APPARATUS FOR POSITIONING AN IC

TECHNICAL FIELD

This invention relates to an IC positioning apparatus or device (hereinafter referred to as positioner) for use in an IC transporting and processing system (commonly known as IC handler) for transporting semiconductor devices (typically ICs, i.e. semiconductor integrated circuits) through a test section and sorting the tested ICs on the basis of the test results, and particularly to an IC positioner which is capable of accurately positioning an IC having very thin IC leads vulnerable to distortion such as an IC provided with numerous finely pitched leads without distorting the IC leads, and which allows the thus positioned IC to be externally inspected from the lateral sides thereof for any distortion of the IC leads.

BACKGROUND ART

A semiconductor testing apparatus (commonly known as IC tester) for testing ICs employs an IC handler usually integrally incorporated therein for transporting devices to be tested, i.e. devices under test (commonly called DUT) to perform a predetermined test.

An example of the prior art IC handler called "forced horizontal transporting system" is shown diagrammatically in Fig. 1. The illustrated IC handler 10 comprises a loader section 11 where ICs 15 to be tested which a user has beforehand loaded on a customer (user) tray 13 are transferred and reloaded onto a test tray 14 capable of withstanding high/low temperatures, a constant temperature or thermostatic chamber 20 including a test section 21 for receiving and testing the ICs from the loader section 11, and an unloader section 12 where the tested ICs 15 which

have been carried on the test tray 14 out of the constant temperature chamber 20 subsequently to undergoing a test in the test section 21 are transferred from the test tray 14 to the customer tray 13 to be reloaded on the latter (generally, the tested ICs are often sorted into categories based on the data of the test results and transferred onto the corresponding customer trays 13). Depending upon the type of ICs to be tested (in the case of the surface mount type ICs or the like packaged in a dual-in-line flat packages, for example), each IC may be loaded on an IC carrier, and then the IC carrier loaded with the IC may be placed on a customer tray.

The test tray 14 is moved in a circulating manner from and back to the loader section 11 sequentially through the constant temperature chamber 20 and the unloader section 12. More specifically, the test tray 14 loaded with a plurality of (for example, 64) ICs 15 to be tested is transported from the loader section 11 to a soak chamber 22 within the constant temperature chamber 20 where the ICs 15 placed on the tray 14 are heated or cooled to a predetermined constant temperature. Generally, the soak chamber 22 is adapted to store a plurality of (say, nine) test trays 14 stacked one on another such that a test tray 14 newly received from the loader section 11 is stored, for example, at the bottom of the stack while the uppermost test tray is carried to the test section 21.

The ICs 15 to be tested are heated or cooled to a predetermined constant temperature while the test tray 14 is moved from the bottom to the top of the stack within the soak chamber 22. The heated or cooled ICs 15 together with the test tray 14 are then transported while maintained at the constant temperature from the soak chamber 22 to the test section 21 where the ICs under test are brought into

electrical contact with sockets (not shown) disposed in the test section 21 and are measured for their electric characteristics.

Upon completion of the test, the tested ICs 15 are transported from the test section 21 to an exit chamber 23 where they are restored to the ambient temperature. Like the soak chamber 22, the exit chamber 23 is also adapted to accommodate test trays in the form of a stack. For example, the arrangement is such that the tested ICs 15 are brought back to the ambient temperature as the associated test tray is moved sequentially from the top to the bottom of the stack within the exit chamber 23. Thereafter, the tested ICs 15 as carried on the test tray 14 are passed to the unloader section 12 where the tested ICs are sorted into categories based on the data of the test results and transferred onto the corresponding customer trays 13. The test tray 14 emptied in the unloader section 12 is delivered back to the loader section 11 where it is again loaded with ICs 15 to be tested from the customer tray 13 to repeat the same steps of operation as mentioned above.

It is to be noted that the transfer of ICs already tested as well as ICs to be tested between the customer tray 13 and the test tray 14 is typically effected by suction transport means utilizing a vacuum pump which may pick up one to several ICs at a time for the transfer.

While the IC handler 10 illustrated in Fig. 1 is of the type which is configured to transport ICs under test as placed on the tray, IC handlers of the type adapted to transport ICs under test individually are also currently used.

In the illustrated example, the test section 21 is so arranged that those in odd-numbered rows, for example, of

the ICs under test carried on one test tray 14 are first tested, followed by those in even-numbered rows being tested. For this reason, two test trays 14 are shown in the test section 21. This is because the number of ICs to be tested at one time by an IC tester is limited (say, up to thirty-two), while too many (sixty-four, for example) ICs to be tested at one time are carried on one test tray in this example. One test tray is adapted to accommodate sixty-four ICs in a matrix of 4 columns × 16 rows.

It is also to be noted that there is still another type of IC handlers in which ICs to be tested are sequentially transferred from the tray into a socket or sockets for the test at a time and upon the test being completed the IC or ICs are transferred from the socket or sockets back onto the tray, in the test section 21.

As described above, ICs to be tested are transported by the IC handler 10 from the loader section 11 to the test section 21 whence upon completion of the test they are passed to the unloader section 12. In the test section 21, the ICs to be tested undergo a test for their electric characteristics while they are electrically connected with IC sockets which are supplied with signals of a predetermined test pattern from an IC tester. ICs to be tested and ICs already tested are transferred from one to another tray, from a tray to transfer means, or from transfer means to a tray at various locations as required while being transported by the IC handler. It is required that ICs to be tested and ICs already tested be reliably and accurately positioned during the transfer, and yet IC leads of each of them must not be deformed.

Different positioners have heretofore been employed to position ICs in an IC handler, depending on the strength of leads of an IC being positioned. For an IC to be

positioned having relatively strong IC leads, an IC positioning device or positioner 30 as illustrated in Figs. 2 and 3 has been used. The IC positioner 30 comprises a generally rectangular box-like frame 31 having a upwardly open pocket 33 for accommodating an IC 32. The pocket 33 comprises a rectangular lower recess 33a having four vertical side walls and a bottom wall so shaped as to conform with the outer dimensions of the mold (package) 32M and leads 32L of the IC 32, and upper wall portions 34 extending upwardly and outwardly tapered from the upper ends of the vertical side walls of the recess 33a. The IC 32 to be positioned is transported or transferred from another location to a position above the pocket 33 of the positioner 30 whereupon it is released from a suction pick-up means to be allowed to fall. As a result, the IC 32 falls by gravity down into the pocket 33 to be accommodated in the bottom recess 33a as it is guided along the tapered walls 34 with the leads 32L sliding down the tapered walls 34. The IC 32 is thus positioned in place. If an IC 32 to be positioned is square in shape, it is needless to say that the recess 33a is formed to have a complementary square shape in plan view and have four vertical side walls.

When an IC to be positioned has relatively weak leads, there is a great possibility that the leads of the IC being positioned may be distorted as they are in sliding contact with the tapered wall of the pocket. For this reason, an IC positioning device or positioner 40 as illustrated in Figs. 4 and 5 has been used, instead of the IC positioner 30 of the gravity-falling type as shown in Figs. 2 and 3.

The IC positioner 40 comprises a generally rectangular box-like frame 41 having a central opening 42 extending

therethrough and a movable bottom block 44 mounted for vertical movements through the central opening 42. The through opening 42 comprises a rectangular lower IC positioning aperture 42a having four vertical side walls and so shaped as to conform with the outer dimensions of the mold (package) 32M and leads 32L of the IC 32, and upper wall portions 43 extending upwardly and outwardly tapered from the upper ends of the vertical side walls of the aperture 42a. The movable bottom block 44 is vertically movable in the through aperture 42a between an IC loading position as shown in Fig. 4 where the top surface of the bottom block 44 extends more or less above the top surface of the frame 41 and an IC storing position as shown in Fig. 5 where the top surface of the bottom block 44 is located in the through aperture 42a at a middle height thereof, that is, where a pocket-like recess for storing and positioning an IC 32 is formed.

When an IC is to be positioned, the movable bottom block 44 is moved to the IC loading position shown in Fig. 4. The IC to be positioned is then transported or transferred from another location to a position above the movable bottom block 44 of the positioner 40 whereupon it is released from a suction pick-up means. As a result, the IC 32 is allowed to drop and rest on the the top surface of the bottom block 44 as shown in Fig. 4. From this position the movable bottom block 44 with the IC carried thereon is moved down to reach the IC storing position shown in Fig. 5 where the IC 32 is positioned in place as shown. During this process if the leads 32L of the IC 32 on one side thereof for example protrude laterally more or less from the top surface of the bottom block 44, those leads are moved downwardly in sliding contact with the corresponding tapered side wall 34 to reach the IC storing position shown

in Fig. 5, whereby the IC 32 may be positioned in place.

It should here be noted that the tested IC is subjected to inspection for the external appearance of its IC leads while it is transported from the exit chamber 23 of the constant temperature chamber 20 to the unloader section 12. The external inspection of IC leads is generally carried out by photographing the forward ends (end faces of the horizontal legs) of the IC leads from laterally with a camera. Taking an IC having IC leads extending in four directions therefrom as an example, since a single camera is usually used to photograph, the IC leads protruding from the four sides of the IC are sequentially photographed by rotating the IC four times, each time by 90° . Accordingly, in order to effect the external inspection it is required to position the IC precisely in a predetermined position for inspection. In the prior art, the positioners 30 and 40 as described above are used to this end as well. Of course, such positioners are used at various locations requiring the positioning of ICs.

With a recent enhancement in the degree (density) of integration of IC, the number of leads protruding from the IC package is increased with a decrease in the lead spacing (reduction in the lead pitch) and a substantial reduction in the thickness of leads. If one or more of the leads of an IC positioned by the aforesaid positioner 30 or 40 should be distorted by the positioner or due to some cause or other in transit, the IC would be sorted into the group of failure in the unloader section 12, because in the case of a surface mount type IC, for example, one or more distorted leads would make it hard to mount the IC on a printed circuit board. Since ICs such as memories are finely grouped into four classes of non-failures and four classes of failures in the unloader section 12, the

external inspection of IC leads is of great importance.

With the construction of the IC positioner as illustrated in Figs. 2 and 3, neither it can be effectively used to position ICs having IC leads with a reduced pitch, nor can it permit the external inspection of IC leads because the IC is stored in the pocket 33 surrounded by walls on all sides thereof. Consequently, it is required to remove the IC from the pocket 33 in the next step to carry out the external inspection. This not only adds to the number of steps required, but also may increase the risk of distorting the IC leads when the IC is removed from the pocket.

With the construction of the IC positioner as illustrated in Figs. 4 and 5, it would be possible to effect the external inspection of IC leads by moving the movable bottom block 44 to the IC loading position of Fig. 4. As discussed above, however, if the leads 32L of the IC 32 protrude laterally more or less from the top surface of the bottom block 44, those leads are moved downwardly in sliding contact with the tapered side wall 34 to reach the IC storing position shown in Fig. 5. Consequently, in the case of an IC having closely pitched weak IC leads, the leads are susceptible to distortion, with the result that the IC will be labeled as failure in the external inspection in the final stage. Another problem is that should the IC leads become distorted during the positioning operation before the IC is transported into the constant temperature chamber 20, it may be a cause of failure in contact between the leads and the IC socket during the subsequent electric testing in the test section 21, resulting in interference with the electric testing.

DISCLOSURE OF THE INVENTION

It is an object of this invention to provide an IC positioner which is capable of positioning an IC in place reliably and accurately without distorting the IC leads even if the IC has a multiplicity of very thin leads with a fine pitch.

Another object of this invention is to provide an IC positioner which permits the external inspection of IC leads to be effected reliably and easily by a simple operation after the IC is accurately positioned in place.

According to the present invention, an IC positioner for use in an IC handler for transporting ICs through a test section and sorting the tested ICs on the basis of the test results is provided. The IC positioner comprises a base including an elongated bar having a pair of legs formed at its longitudinal opposite ends; an IC positioning stand mounted on the upper surface of the bar generally at the center thereof for placing an IC thereon to be positioned in place; a support for supporting the base; a pair of pivot pins extending generally horizontally toward each other from the inner surfaces of the associated legs; a pair of positioning arms mounted on the respective pivot pins for pivotal movements thereabout, each of the positioning arms having an IC abutment portion at the forward end thereof, the rearward end portion of each of the positioning arms extending rearwardly from the associated pivot pin being heavier than the forward end portion; and an actuator adapted to abut against the positioning arms at their rearward ends to swing the arms simultaneously about the pivot pins; the IC abutment portion of each of the positioning arms being so formed on the forward end as to abut against and be stopped by the corresponding corner of the IC positioning stand when the rearward end of each of the positioning arms is in its free

lower position, and as the actuator is actuated to abut against the rearward ends of the positioning arms to raise the rearward ends, the positioning arms are pivotally moved so that the IC abutment portions at the forward ends of the arms are lowered downwardly of and outwardly away from the IC positioning stand whereby all of the side surfaces of the IC positioning stand are exposed.

In a preferred embodiment, the support for supporting the base is a columnar support, and the actuator is in the form of a planar plate having an opening formed therethrough for loosely receiving the columnar support and adapted to be moved vertically relative to the support. The columnar support rotatably supports the base and the IC positioning stand. Each of the positioning arms is generally in the shape of L. The IC abutment portion is formed on the forward end of one leg of the L-shape while the other leg is pivotally supported by the associated pivot pin. Each of the abutment portions is formed with a generally right-angled recess to fit in complementary abutting engagement with the corresponding corner of the IC positioning stand.

Preferably, the base, the IC positioning stand and the pair of positioning arms are built up as a unitary assembly. It is possible to position ICs of various types, configurations and sizes accurately and reliably by removably mounting the unitary assembly on the support.

In addition, the IC positioning stand 55 is square or rectangular in shape and is slightly larger than the external dimensions of the leads of an IC being placed on the stand whereby the corners of the stand may serve as stop means to limit the movement of the corresponding IC abutment portions of the positioning arms so as to prevent excessive stresses which otherwise might distort the leads

of an IC to be positioned from being exerted on the leads.

With the construction of this invention as described above, as the opposed IC abutment portions of the two positioning arms are closing towards each other due to the arms' own weights only, the right-angled recesses of the IC abutment portions push on the leads of the IC with a very slight force. Moreover, the rate at which the IC abutment portions are moving to their closed position can be controlled by regulating the rate at which the actuator is lowered. In addition, since each right-angled recess simultaneously pushes on a plurality of leads on each of the adjoining side walls of an IC, the stress exerted on each of the leads may be noticeably reduced as compared with the prior art positioning apparatus. It is thus to be appreciated that the positioner of this invention is capable of positioning an IC in place accurately without distorting the IC leads.

What is more, upon the IC being positioned in place, the IC abutment portions of the positioning arms may be moved downwardly and outwardly out of engagement with the positioning stand by moving the actuator upwardly. All the side surfaces of the IC placed on the positioning stand may be completely exposed so that the external inspection of the IC leads by the use of a single camera may be easily carried out. Further, it is possible to effect the external inspection of the IC leads on any side wall of the IC by rotating the columnar support.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagrammatical illustration of the general arrangement of a conventional IC handler in the form of a forced horizontal transporting system;

Fig. 2 is a perspective view of an example of the

prior art IC positioner for use on an IC having relatively strong IC leads;

Fig. 3 is a cross-sectional view of the IC positioner of Fig. 2, illustrating the IC being positioned;

Fig. 4 is a cross-sectional view of an example of the prior art IC positioner for use on an IC having relatively weak IC leads illustrating the positioner being in its IC loading position;

Fig. 5 is a cross-sectional view of the IC positioner of Fig. 4 illustrating the positioner being in its IC positioning position;

Fig. 6 is a perspective view of an embodiment of the IC positioner according to this invention illustrating the positioner being in the position for locating an IC;

Fig. 7 is a perspective view of the IC positioner of Fig. 6 illustrating the positioner being in the position for permitting the external inspection of IC leads; and

Fig. 8 is a perspective view of an assembly of a rotary stage, a pair of positioning arms, and an IC positioning stand used in the IC positioner of Fig. 6.

BEST MODES FOR CARRYING OUT THE INVENTION

One embodiment of the invention will be described in details with reference to the accompanying drawings. Like numerals indicate like elements throughout all the drawings.

Figs. 6 and 7 illustrate the construction of an embodiment of the IC positioner according to this invention. While the invention is described herein as applied to an IC positioner for use in an apparatus for inspecting the external appearance of IC leads which is disposed in the path of ICs subjected to the electrical testing being transported to the unloader section 12 (see

Fig. 1), it is to be understood that this invention is applicable to positioning ICs at any other location than that for the external inspection in the IC handler.

As shown in Figs. 6 and 7, the illustrated IC positioning device or positioner 50 comprises a rotary stage or base 53 including a generally rectangular elongated bar 51 having a pair of integral legs 52, 52 (only one of which is visible in the drawings) depending therefrom at its opposite ends, a generally square-shaped IC positioning stand 55 mounted on the upper surface of the bar 51 generally at the center thereof, a rotary shaft 54 mounted to the bar 51 generally at the center thereof for supporting the rotary stage 53 and the IC positioning stand 55 for rotation together with the shaft in a horizontal plane, a pair of positioning arms 57, 57 pivotally mounted on respective pivot pins 56, 56 (only one of which is visible in the drawings) extending toward each other from the inner surfaces of the associated legs 52 for vertical pivotal movements, and a planar plate-like actuator 58 mounted for movements axial of the rotary shaft 54 and adapted to abut against the positioning arms 57 to swing the both arms simultaneously about the pivot pins 56.

The rotary shaft 54 is rotatively driven to any desired angular position by any conventional suitable drive means, not shown. As the rotary stage 53 and positioning stand 55 are rotated in unison with the rotary shaft 54, the stand 55 may be indexed to any desired angular position. The positioning stand 55 is a stand onto which an IC is loaded from an other location and on which the IC may be positioned in place, and further serves as stop means to limit the movement of the positioning arms 57 by the four side walls of the stand 55. In this regard, the external dimensions of the positioning stand 55 are such as

to be slightly larger than the outlines of the outermost ends of the IC leads 32L of the IC being positioned in order to prevent the IC leads from being deformed.

In the illustrated embodiment, the planar plate-like actuator 58 has an opening 59 formed therethrough for loosely receiving the rotary shaft 54 and is adapted to be moved vertically by any conventional suitable drive means, not shown. While the IC positioning stand 55 is shown as generally square-shape in a plan view in the illustrated embodiment, it is just because the IC 32 to be positioned is a surface-mounting type IC having leads protruding from four sides of its generally square mold (package), it is a matter of course that the shape and dimensions of the positioning stand 55 may be varied depending on the shape and dimensions of the IC to be positioned.

Actually, the rotary stage 53, IC positioning stand 55 and the pair of positioning arms 57 are built up as an assembly and aligned apertures 62 are formed through the rotary stage 53 and IC positioning stand 55 to receive the rotary shaft, as shown in Fig. 8. The assembly is thus a change kit which is removably secured to the rotary shaft 54 for rotation therewith by fitting the shaft receiving apertures over the upper end portion of the rotary shaft. It is accordingly possible to accommodate various types, shapes and sizes of ICs for positioning by exchanging such change kits.

It is to be noted that the IC positioning stand 55 is fixed to the top surface of the bar 51 of the rotary stage 53 such that bisectors of one pair of diagonally opposed right-angled corners or apices of the stand 55 lie on or in parallel with a line perpendicular to the longitudinal axis of the bar 51 and that bisectors of the other pair of diagonally opposed right-angled corners or apices of the

stand 55 lie on or in parallel with a line parallel to the longitudinal axis of the bar 51. In the illustrated embodiment where the IC positioning stand 55 is of a square shape, the stand 55 is fixed to the bar 51 such that one of the diagonal lines of the square stand extends parallel to the longitudinal axis of the bar 51 while the other of the diagonal lines intersects orthogonally with the longitudinal axis of the bar 51.

As the pair of positioning arms 57 are identical in shape and construction, only one of them will now be described in more details. In the illustrated embodiment the positioning arm 57 is generally L-shaped in a plan view with the longer leg 57a of the L-shaped arm being pivotally supported generally at a mid-point by the pivot pin 56 for swinging motions in a vertical plane. The shorter leg 57b of the L-shaped positioning arm 57 is made to have a greater thickness than the longer leg 57a and has an IC abutment portion 61 formed at its forward end integrally therewith, the abutment portion 61 having a generally right-angled recess 60 (a recess having two walls forming an angle of 90° with each other). As will be described later, the IC abutment portions 61 of the pair of positioning arms 57 are configured such that when it is desired to position an IC in place, the right-angled recesses 60 will abut with a pair of opposed corners of the IC, respectively to move the IC to a proper position. The weight of each of the positioning arms 57 is so distributed that the lower end portion of the longer leg 57a is in its lowered position while the right-angled recess 60 of the IC abutment portion 61 of the shorter leg 57b is in abutment with one of the corners of the IC positioning stand 55 as shown in Fig. 8, when the positioning arm 57 is in its normal freely swingable

position in which it is supported by the pivot pin 56 alone (that is, the state in which the actuator 58 is lowered out of engagement with the positioning arm 57). In other words, the longer leg 57a is weighted so as to be heavier with respect to the pivot pin 56 than the shorter leg 57b.

The operation of the IC positioner constructed as described above will be as follows:

The planar plate-like actuator 58 is moved upward by the associated drive means while no IC to be positioned is placed on the positioning stand 55. This brings the top face of the actuator 58 into abutment against the lower ends of the longer legs 57a of the pair of positioning arms 57, so that as the actuator 58 is moved upwardly, the lower ends of the longer legs 57a of the positioning arms 57 are raised to swing the positioning arms 57 about the respective pivot pins 56 whereby the IC abutment portions 61 at the forward ends are lowered outwardly and downwardly out of engagement with the positioning stand 55. As is seen in Fig. 7, when the actuator 58 is raised to its uppermost position, the pair of IC abutment portions 61 are lowered below the top surface of the positioning stand 55 and away from the stand. At that position the upper surfaces of the lower end portions of the longer legs 57a abut against the lower surface of the elongated bar 51 of the rotary stage 53, and hence the actuator 58 can be no longer moved upwardly.

An IC to be positioned is deposited on the positioning stand 55 by some other suitable transportation means or transfer means. During this operation, upon being transported or transferred to a position overlying the stand 55, the IC 32 is released from suction pick-up means (not shown), so that it may be deposited on the positioning stand 55 in a position offset angularly and/or

longitudinally or transversely with respect to the stand, as seen in Fig. 7. For this reason, the IC may sometimes be initially placed on the stand 55 with a portion thereof projecting beyond the outline of the stand.

Starting with this state, as the actuator 58 is gradually moved downward, the pair of positioning arms 57 are caused to slowly swing in an opposite direction due to the heavier lower end portions of the longer legs 57a with the IC abutment portions 61 at the forward ends of the positioning arms 57 moving toward the positioning stand 55 and each other. As the IC abutment portions 61 of the positioning arms 57 are closing toward each other, they abut against and push on the leads 32L of the IC 32 with a very slight force. The horizontal length of each side wall of the right-angled recess 60 is dimensioned so as to cover a plurality of IC leads, but to be shorter than one-half the length of one side of the positioning stand 55. Each side wall of the right-angled recess 60 will thus abut against a plurality of the leads 32L of the IC 32 to push the IC into alignment with the center of the positioning stand 55. At the same time, the angular position of the IC 32 is also corrected by the engagement of the right-angled recesses 60 with the corresponding corners of the IC 32. It is thus to be appreciated that the swinging movement of the two positioning arms 57 is terminated by the abutment of the IC abutment portions 61 against the diagonally opposed right-angled corners of the positioning stand 55, respectively, whereby the IC may be positioned in a desired precisely aligned and correct angular position. Fig. 6 shows the IC 32 as being accurately positioned on the positioning stand 55 by the operation of the positioner as discussed above.

Upon completion of the positioning, the actuator 58

is moved back upwardly to bring the top face of thereof into abutment against the lower ends of the longer legs 57a of the pair of positioning arms 57. With the continued upward movement of the actuator 58, the positioning arms 57 are caused to swing about the respective pivot pins 56 whereby the IC abutment portions 61 at the forward ends are lowered outwardly and downwardly out of engagement with the positioning stand 55. Since the pair of IC abutment portions 61 are lowered below the top surface of the positioning stand 55 and away from the stand as is seen in Fig. 7, the IC on the positioning stand 55 is fully exposed on its all sides so that the IC leads 32L may easily be externally observed from laterally. It is thus possible to take a photograph of the configuration of the leads 32L of the IC 32 by camera means 70 such as a CCD (charge coupled device) camera disposed on one side of the positioning stand 55. In this regard, the camera means 70 is located in a position to take the best photograph of the configuration of the leads 32L of the IC 32. The rotary shaft 54 may be rotated to index each of the sides of the IC 32 to a position in front of the camera 70 whereupon the shaft is held still for a while for photographing.

The camera 70 is used to automatically effect the external inspection, that is, the inspection of the configuration of the IC leads 32L. The photographs taken by the camera 70, that is, images of the IC leads are picture processed to inspect for any crooking of the leads and contact between adjacent leads. The method of externally inspecting the IC by the use of a camera is well known in the art, and therefore will not be described any further.

While in the embodiment described above the arrangement is such that as the IC abutment portions 61 of

the positioning arms 57 are closing toward each other, they abut against and push on the leads 32L of the IC 32 with a very slight force to thereby position the IC in a desired precise position, it is to be understood that the risk of deforming IC leads during the positioning may be completely eliminated if the positioning of an IC 32 is effected by bringing the IC abutment portions 61 of the positioning arms 57 into engagement with the mold 32M only of the IC 32. However, the mold of the modern IC may be as thin as 1.2 mm, for example. In that case, it would be difficult to abut the IC abutment portions 61 of the positioning arms 57 against the mold 32M alone. This is one of the reasons why the invention contemplates to prevent the distortion of IC leads by pushing the leads with a very weak force due to only the weight of the positioning arm 57 itself.

While the illustrated embodiment has been described as applied to the use for positioning an IC having IC leads extending in four directions, it will be obvious to those skilled in the art that the positioner according to this invention is equally applicable to a case for positioning an IC having IC leads extending in two directions and performing the external inspection. The positioner of this invention may also be used to position leadless type ICs having no leads, semiconductor devices other than ICs, and the like. Moreover, it should be noted that the positioner of this invention is useful at any location where it is required to position ICs other than the station for the external inspection of ICs. Where no external inspection takes place, there is usually no need for rotating the IC, so that neither the rotary shaft 54 nor the rotative drive means therefor is required. At any rate, where there is no need for rotating the positioning stand 55 whether or not the external inspection may be carried out, neither the

rotary shaft 54 nor the rotative drive means therefor is required. It is only required to provide means for simply supporting the rotary stage 53 and the IC positioning stand 55.

As is apparent from the foregoing descriptions, according to the positioner of this invention, as the IC abutment portions 61 of the positioning arms 57 are closing towards each other due to the arms' own weights alone, the right-angled recesses 60 of the IC abutment portions 61 push on the leads 32L of the IC 32 with only a very slight force. Moreover, the rate at which the IC abutment portions 61 are moving to their closed position can be set to any desired speed by regulating the rate at which the actuator 58 is lowered. On top of that, since each of the right-angled recesses 60 of the IC abutment portions 61 simultaneously pushes on a plurality of leads on either of the adjoining side walls of an IC, the stress which may be exerted on each of the leads may be noticeably reduced as compared with the prior art positioning apparatus. It is thus possible to accurately position an IC in place without distorting the IC leads. In other words, the present invention is capable of controlling the pushing force of the IC abutment portions 61 of the positioning arms 57 to a minimal level at which no distortion of the IC leads can occur depending on the type of the IC to be positioned.

In addition, the external dimensions of the IC positioning stand 55 are sized to be slightly larger than the outlines of the leads of an IC being placed on the stand so that the opposed corners of the stand may serve as stop means to limit the movement of the corresponding positioning arms to thereby prevent excessive stresses which otherwise might distort the leads of the IC from being exerted on the leads.

Once the IC has been positioned in place, the IC abutment portions 61 of the positioning arms 57 may be moved downwardly and outwardly out of engagement with the positioning stand 55 by moving the actuator 58 upwardly. Accordingly, all the side surfaces of the IC placed on the positioning stand 55 may be fully exposed so that the external inspection of the IC leads by the use of a camera may be easily carried out. Further, it is possible to effect the external inspection of the IC leads on any side wall of the IC by rotating the rotary shaft 54.

CLAIMS

1. An IC positioning device for use in an IC handler for transporting ICs through a test section and sorting the tested ICs on the basis of the test results, said IC positioning device comprising:

a base including an elongated bar having a pair of legs formed at its longitudinal opposite ends;

an IC positioning stand mounted on the upper surface of said bar generally at the center thereof for placing an IC thereon to be positioned in place;

a support for supporting the base;

a pair of pivot pins extending generally horizontally toward each other from the inner surfaces of the associated legs;

a pair of positioning arms mounted on the respective pivot pins for pivotal movements thereabout, each of said positioning arms having an IC abutment portion at the forward end thereof, the rearward end portion of each of the positioning arms being heavier with respect to the associated pivot pin than the forward end portion; and

an actuator adapted to abut against said positioning arms at their rearward ends to swing the positioning arms simultaneously about the pivot pins;

said IC abutment portion of each of said positioning arms being so formed on the forward end as to be stopped in abutment against the corresponding corner of said IC positioning stand when the rearward end of each of said positioning arms is in its free lower position; and

said positioning arms are pivotally moved, as said actuator is actuated to abut against the rearward ends of said positioning arms to raise the rearward ends, so that the IC abutment portions at the forward ends of said arms

are lowered downwardly and outwardly away from said IC positioning stand whereby all of the side surfaces of the IC positioning stand are exposed.

2. The IC positioning device according to claim 1, wherein said support for supporting the base is a columnar support, and said actuator is in the form of a planar plate having an opening formed therethrough for loosely receiving said columnar support and adapted to be moved vertically relative to the support.

3. The IC positioning device according to claim 2, wherein said columnar support rotatably supports said base and said IC positioning stand.

4. The IC positioning device according to claim 1, wherein each of said positioning arm is generally in the shape of L, said IC abutment portion being formed on the forward end of one leg of the L-shape while the other leg is pivotally supported by the associated pivot pin, and each of said abutment portions being formed with a generally right-angled recess to fit in complementary abutting engagement with the corresponding corner of said IC positioning stand.

5. The IC positioning device according to claim 1, wherein said base, said IC positioning stand and said pair of positioning arms are built up as a unitary assembly, said unitary assembly being removably mounted on said support.

6. The IC positioning device according to claim 1, wherein said IC positioning stand is either square or

rectangular in shape and is slightly larger than the external dimensions of the leads of an IC to be placed on said stand whereby the corners of said stand may also serve as stop means to limit the movement of the corresponding IC abutment portions of said positioning arms.

ABSTRACT

A rotary stage 53 comprising a rectangular elongated bar 51 and legs 52 integrally with the bar at its opposite ends is provided. A square or rectangular IC positioning stand 55 is mounted on the upper surface of the bar 51, and a rotary shaft 54 for rotatably supporting the rotary stage and the IC positioning stand is secured to the rotary stage. A pair of positioning arm 57 are pivotally supported on respective pivot pins 56 mounted to and extending from the inner surface of the legs of the rotary stage respectively, and a planar plate-like actuator 58 is provided for abutting against the rearward ends of the positioning arms to swing them simultaneously about the pivot pins. The weight of each of the positioning arms is so distributed that the rearward end thereof is lowered in its free state and that an IC abutment portion formed at the forward end of each of the positioning arms is stopped in abutment with the corresponding corner of the IC positioning stand, whereby the IC deposited on the positioning stand may be urged by the weight of the positioning arms so as to be positioned in place. The actuator is actuated to abut against and raise the rearward ends of the positioning arms, whereby the IC abutment portions of the positioning arms are lowered outwardly and downwardly away from the positioning stand to expose all of the side walls of the positioning stand.

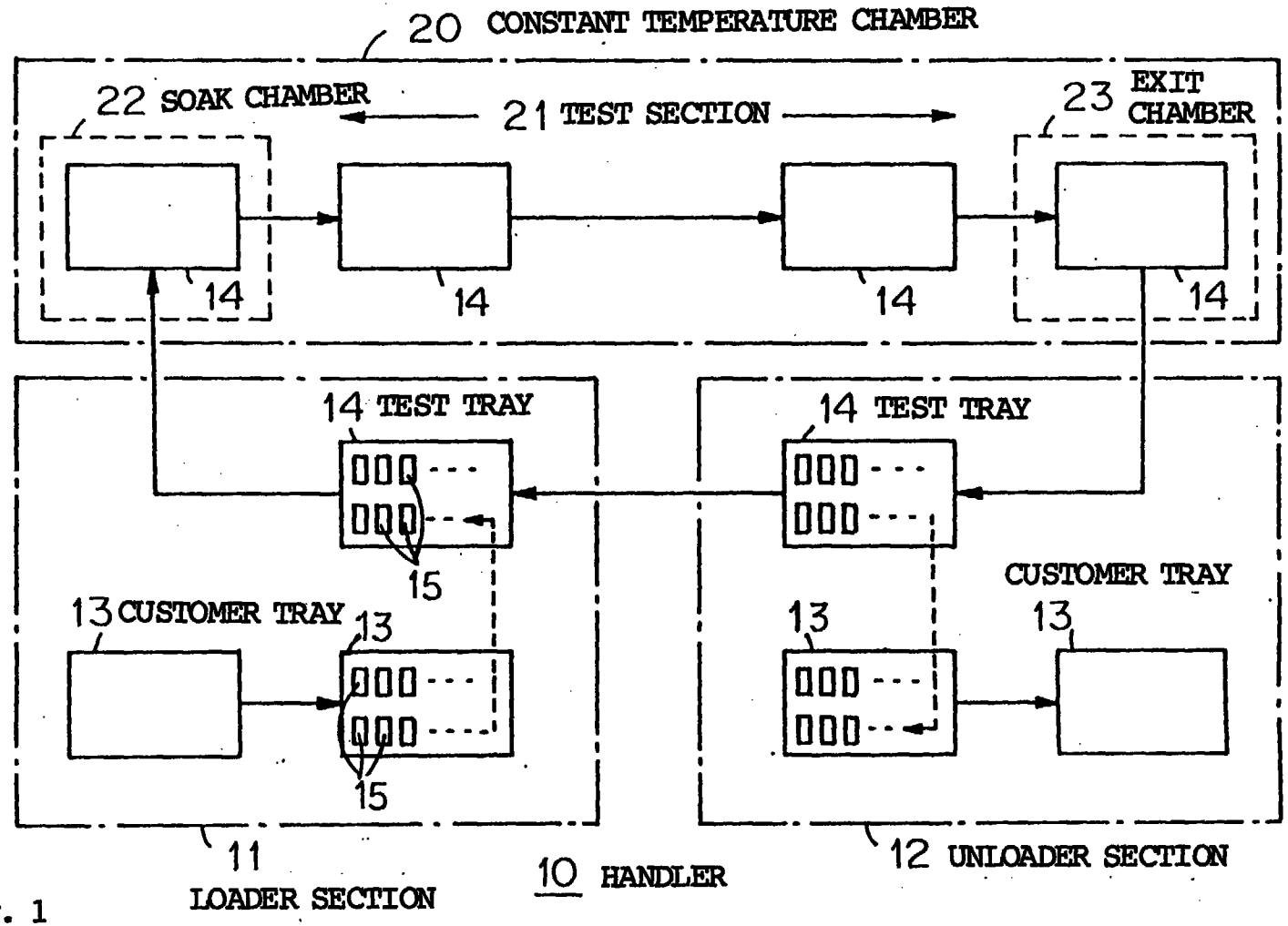

20 CONSTANT TEMPERATURE CHAMBER
22 SOAK CHAMBER
21 TEST SECTION
23 EXIT CHAMBER
14
14
14
14
14 TEST TRAY
14 TEST TRAY
15
13 CUSTOMER TRAY
13
13
CUSTOMER TRAY
13
15
11
LOADER SECTION
10 HANDLER
12 UNLOADER SECTION

Fig. 1

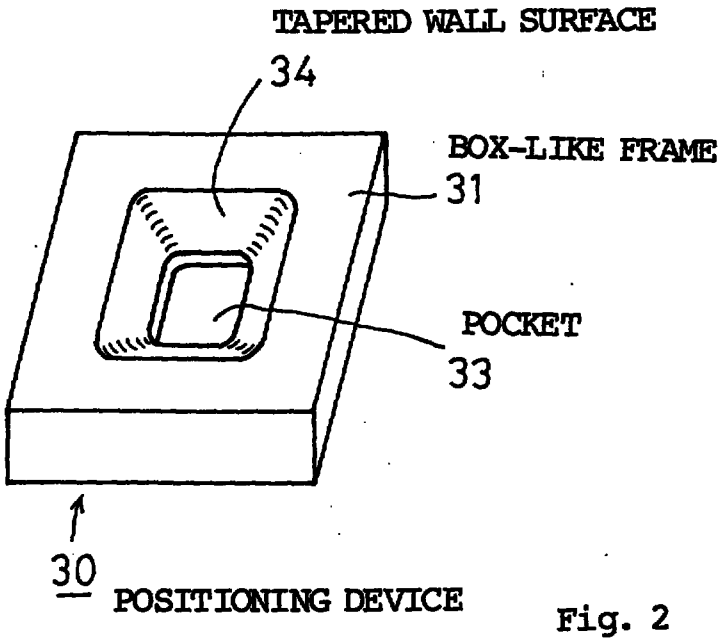

TAPERED WALL SURFACE
34
BOX-LIKE FRAME
31
POCKET
33
30
POSITIONING DEVICE

Fig. 2

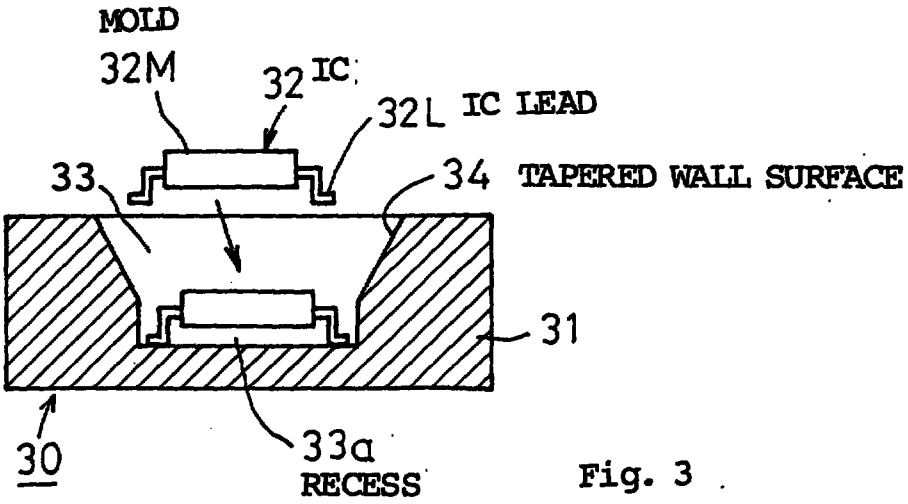

MOLD
32M
32 IC
32L IC LEAD
33
34 TAPERED WALL SURFACE
31
30
33a
RECESS

Fig. 3

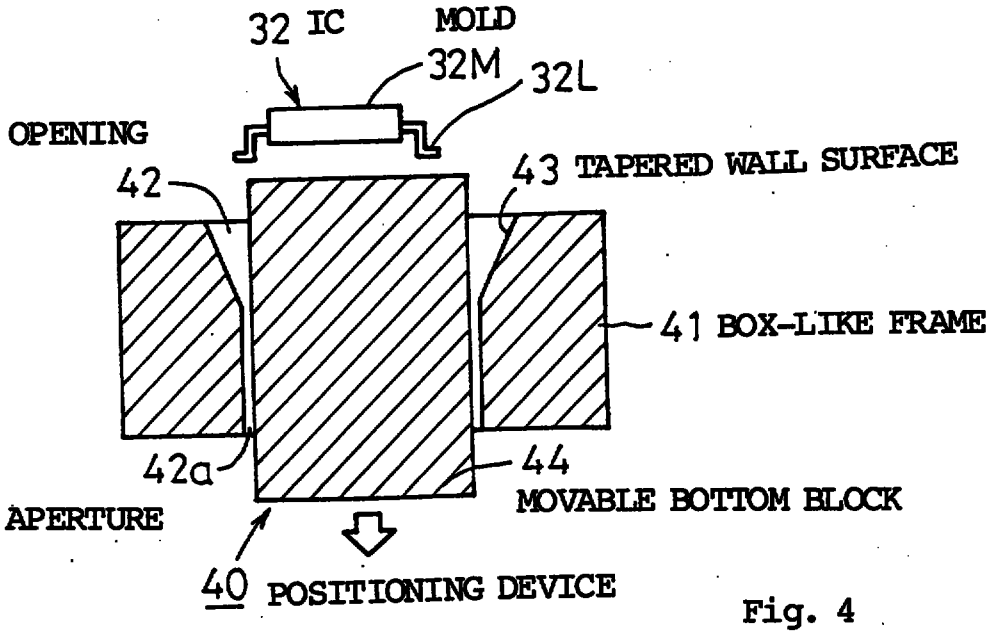

32 IC
MOLD
32M
32L
OPENING
42
43 TAPERED WALL SURFACE
41 BOX-LIKE FRAME
42a
44
APERTURE
MOVABLE BOTTOM BLOCK
40 POSITIONING DEVICE

Fig. 4

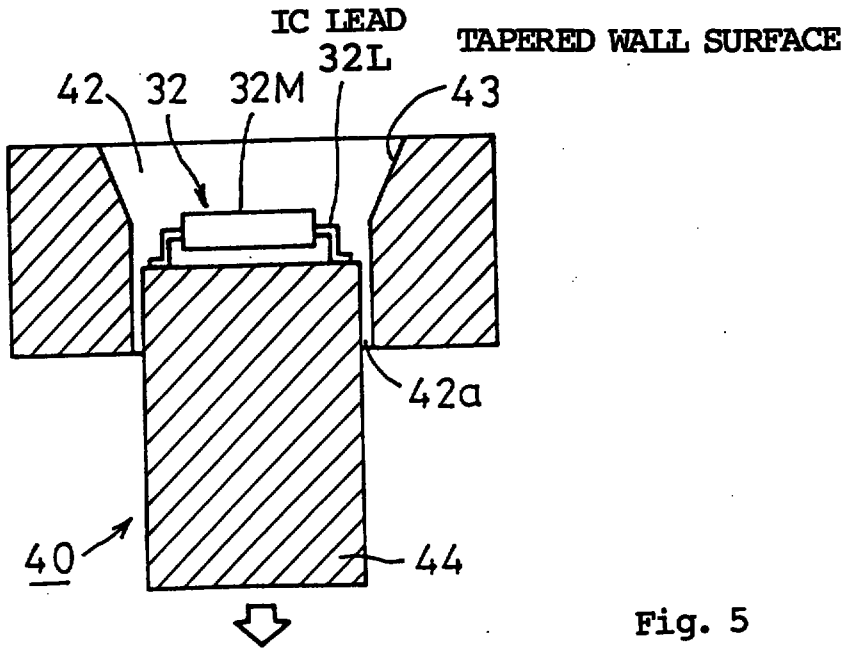

IC LEAD
32L
TAPERED WALL SURFACE
42
32
32M
43
42a
40
44

Fig. 5

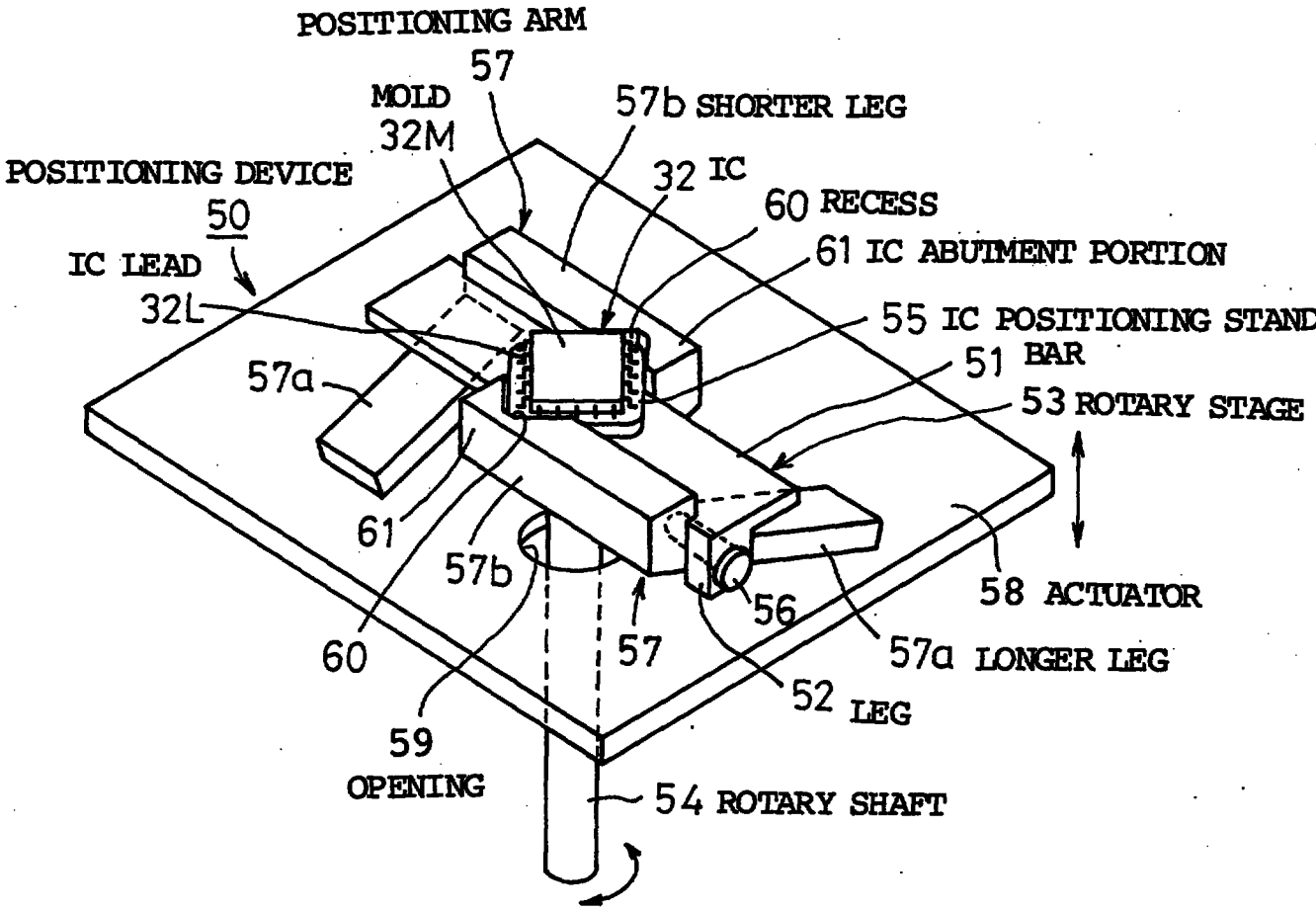

POSITIONING ARM
57
MOLD
32M
57b SHORTER LEG
POSITIONING DEVICE
50
32 IC
60 RECESS
61 IC ABUTMENT PORTION
IC LEAD
32L
55 IC POSITIONING STAND
51 BAR
57a
53 ROTARY STAGE
61
57b
56
58 ACTUATOR
60
57
57a LONGER LEG
52 LEG
59
OPENING
54 ROTARY SHAFT

Fig. 6

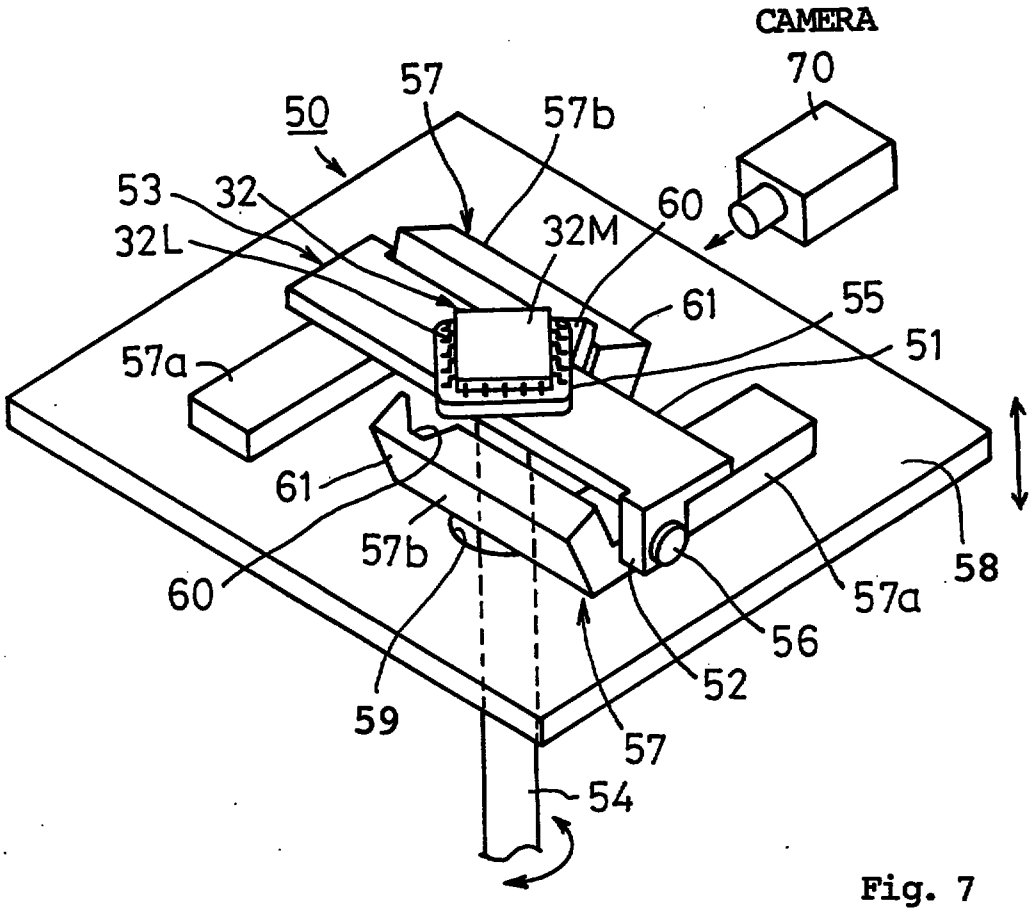

CAMERA
70
57
57b
50
53
32
32L
60
32M
61
55
51
57a
61
57b
60
59
57
54
56
52
57a
58

Fig. 7

ROTARY SHAFT RECEIVING APERTURE

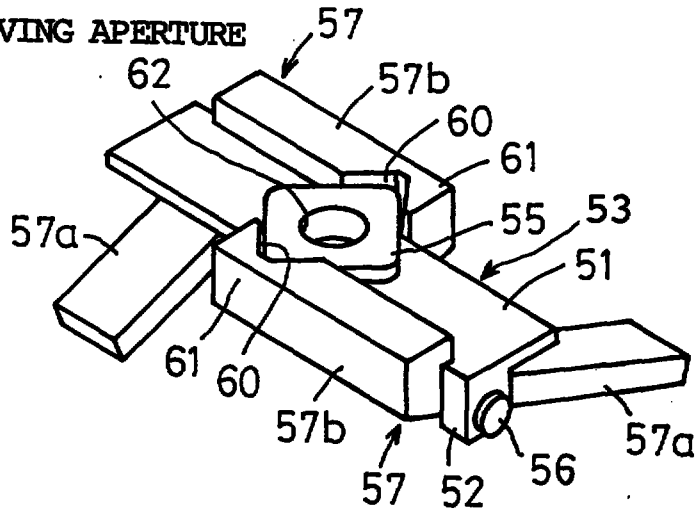


Fig. 8