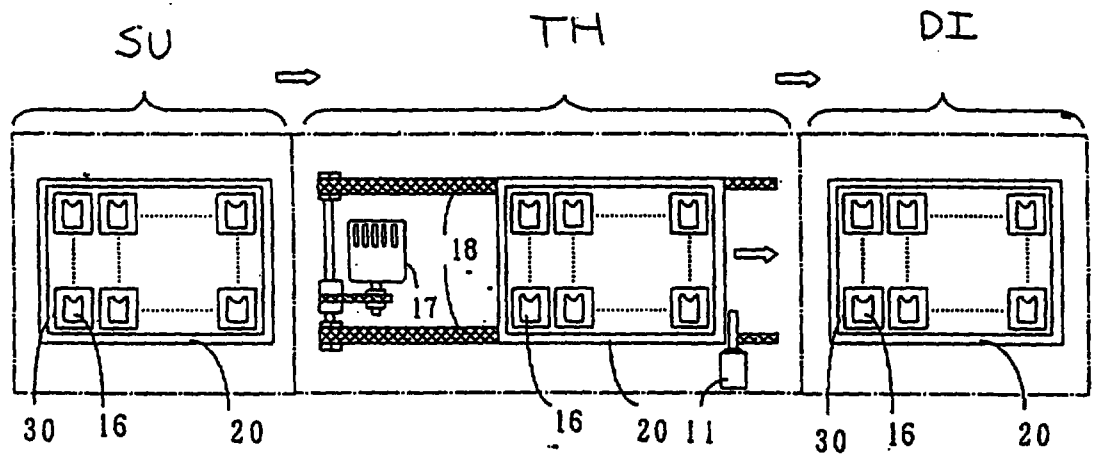




Fig. 7



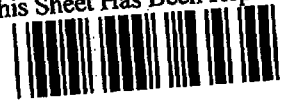


Fig. 8

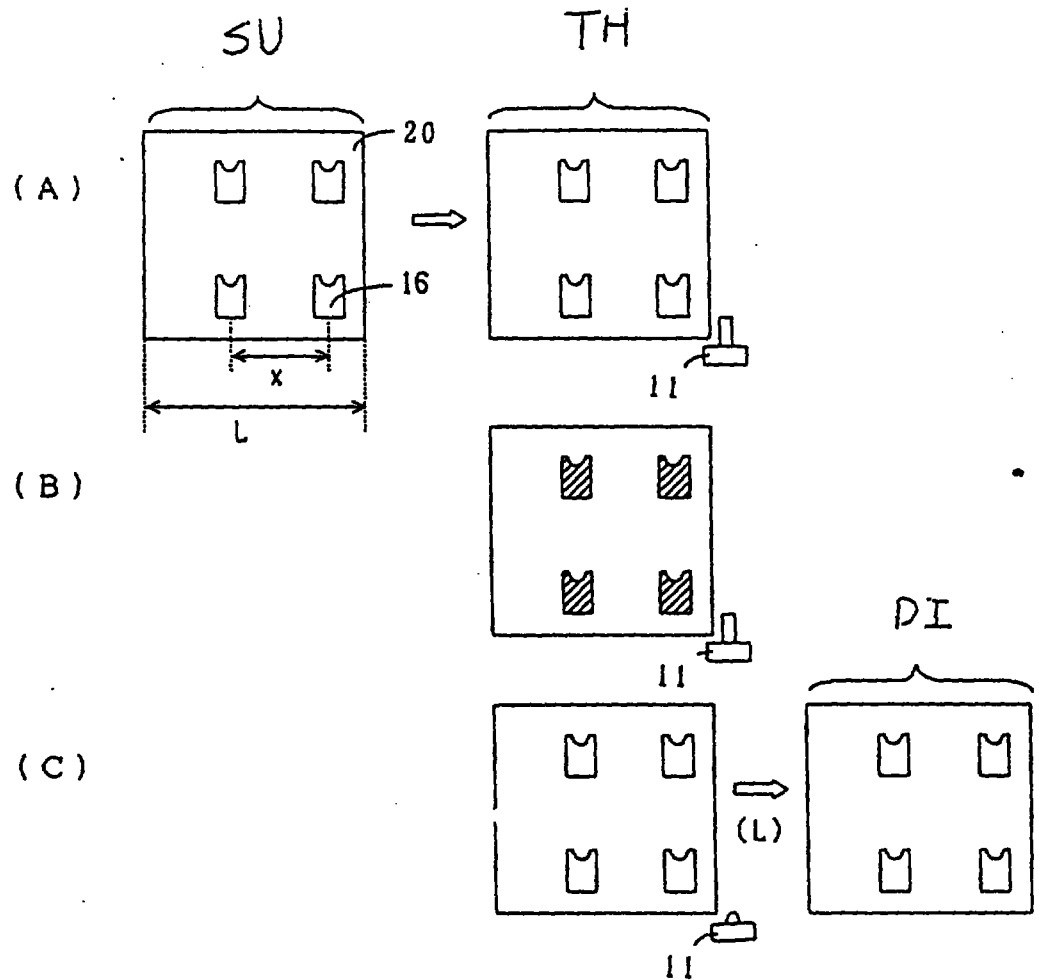
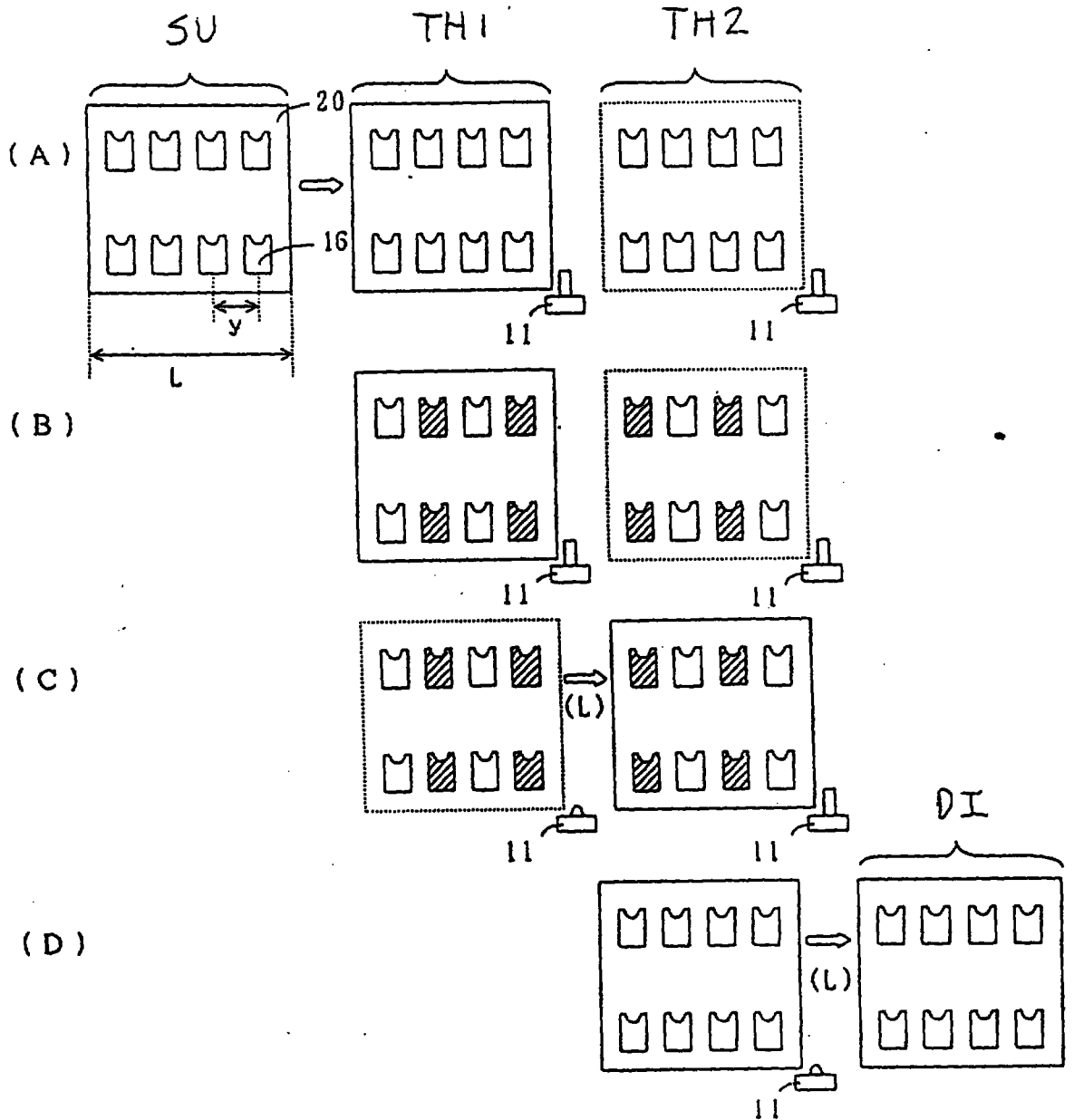




Fig. 9



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AUTOMATIC HANDLER FOR IC TEST SYSTEM, TEST TRAY
STOPPING MECHANISM AND TEST TRAY TRANSFERRING
METHOD FOR AUTOMATIC HANDLER OF IC TEST SYSTEM

5 FIELD OF THE INVENTION

The present invention relates to an automatic handler of an IC test system that transfers IC devices to be tested, from a supply area to a test head area, then to a discharge area, which is capable of minimizing time for switching a
10 test tray to a next test tray (referred to as an index time) to start the device test for the latter test tray after the device test for the former test tray is completed, more particularly to a test tray positioning stopper mechanism for automatic handler to increase flexibility and a choice
15 of the number of IC devices to be tested simultaneously, and to a method for transferring the test trays to a test head area and for discharging them therefrom.

BACKGROUND OF THE INVENTION

20 In general, an IC test system performs an IC device test by electrically contacting IC devices to be tested with test contactors in pin electronics or pin cards provided in a test head area to supply test signals to the IC devices and receive the resulted outputs from the IC devices. The
25 resulted signals are compared with expected signals to determine whether the outputs from the IC devices are acceptable or not.

Hence, an automatic handler transfers IC devices to be tested from a supply area to a test head area. After the
30 test, IC devices that have been tested are transferred from test the head area to a discharge area and are sorted according to the test results. During these times required for transferring the IC devices, the test cannot be

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performed since IC devices to be tested cannot determine their position with respect to contactors in the test head and thus they cannot be electrically contacted. Reducing this transfer time, i.e., an index time, is desirable since the index time is useless for the IC device testing. Hence, there is a need to minimize the index time in an automatic handler.

Figure 7 shows a conventional automatic handler for an IC test system. As shown, test trays 20 are used as means of transferring IC devices 16 to be tested in the IC test system. A plurality of carrier modules 30 are maintained in a floating state in each test tray 20. An IC device 16 is mounted on each carrier module 30. The test trays 20 having the IC devices 16 are arranged at the supply area SU. IC devices 16 are then transferred to the test head area TH while being maintained on the test tray 20. At the test head area TH, the test tray 20 is carried on a belt conveyer 18 by a driving power of a motor 17 until the test tray is stopped by a projection of a stopper 11.

At the test head area TH, the test tray 20 is positioned and fixed by the stopper 11. Then, the IC devices 16 are pushed downward, for example, for the electric connection with the test contactors of the pin electronics (not shown) provided at the test head in the IC test system. The IC devices 16 keep electronic contact with the pin electronics in the IC test system during the testing. Recently, a plurality of test head areas are provided for performing simultaneous testing of IC devices mounted on a plurality of test trays. The test tray 20 is then transferred to the discharge area DI where the IC devices 16 are classified depending on the test results.

Figure 8 is a schematic diagram showing an example of test process in a conventional automatic handler. In the

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example shown in Figure 8A, there are four (4) IC devices 16 seated in the test tray 20. In recent years, smaller devices are widely used and thus a larger number of IC devices, such as eight (8) IC devices can be arranged in the test tray 20 according to the actual density of IC devices as shown in Figure 8A. However, the minimum distance between the device contactors along the moving direction of the test tray in the test head is limited to x in Figure 8A because of the limitation in a packaging density of pin electronics in the test heads. Therefore, as shown in Figure 8A, since the test contactors in the pin electronics of the IC test system consist of mechanical and electronics parts and thus require a certain size and space which determine the distance x .

Hence, in the example of Figure 8A, four IC devices 16 are arranged in a length L of the test tray 20. The test tray 20 is shifted from the supply area SU to the test head area TH. After the test tray 20 is transferred to the stopper 11 in the test head area TH, each IC device 16 is electrically contacted by the pin electronics (not shown) as shown in Figure 8B and the test is initiated. After the test, the projection of the stopper 11 withdraws so that the test tray 20 transfers to the discharge area DI. As a result, the test for the IC devices in the next test tray can be ready. An index time is defined as time required for discharging a test tray in a test head area and placing a next test tray to the test head area. In short, the index time is approximately equal to time required for moving a test tray by its length L along the moving direction. Thus, the index time t_1 is given as $t_1 = L/s$, where s is the moving speed of a test tray 20. The index time per device t_1' is given as $t_1' = (L/s)/4$.

Figure 9 is a schematic diagram showing an example of

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test process of IC device testing in another conventional automatic handler. In the example of Figure 9, the IC test system includes two test heads TH1 and TH2. As shown in Figure 9, eight (8) IC devices 16 are arranged in the test tray 20. The spacings between the IC devices to be tested are y where it is assumed that $x/2 < y < x$. The IC devices 16 to be tested are arranged in the way that the spacing y between the IC devices 16 to be tested are minimized to the limit of the packaging density of the IC devices 16 in the length L of the test tray 20. In contrast, as discussed above with reference to Figure 8, the distance x is determined by the density of the test contactors in the pin electronics which is larger than that of the IC devices.

As shown in Figure 9A, the test tray 20 is transferred from the supply area SU to the first test head TH1 by the transfer system such as shown in Figure 7. The position of the test tray is determined by the stopper 11, provided at the first test head TH1 by the transfer system. Then, the IC devices 16 on the test tray are electrically contacted with the pin electronics in the test head area so that the test is initiated. Since there is a limitation in the density such as in the pin electronics or pin cards in the test heads, and thus the plurality of test contactors in the pin electronics have a greater spacing x than the spacing y of the IC devices 16 to be tested, not all IC devices 16 in the test tray 20 can be simultaneously tested. Therefore, for example, at the first test head TH1, only the IC devices 16 of odd lines in the test tray 20 are electrically contacted and tested. This is shown in Figure 9B by the shades of the corresponding IC devices 16 in the test tray 20.

After finishing the test for the IC devices 16 in the

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odd lines, the projection of the stopper 11₁ at the test head TH1 is detracted and the test tray 20 is transferred to the second test head TH2 as shown in Figure 9C. The test tray 20 is positioned accurately at the second test head TH2 by the stopper 11₂. At the test head area TH2, this time, only the IC devices 16 of even lines in the test tray 20 are electrically contacted by the pin electronics in the second test head TH2 as shown by the shaded lines in Figure 9C.

Since there are two (2) test heads TH1 and TH2 are provided in this example and both test heads can perform the test simultaneously, it is possible for the second test head TH2 to test the IC devices in the even lines in the test tray 20 while the first test head TH1 simultaneously tests IC devices in the odd lines in the next test tray. Thus, all eight (8) IC devices 16 to be tested in the test tray 20 can be tested in the manner described above by allocating the IC devices to the first test head TH1 and the second test head TH2. After the test, the projection of the stopper 11₂ at the second test head TH2 pulls back, and the test tray 20 is transferred to the discharge area DI as shown in Figure 9D.

In this situation, when the transfer speed of the test tray 29 is expressed as s , the index time in the simultaneous testing performed continuously as above is:

$$t_2 = 2L/s.$$

In this case, although more devices can be arranged on a test tray by making the device spacing y small, the index time becomes larger. The index time per device t_2' can be calculated as

$$t_2' = (2L/s)/8 = (L/s)/4,$$

and this is the same as in Figure 8A.

As described above, in the prior art, the number of devices arranged on a test tray cannot be increased without

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increasing the index time, and thus index time per device cannot be decreased.

SUMMARY OF THE INVENTION

5 Therefore, it is an object of the present invention to provide an automatic handler for an IC test system which is capable of minimizing the index time required for transferring the test trays having IC devices to be tested by uniquely arranging a plurality of stoppers for
10 positioning the test trays.

 It is another object of the present invention to provide an automatic handler for an IC test system which is capable of minimizing the index time for transferring the test trays by providing a plurality of stoppers
15 corresponding to a single test head of the IC test system to determine a plurality of positions in the test head area.

 It is another object of the present invention to provide an automatic handler which is capable of increasing
20 the number of test positions for the test tray by providing a groove on the test tray which receives and engages with projections of the stoppers.

 It is a further object of the present invention to provide an automatic handler for an IC test system which is
25 capable of minimizing the index time without increasing mechanical parts or spacing in the handler.

 It is yet further object of the present invention to provide a test tray transferring method for an automatic handler of an IC test system which is capable of reducing
30 the index time per device by employing shorter device spacing y than device contactor spacing x without increasing the index time. This could be achieved according to the present invention characterized in that the test tray is

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5 stopped a plurality of times at an interval of an integer multiple of the array spacing along the transfer direction of the devices to be tested on the test tray in the test head area, and at each stop position of the test tray, a different device on the test tray is tested.

10 According to the first aspect of the present invention, IC devices to be tested are arranged in the length of the test tray to a limit of their density. After being transferred to a test head area by a transfer system, the test tray is positioned by a first positioning stopper. The IC devices in a predetermined line in the test tray are electrically contacted with contactors in pin electronics of the test head area and the IC test is performed. At this point, only the IC devices of odd lines, for example, are
15 electrically contacted and tested at this first step since the spacing of the contactors in the test head is larger than that of the IC devices in the test tray.

20 After the test for the IC devices in the odd lines, a projection of the first positioning stopper is retracted so that the test tray is transferred to the next position where it is positioned by a second stopper. At this second step, only IC devices of even lines in the test tray are electrically contacted with the contactors in the pin electronics to proceed the IC test. Thus, when the test
25 tray transfers from the first step to the second step, the test tray transfers the distance D which is the distance between the first stopper and the second stopper. This distance D is also identical to the spacing between the IC devices in the test tray.

30 After the test, a projection of the second stopper at the test head area is retracted and the test tray advances to a discharge area. In this case, the transfer distance of the test tray is $(L-D)$. Thus, the transfer distance of

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the test tray is reduced compared to the conventional arrangement, which contributes to a reduction of the index time.

5 According to the second aspect of the present invention, a groove is provided on the test tray to receive the positioning stoppers therein. The groove has a predetermined length including an end surface the distance of which is an integer multiple, for example, twice as long as the distance between the positioning stoppers.

10 There can be several grooves on the test tray and at least one stopper is needed. Consequently, the number of possible test positions for the test tray is increased to the number of grooves multiplied by the number of stoppers.

15 Thus, by setting the distance between a flat surface in the front of the test tray and the end surface of the groove as twice as long as the distances between two stoppers, the total test positions for the test becomes four.

In the test tray transferring method of the present invention, there are several view points as described below:

20 The first view point is characterized in that the stop position interval of the test tray is equal to the array spacing, each of the intervals of device contactors of the test head area along the transfer direction is n times (n is an integer equal to or greater than 2) of the device array spacing, and the number of positions where the test tray stops is n .

25 The second view point is characterized in that each of the stop position intervals of the test tray is p times (p is an integer equal to or greater than 2) of the device array spacing, the number of test head areas provided along a moving direction of the test tray is p , and at each initial stop position of the each test head area, different one of first p lines of devices along the moving direction

30

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of the test tray from the initial stop position are tested respectively.

5 The third view point is, in the second view point above, characterized in that the interval of the device contactors along the moving direction of the test tray is $p \cdot n$ times (n is an integer equal to or greater than 2) of the device array spacing and the number of stop positions of the test tray is n .

10 The fourth view point is characterized in that test tray stoppers are provided corresponding to the respective stop positions so that each of the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, and said test tray is stopped at each of the stop positions by controlling those stoppers.

15 The fifth view point is characterized in that a test tray stopper is provided corresponding to the first stop position so that the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with
20 the stopper in the state that the stopper is projected on the test tray path are provided on the test tray at the stop position intervals along the moving direction of the test tray, the number of the engaging parts is equal to the number of the stop positions, and the test tray is stopped
25 at each of the stop positions by controlling the stopper.

The sixth view point is characterized in that two test tray stoppers are provided at the stop position intervals along the moving direction of the test tray corresponding to the first and the second stop positions respectively so that
30 each of the two stoppers can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with one of the two stoppers in the state that one of the two stoppers is

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projected on the test path are provided on the test tray at the two time interval of the distance between the stoppers along the moving direction of the test tray, the number of the engaging parts is one second of said number of stop positions, and the test tray is stopped at each of the stop positions by alternately controlling the stoppers to be positioned on the test tray path.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a schematic view showing the second embodiment of the automatic handler in accordance with the present invention.

Figure 2 is a schematic view of an automatic handler for explaining a situation where test trays stop at four (4) positions in a test head area in the second embodiment of the present invention of Figure 1.

15 Figure 3 is a schematic view of the first embodiment of the automatic handler in accordance with the present invention showing a situation where test trays stop at two (2) positions in a test head area.

20 Figure 4 is a schematic diagram showing a test procedure of IC devices in accordance with the automatic handler of the first embodiment of Figure 3.

Figure 5 is a plain view showing the first embodiment of the present invention.

25 Figure 6 is a perspective view for explaining the relationship between the test tray and the positioning stopper in the first embodiment of the present invention.

Figure 7 is a diagram showing an example of conventional automatic handler for an IC test system.

30 Figure 8 is a schematic view showing a test process for IC devices in the conventional automatic handler of Figure 7.

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Figure 9 is a schematic view showing a test process for IC devices in another example of conventional automatic handler.

5 DETAILED DESCRIPTION OF THE INVENTION

Preferred embodiments of the present invention will be described with reference to the drawings. Figure 5 shows the first embodiment of the present invention. Figure 5 is a plan view showing an automatic handler corresponding to a test head area TH of an IC test system. The test tray 20 having the IC devices 16 to be tested is placed on the belt conveyor 18 which is driven by the motor 17 as in the same manner shown in Figure 7. In Figure 5, in addition to the conventional stopper 11, the second stopper 12 is also provided in the test head TH along a moving direction of the test tray 20. The distance D between the second stopper 12 and the first stopper 11 is adjusted to be equal to the distance y between the adjacent IC devices 16 to be tested in the test tray 20. The IC devices 16 to be tested in the test tray 20 is arranged in a manner discussed with respect to Figure 9 where the spacing y between the IC devices is decreased to the minimum possible value. An operation of extension and withdrawal of the projection in each stopper is controlled independently.

25 Figure 4 is a schematic diagram showing a test process of the IC devices 16 to be tested according to the automatic handler of the present invention. In the example of Figure 4, eight (8) IC devices 16 to be tested are arranged in the test tray 20. Namely, the IC devices 16 to be tested are aligned in the test tray 20 such that the spacing between the adjacent devices is reduced to the minimum in terms of packaging density of the IC devices 16 to be tested. Thus, the IC devices 16 to be tested are aligned with the spacing

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y in the test tray 20 whose length is L.

The test tray 20 is moved from the supply area SU to the test head area TH until it is stopped by the stopper 11 provided in the test head area TH as shown in Figure 4A.

5 Then the test tray 20 is pressed downward, for example, for accomplishing the electrical contact between the test contactors in the pin electronics of the IC test system and the IC devices 16 to be tested as shown in Figure 4B. AT this time, only the IC devices of the odd lines in the test
10 tray 20 are electrically connected and tested as shown by the shaded lines of Figure 4B. This is because the test contactors in the pin electronics in the test head TH have the minimum distance x which is different from the minimum distance y of IC devices in the test tray 20. Usually, the
15 distance x between the adjacent test contactors is greater than the distance y between the adjacent IC devices 16 aligned in the test tray 20. Therefore, in this example, the distance x in the test head is adjusted to be $x=2y$ to that the IC devices in the every other lines in the test
20 tray 20 can be electrically connected with the test head.

After finishing the test for the IC devices in the odd lines, the protrusion of the first stopper 11 is pulled in and the test tray 20 is transferred to the right hand side until it is stopped by the second stopper 12 as shown in
25 Figure 4C. The test tray 20 is then fixed by the projection of the second stopper 12 in the appropriate position in the test head area TH. As stated above, the spacing between the first stopper 11 and the second stopper 12 is D which is the same as distance y between the IC devices 16 in the test
30 trays 20. Thus, when the test tray 20 transfers from the first step (Figure 4B) to the second step (Figure 4C), the IC devices in the even lines are positioned to contact with the contactors in the test head TH.

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At this position, the IC devices in the even lines in the test tray 20 are electrically connected with the test contactors of the pin electronics in the IC test system and tested thereby. Therefore, in the first position which is determined by the first stopper 11, the IC devices 16 in the odd lines in the test tray 20 are tested and in the second position which is determined by the second stopper 12, the IC devices 16 in the even lines in the test tray 20 are tested. As a result, all of the eight (8) IC devices in the test tray 20 can be tested after the process of Figure 4C. Then, the projection of the second stopper 12 is withdrawn and the test tray 20 is transferred to the discharge area DI.

In this process, the transfer distance of the test tray 20 between the second position and the discharge area DI is (L-D) as shown in Figure 4D. When the transfer speed of the test tray 20 is s, the index time is:

$$t_3 = (D/s + (L-D)/s) = L/s$$

The index time per device per is

$$t'_3 = (L/s)/8$$

Hence, the index time per device in this example can be reduced to a half of that in the conventional automatic handler of Figures 7 or 9 in which the index time is $L/4s$.

In the above example, the IC test is performed in two steps, i.e., by dividing the IC devices in the odd lines and in the even lines in the test tray 20. However, based on the inventive features of the present invention, the test can be divided into three steps when even smaller IC devices to be tested are arranged in the test tray. In such a situation, the number of stoppers to be provided will be increased to three each of which is apart from one another by the distance the same as that of the IC devices in the test tray.

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Further, the number of steps or the stoppers can be increased arbitrarily according to the relationship between the spacing in the IC devices in the tray and the spacing of the pin electronics in the test head. Even if the number of stoppers and thus the steps for testing the IC devices to be tested is altered, the index time can be increased in the same manner as describe in the foregoing. The only limitation in increasing the number of the stoppers is that the stoppers have to be aligned in the direction to which the test tray is transferred.

Figure 6 shows an example of the test tray 20 and the positioning stoppers 11 and 12. In this example, the stopper 11 and the stopper 12 are distanced by a pitch D and are arranged on a stopper body 13. The projections P_{11} and P_{12} on the end of the stoppers 11 and 12, respectively, are driven independently from each other.

The test tray 20 is provided with, for example, 64 carrier modules 30 so that 64 IC devices to be tested can be loaded in the seats of the carrier modules 30. The test tray 20 has a flat surface 14 and is transferred to the moving direction Q in Figure 6. In the test area, the flat surface 14 meets with the projection P_{11} of the stopper 11 or the projection P_{12} of the stopper 12 so that the appropriate positions of the IC devices to be tested is determined with respect to the pin electronics in the test head.

Thus, the test tray 20 can be stopped at two positions distanced by the pitch D on the test head area. The first positioning can be accomplished when the projection P_{11} of the stopper 11 touches the flat surface 14. Then, after testing the predetermined lines of IC devices on the test tray 20, the projection P_{11} is retracted in the stopper 11 so that the test tray 20 can further advances to the

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direction Q. The flat surface 14 of the test tray 20 then meets with the projection P₁₂ of the stopper 12, which determined the second position of the test tray 20 on the test head area.

5 Figure 3 shows an arrangement of an automatic handler for use with an IC test system having two test heads (test chambers) TH1 and TH2 for testing the IC devices. In this arrangement, the automatic handler includes stoppers 11₁ and 12₁ for the first test head TH1, and stoppers 11₂ and 12₂ for the second test head TH2. In each pair of the stoppers, one stopper is separated by a distance D from the other. A pair of plural position sensors 15₁ and 15₂ are also provided in each test head for monitoring the movement of the test trays 20. In this example, although not shown, the test contactors of the pin electronics in each of the test heads TH1 and TH2 have a spacing with respect to the adjacent contactors by a distance which is four times larger than the distance D between the IC devices 16.

15 Thus, in the first test head TH1, four lines (A, C, A, C) of IC devices in the test tray 20 are first tested at the position determined by the stopper 11₁ as shown in Figure 3a. Then, also in the test head TH1, another four lines (B, D, B, D) of IC devices in the test tray 20 are tested at the position determined by the stopper 12₁ as shown in Figure 3b, which is shifted by the distance D from the previous position. Namely, in this example, 32 IC devices are tested in the first test head TH1.

20 The test tray 20 is then transferred to the second test head TH2 as shown in Figures 3c and 3d. In the second test head TH2, four lines (E, G, E, G) of IC devices in the test tray 20 are first tested at the position determined by the stopper 11₂ as shown in Figure 3c. Then, also in the second test head TH2, another four lines (F, H, F, H) of IC devices

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in the test tray 20 are tested at the position determined by the stopper 12, as shown in Figure 3d, which is shifted by the distance D from the previous position. Thus, in this example, a total of 64 IC devices are tested in the first and second test heads TH1 and TH2.

In the example of Figures 3 or 5, when more devices are attempted to be tested in each test head or when the spacing difference between the IC devices to be tested and the pin electronics is greater than the example of Figure 3, the IC test can be carried out in a similar manner by increasing the number of stop positions in each test head. Such an increase of stop positions is possible by providing the corresponding number of stoppers in the direction where the test tray advances. However, the following problem occurs in such modification. Namely, the number of stop positions may be limited since the number of stoppers have to be increased accordingly. One of the reasons is that the increase in the number of stoppers causes an increase of corresponding mechanical parts and drive mechanism which will increase the overall size of the automatic handler.

Figure 1 shows the second embodiment of the present invention which is able to increase the number of stop positions without increasing the number of stoppers. Figure 1 shows an example in which four (4) stop positions are established for each test head. In this example, the positioning stoppers 11 and 12 are the same as the one used in the first embodiment and may be mounted on the stopper body 13 as discussed with reference to Figure 6. The major difference between the first embodiment and the second embodiment is that, in this embodiment, it is provided with a groove 21 on the test tray 20 to receive the stoppers 11 and 12 therein. The groove 21 is positioned on the side of the test tray 20 which is in parallel to the tray moving

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direction. The end surface 22 of the groove 21 has an accurate distance D from the flat surface 14 of the test tray 20, which is, for example, two time as long as the distance between D the stoppers 11 and 12.

5 With further reference to Figure 1, the operation of positioning the test tray at the 4 positions is explained. In the following, the state where the projections of the stopper 11 or 12 expands to stop the test tray 20 is regarded as ON, while the state where the projection of the
10 stopper 11 or the stopper 12 retracts to allow the test tray 20 go forward is regarded as OFF.

Position A

The stopper 11 and the stopper 12 are both turned ON as shown in Figure 1a. The projection of the stopper 11
15 contacts the flat surface 14 of the test tray so as to fix the position A of the test tray 20.

Position B

The projection of the stopper 11 is turned OFF at the position A so that the test tray 20 advances in the right
20 hand direction until the flat surface 14 contacts with the projection of the stopper 12. The test tray 20 then stops at the position B which is a distance D from the position A.

Position C

At the position B, the stopper 11 is turned ON while
25 the stopper 12 is turned OFF. Thus, the projection of the stopper 11 is in the groove 21 of the test tray 20. The test tray 20 moves in the transfer direction until the end surface 22 of the groove 21 meets with the projection of the stopper 11. The test tray 20 then stops at the position C
30 which is a distance D from the position B.

Position D

At the position C, the stopper 12 is turned ON while the stopper 11 is turned OFF. Thus, the projection of the

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stopper 12 is in the groove 21 of the test tray 20 while the projection of the stopper 11 withdraws from the groove 21. The test tray 20 moves in the transfer direction until the end surface 22 of the groove 21 contacts the projection of the stopper 12. The test tray 20 then stops at the position D which is a distance D from the position C.

Therefore, in the example of Figure 1, the four test positions each of which is apart from the other by the distance D are realized by the two stoppers 11 and 12. The IC devices in the corresponding positions in the test tray 20 will be tested in each position. After the test, the stopper 11 and the stopper 12 are turned OFF in order to transfer the test tray 20 to the next test head or the discharge area of the automatic handler.

Figure 2 shows an example of automatic handler where the stoppers and the groove in test tray shown in Figure 1 are used in the IC test system having two test heads (test chambers) TH1 and TH2 for testing the IC devices. In this arrangement, similar to the example of Figure 3, the automatic handler includes stoppers 11₁ and 12₁ for the first test head TH1 and stoppers 11₂ and 12₂ for the second test head TH2. In each pair of the stoppers, one stopper is separated by a distance D from the other. The IC devices to be tested in the test tray 20 are also apart from one another by the distance D.

The test tray 20 is provided with a groove 21 and a end surface 22 of the groove as shown in Figure 1. The end surface is distanced from the flat surface 14 of the test tray 20 by 2D. A pair of plural position sensors 15₁ and 15₂ are also provided in each test head for monitoring the movement of the test trays 20. Although not shown, the pin electronics in each of the test heads TH1 and TH2 has a spacing with respect to the adjacent pin electronics by a

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distance which is eight times larger than the distance D between the IC devices.

Thus, in the first test head TH1, the IC devices in the two lines (A, A) in the test tray 20 are first tested at the position A determined by the stopper 11, as shown in Figure 2a. Then, also in the test head TH1, another two lines (B, B) of IC devices are tested at the position B determined by the stopper 12, as shown in Figure 2b, which is shifted by the distance D from the previous position. Further, the IC devices in two lines (C, C) are tested at the position C which is determined by the stopper 11, and the groove 21. Moreover, the IC devices in two lines (D, d) are tested at the position D which is determined by the stopper 11, and the groove 21. Namely, in this example, 32 IC devices are tested in the first test head TH1.

The test tray 20 is then transferred to the second test head TH2 wherein the IC devices in each two lines in the test tray 20 are tested in the same manner in the first test head TH1 as described above as shown in Figures 2e-2h. Thus, in the test head TH2, the test tray 20 is positioned in the four positions by the pair of stoppers 12, and 12, in each position of which the IC devices of each two lines in the test tray are tested. Therefore, in this arrangement of Figure 2, a total of 64 IC devices are tested in the first and second test heads TH1 and TH2.

In the above example, it is disclosed that a single groove is provided on the test tray to increase the number of test positions. However, the present invention can be applied to a situation where two or more grooves are provided on the test tray 20 to further increase the number of test positions without increasing the number of stoppers.

Namely, the number of positions for the test tray 20 can be increased by the numbers of grooves multiplied by the

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numbers of stoppers.

5 The distance E that is from the flat surface 14 of the test tray 20 to the end surface 22 of the groove 21 in Figure 1 can be made twice as long as D which is the distance between the stopper 11 and the stopper 12. Then, the test tray 20 can stop at each position spaced by the distance D. Also, the test tray 20 can be stopped at different intervals by changing the distances D and E.

10 In the example shown in Figure 1, a groove 21 is provided on the test tray 14 and the stopper 11 or 12 is engaged with one end of the groove 21. However, as an alternative way, a convex part provided on the test tray 14 may be engaged with the stopper. Moreover, such a groove or convex part can be formed not only on the side of the test
15 tray 14 but also on the upper or bottom surface of the test tray 14. The number of test head areas can be more than three. Further, as apparent from the previous explanation, the index time per device could be reduced if the test tray is stopped a plurality of times at an interval of an integer
20 multiple of the device array spacing y along the transfer direction of the devices to be tested on the test tray in the test head area, and at each stop position of the test tray, a different device on the test tray is tested. In this case, the test tray could be stopped by controlling
25 the test tray transferring drive rather than controlling the stopper.

According to the present invention, when the first embodiment is performed, the following advantages are obtained. The index time is decreased to a half of the
30 conventional ones since an automatic handler for an IC test system is comprised of a plurality of stoppers 11 and 12 provided along the moving direction of the test tray 20 in a test head area. Thus, the present invention provides an

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5 automatic handler for an IC test device which is able to
reducing the index time required when devices to be tested
are transferred from the supply area to the test head area
or from the test head area to the discharge area in the IC
test system.

10 When the second embodiment is implemented, the number
of test positions for the test tray per test head can be
increased without increasing mechanical components or
spaces in the automatic handler. Consequently, IC devices
to be tested at one position can be reduced and the number
of stops can be the same as conventional ones. Hence,
an automatic handler of the present invention allows
flexibility of IC test where the number of devices to be
tested at a time is increased and freely selectable.

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CLAIMS:

1. An automatic handler for an IC test system to test IC devices by transferring the IC devices from a supply area to a test head area which has a plurality of test contactors and further transferring the tested IC devices from the test head area to a discharge area, comprising:

a test tray for loading said IC devices to be tested, said IC devices to be tested are aligned in said test tray with a distance between one another which is shorter than a distance between said test contactors in said test head area;

a pair of positioning stoppers provided in said test head area along a moving direction of said test tray, said positioning stoppers are spaced by the distance equal to the distance of said IC devices to be tested in said test tray;

wherein said distance of said contactors is adjusted to an integer multiple of said distance of said IC devices to be tested in said test tray, one of said positioning stoppers contacts said test tray to determine a first position for testing said IC devices in a first line in said test tray, and then said test tray is transferred until other positioning stoppers contacts said test tray in a second position for testing said IC devices in a second line in said test tray, said test tray being transferred to said discharge area after said testing.

2. An automatic handler as defined in Claim 1, further includes an additional pair of said positioning stoppers corresponding to an increase in a number of said test head area in said IC test system.

3. An automatic handler as defined in Claim 1, wherein



said positioning stopper includes a projection which expands or retracts to positioning said first and second positions of said test tray. This is the replacement sheet

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4. An automatic handler as defined in Claim 1, wherein said test tray includes a flat surface to meet with said projection of said positioning stopper, said first position and second position are determined when said flat surface contacts said projections of said pair of positioning stoppers.

5. A mechanism in an automatic handler for positioning a test tray having a large number of IC devices to be tested aligned therein, comprising:

a stopper which determines a first position of said test tray when said stopper contacts with an outer surface of said test tray and a second position of said test tray when said stopper contacts with a wall of a groove provided on said test tray;

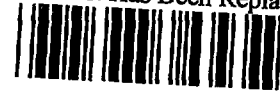
wherein a distance from said outer surface and said wall is equal to or an integer multiple of a distance between adjacent said IC devices in said test tray.

6. A mechanism for positioning a test tray as defined in Claim 5, wherein:

said stopper is comprised of two stopper mechanism independently operable from one another, said two stopper mechanism is separated by a distance equal to said distance of said IC devices in said test tray;

said distance from said outer surface of said test tray and said wall of said groove is equal to two times of said distance of said two stopper mechanism;

whereby said test tray is adjusted in four positions



each of which is apart by the distance between said two stop
per mechanism. ^{This is the replacement sheet}

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7. A mechanism for positioning a test tray as defined in Claim 6, wherein said stopper is comprised of three or more stopper mechanism, and said test tray includes two or more grooves, thereby realizes more than five test positions for said IC devices to be tested.

8. A method for transferring a test tray of an automatic handler for an IC test system wherein said test tray on which devices to be tested are aligned in an array is transferred to a test head area to test said devices to be tested thereat, and is transferred to a discharge area characterized in that comprising steps of:

said test tray is stopped a plurality of times at an interval of an integer multiple of the array spacing along the transfer direction of the devices to be tested on the test tray in said test head area; and

at each stop position of said test tray, a different device on said test tray is tested.

9. The method as defined in Claim 8 characterized in that the stop position interval of the test tray is equal to the array spacing, each of the intervals of device contactors of said test head area along said transfer direction is n times (n is an integer equal to or greater than 2) of said device array spacing, and the number of positions where said test tray stops is n .

10. The method as defined in Claim 8 characterized in that each of the stop position intervals of the test tray is p times (p is an integer equal to or greater than 2) of said



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device array spacing, the number of test head areas provided along a moving direction of said test tray is p , and at each initial stop position of said each test head area, different one of first p lines of devices along the moving direction of the test tray from the initial stop position are tested respectively.

11. The method as defined in Claim 10 characterized in that the interval of the device contactors along the moving direction of the test tray is $p \cdot n$ times (n is an integer equal to or greater than 2) of said device array spacing and the number of stop positions of said test tray is n .

12. The method as defined in either one of Claims 8-11 characterized in that test tray stoppers are provided corresponding to said respective stop positions so that each of the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, and said test tray is stopped at each of said stop positions by controlling those stoppers.

13. The method as defined in either one of Claims 8-11 characterized in that a test tray stopper is provided corresponding to the first stop position so that the stopper can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with the stopper in the state that the stopper is projected on the test tray path are provided on the test tray at said stop position intervals along the moving direction of the test tray, the number of said engaging parts is equal to the number of the stop positions, and said test tray is stopped at each of said stop positions by controlling said stopper.



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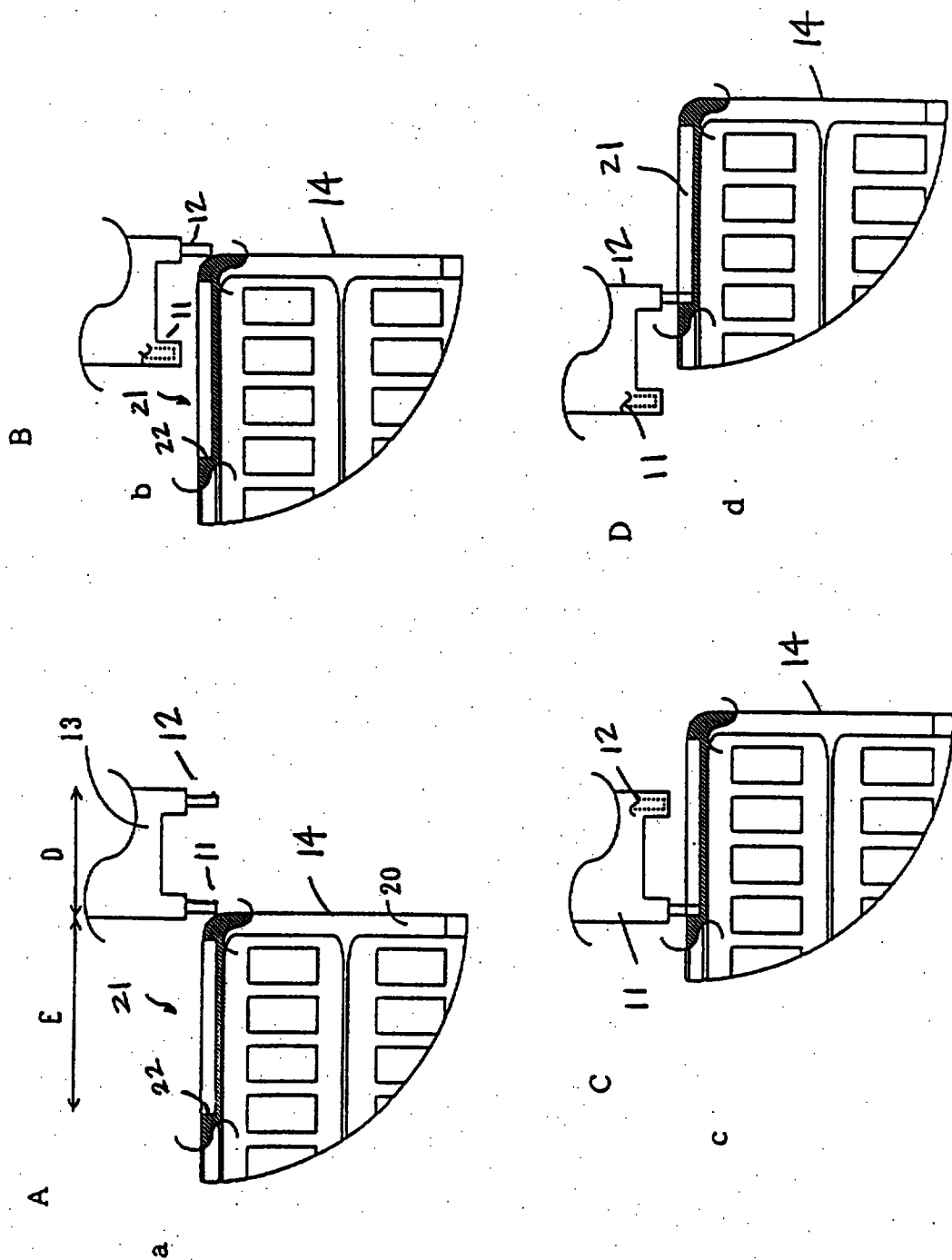


14. The method as defined in either one of Claims 8-11 characterized in that two test tray stoppers are provided at said stop position intervals along the moving direction of the test tray corresponding to the first and the second stop positions respectively so that each of said two stoppers can be controlled to be projected on the test tray path or to be removed from the test tray path, engaging parts which are to be engaged with one of the two stoppers in the state that one of the two stoppers is projected on the test path are provided on the test tray at the two time interval of the distance between said stoppers along the moving direction of the test tray, the number of said engaging parts is one second of said number of stop positions, and said test tray is stopped at each of said stop positions by alternately controlling said stoppers to be positioned on the test tray path.

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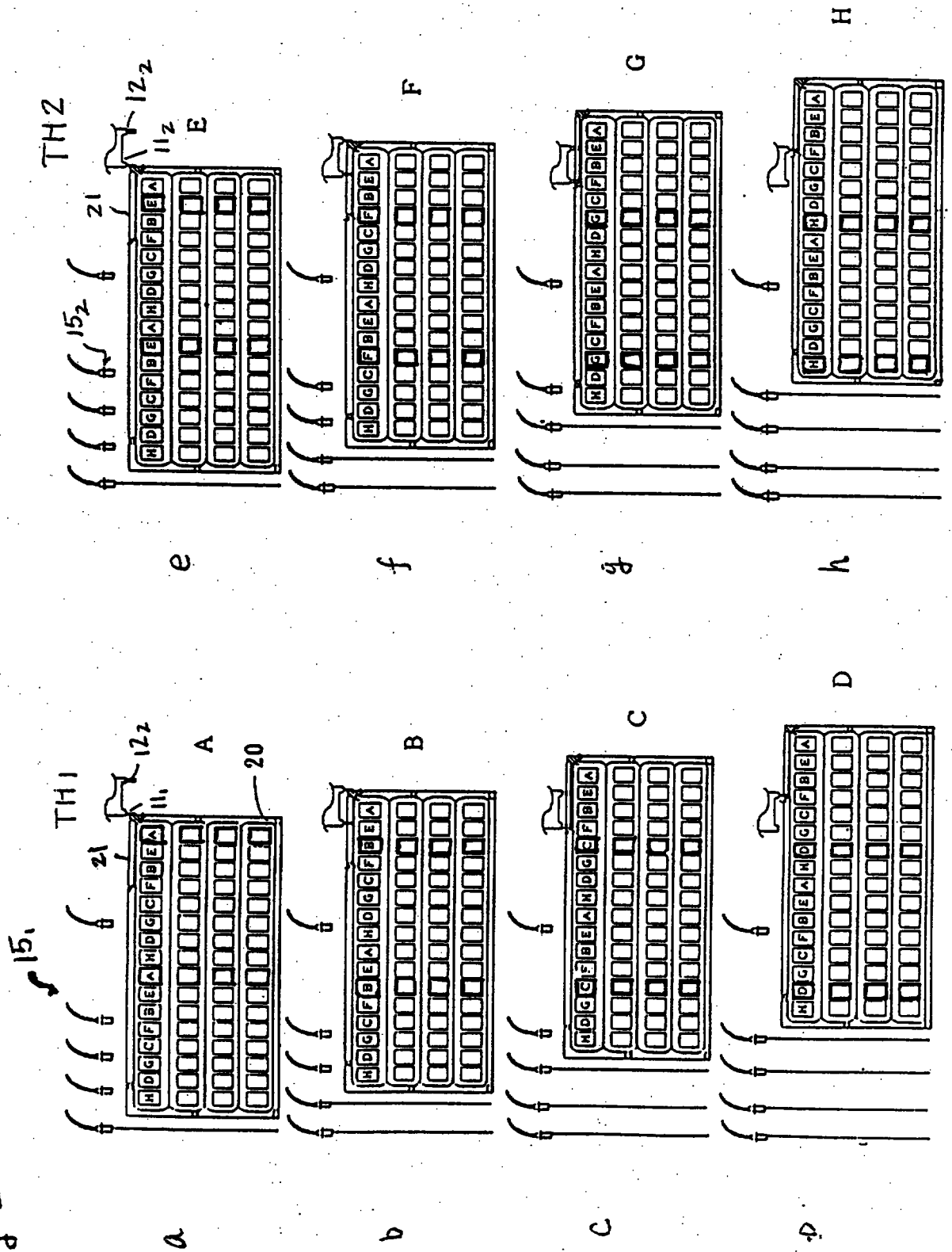
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Fig. 1



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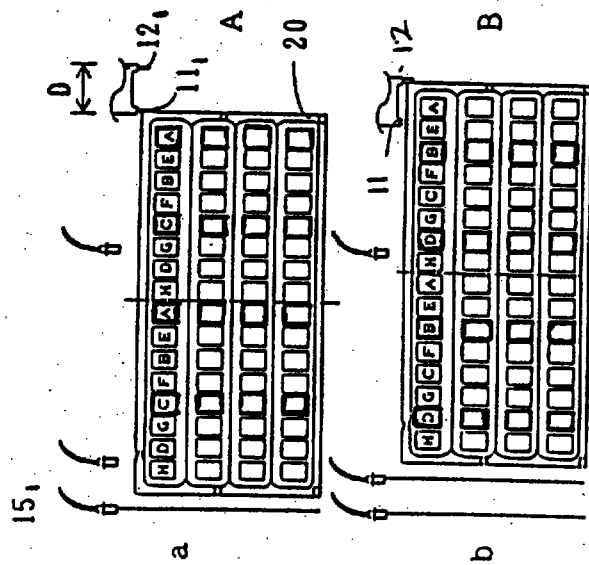
Fig. 2



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Fig. 3

TH1



TH2

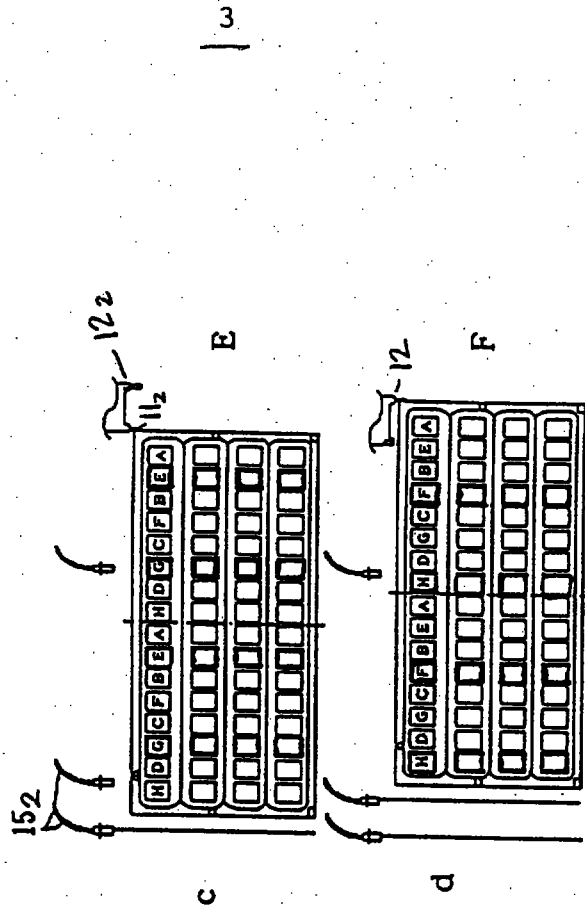
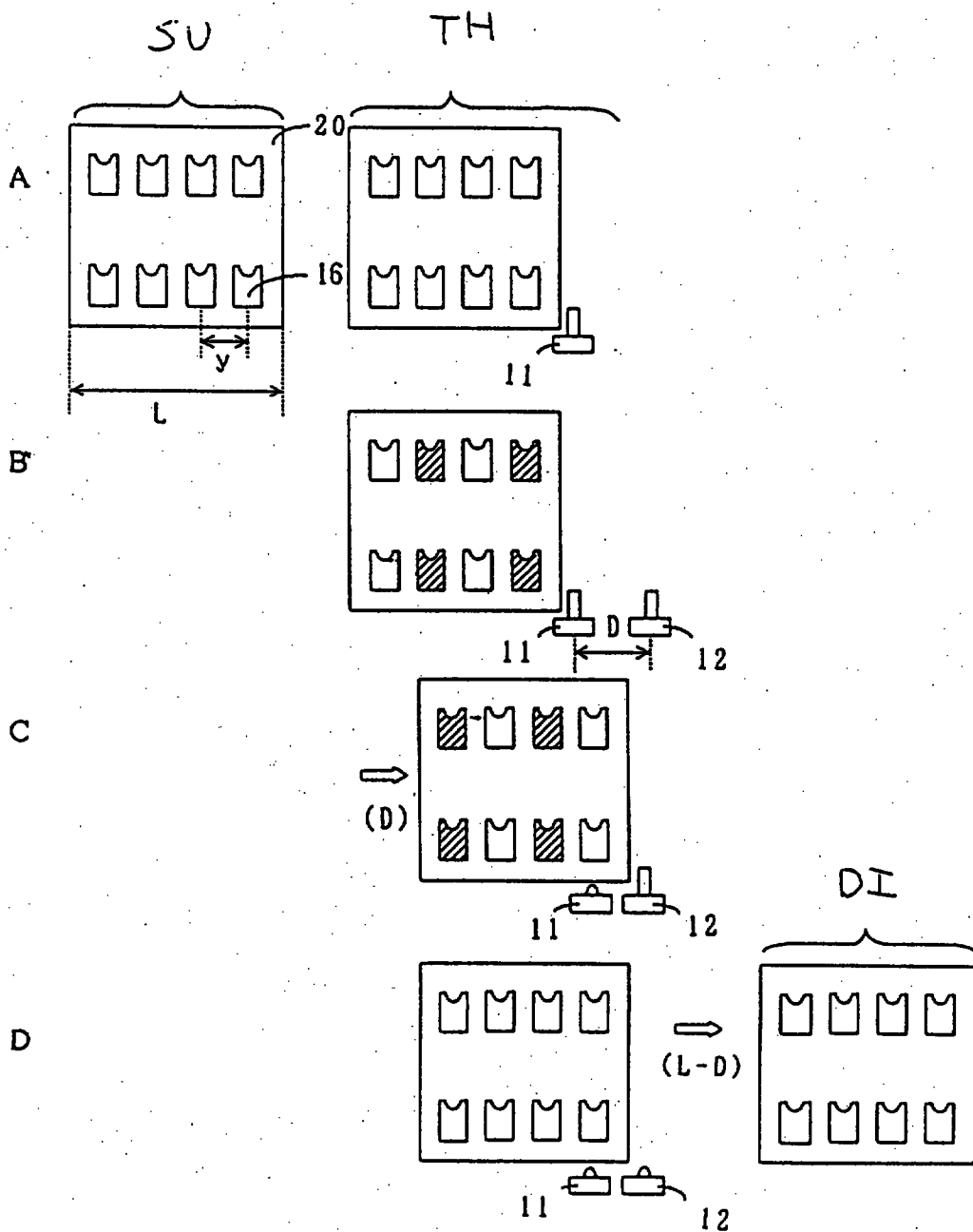


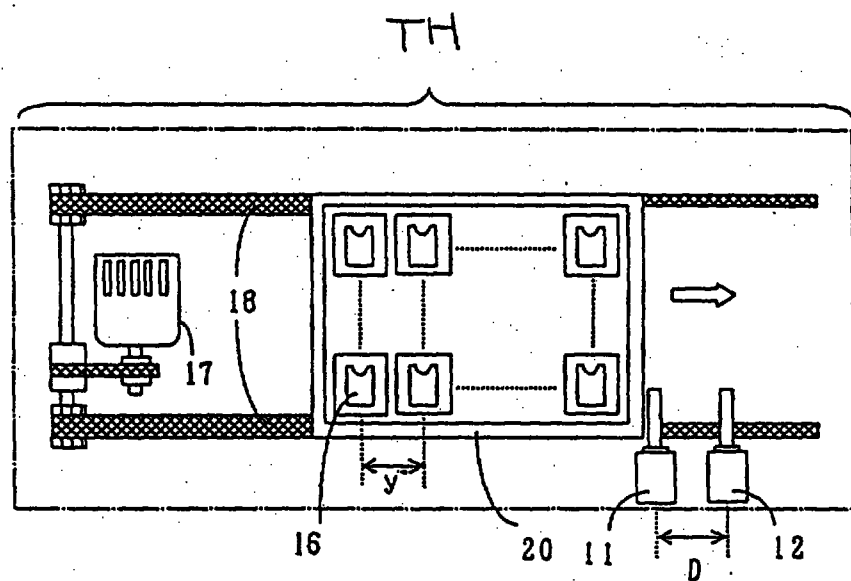
Fig. 4



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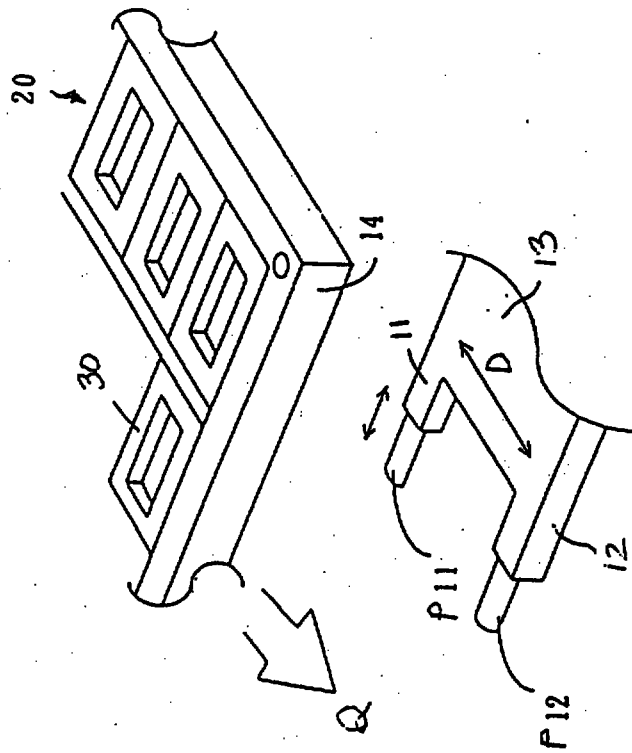
Fig. 5



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Fig. 6



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Fig. 7

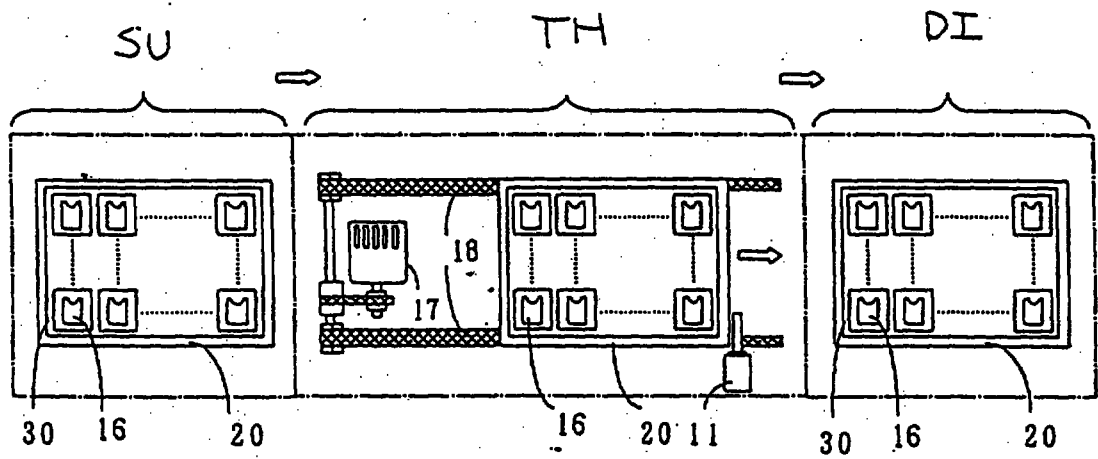
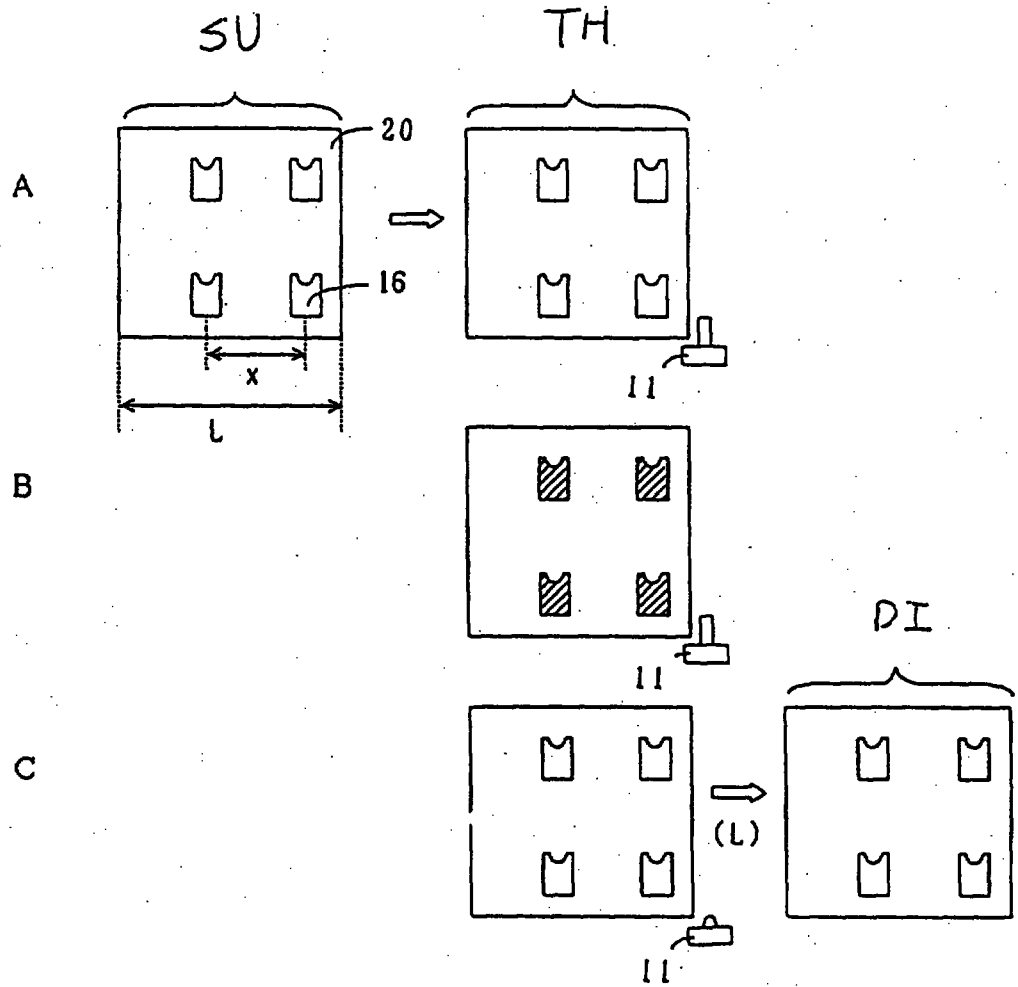


Fig. 8

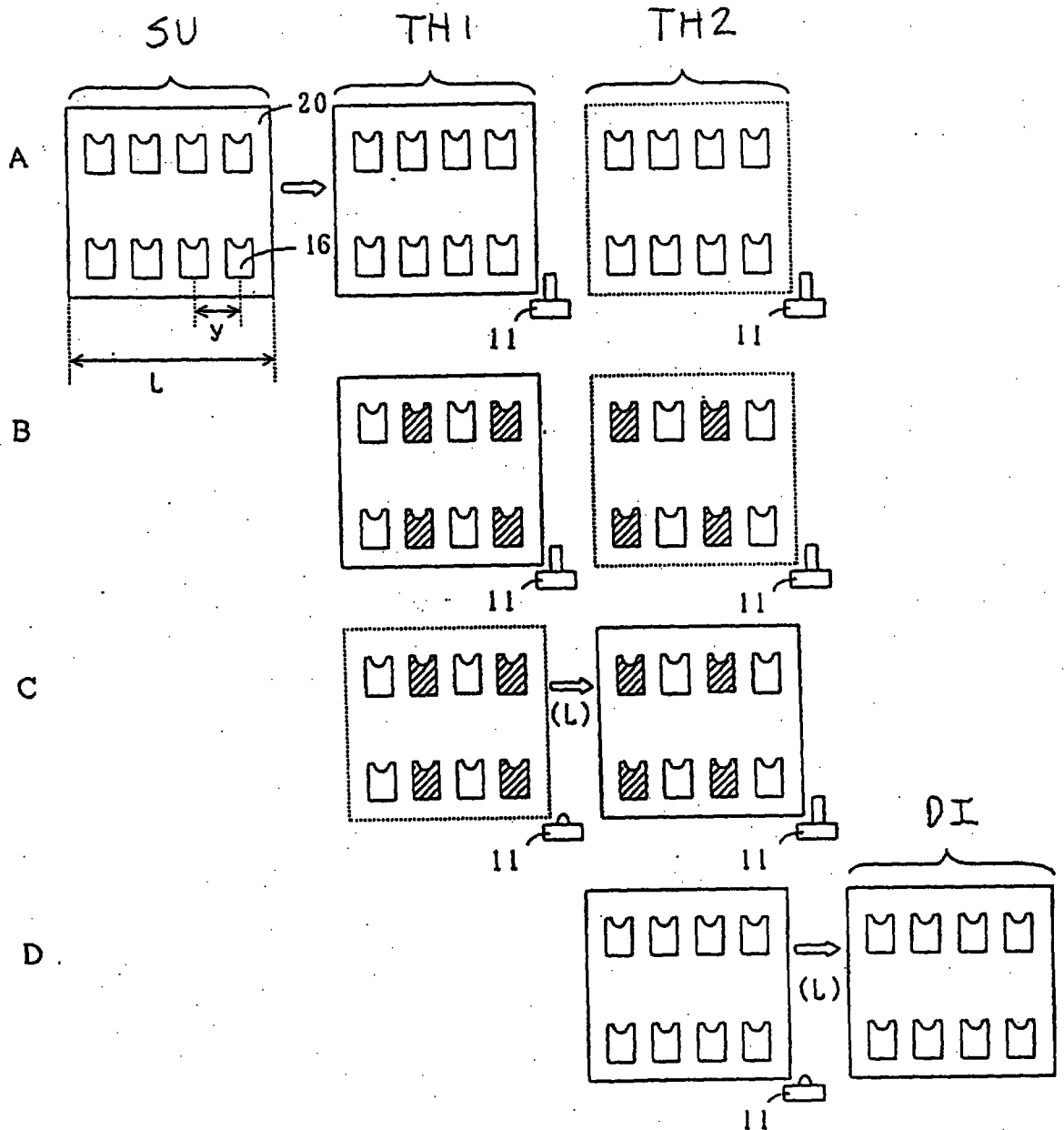
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Fig. 9

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AUTOMATIC HANDLER FOR IC TEST SYSTEM, TEST TRAY
STOPPING MECHANISM AND TEST TRAY TRANSFERRING
METHOD FOR AUTOMATIC HANDLER OF IC TEST SYSTEM

ABSTRACT

A handler includes a tray for loading IC devices in which the IC devices are aligned in the tray with a shorter
5 distance with one another than a distance between test contactors and a pair of positioning stoppers provided in a test head area along a moving direction of the tray in which the positioning stoppers are spaced by the distance equal to the distance of the IC devices in the tray. In
10 the handler, the distance of the contactors is adjusted to an integer multiple of the distance of the IC devices in the tray. One of the positioning stoppers contacts the tray to determine a first position for testing the IC devices in a first line in the tray, and then the tray is
15 transferred until other positioning stoppers contacts the tray in a second position for testing the IC devices in a second line in the tray.

Figure 3

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CLAIMS:

1. An automatic handler for an IC test system to test IC devices by transferring the IC devices from a supply area to a test head area which has a plurality of test contactors and further transferring the tested IC devices from the test head area to a discharge area, comprising:

a test tray for loading said IC devices to be tested, said IC devices to be tested are aligned in said test tray with a distance between one another which is shorter than a distance between said test contactors in said test head area;

a pair of positioning stoppers provided in said test head area along a moving direction of said test tray, said positioning stoppers are spaced by the distance equal to the distance of said IC devices to be tested in said test tray;

wherein said distance of said contactors is adjusted to an integer multiple of said distance of said IC devices to be tested in said test tray, one of said positioning stoppers contacts said test tray to determine a first position for testing said IC devices in a first line in said test tray, and then said test tray is transferred until other positioning stoppers contacts said test tray in a second position for testing said IC devices in a second line in said test tray, said test tray being transferred to said discharge area after said testing.

2. An automatic handler as defined in Claim 1, further includes an additional pair of said positioning stoppers corresponding to an increase in a number of said test head area in said IC test system.

3. An automatic handler as defined in Claim 1, wherein

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said positioning stopper includes a projection which expands or retracts to positioning said first and second positions of said test tray.

4. An automatic handler as defined in Claim 1, wherein said test tray includes a flat surface to meet with said projection of said positioning stopper, said first position and second position are determined when said flat surface contacts said projections of said pair of positioning stoppers.

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AUTOMATIC HANDLER FOR IC TEST SYSTEM, TEST TRAY
STOPPING MECHANISM AND TEST TRAY TRANSFERRING
METHOD FOR AUTOMATIC HANDLER OF IC TEST SYSTEM

ABSTRACT

A handler includes a tray for loading IC devices in which the IC devices are aligned in the tray with a shorter
5 distance with one another than a distance between test contactors and a pair of positioning stoppers provided in a test head area along a moving direction of the tray in which the positioning stoppers are spaced by the distance equal to the distance of the IC devices in the tray. In
10 the handler, the distance of the contactors is adjusted to an integer multiple of the distance of the IC devices in the tray. One of the positioning stoppers contacts the tray to determine a first position for testing the IC devices in a first line in the tray, and then the tray is
15 transferred until other positioning stoppers contacts the tray in a second position for testing the IC devices in a second line in the tray.

Figure 3