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PARTS HANDLING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a parts handling apparatus, and more particularly, to a structure of an apparatus best-suited to handle electronic parts in an electric characteristic inspection of IC devices.

2. Description of the Related Art

In a conventional process of inspecting the characteristics of integrated circuits (IC), an IC handler is used to sequentially place many IC devices in an inspection position. The IC handler is provided with a contact hand for holding the IC device by vacuum suction. The contact hand repeats operations of carrying an IC device from a parts supply position, supplying the IC device to an inspection socket located in the inspection position, taking the IC device out of the inspection socket at the completion of an electric characteristic inspection on the IC device, and carrying the IC device to a parts discharge position.

In the characteristic inspection process using the IC handler, it is required to make an inspection on many IC devices in a short time. Here, the time, which is taken to take an inspected IC device out of the inspection socket,

to set the next IC device to be inspected on the inspection socket and to put outer terminals of the IC device into a stable contact with the inspection socket, is called "index time". In the above process, it is most important to shorten the index time, and the performance of the IC handler is evaluated by the length of the index time thereof.

The most effective method for shortening the index time is to provide a plurality of contact hands, usually two contact hands, for accessing one inspection position. In the IC handler having two contact hands, it is allowed that one contact hand takes an inspected IC device out of the inspection socket and the other contact hand immediately sets an IC device to be inspected on the inspection socket, which can shorten the index time of the IC handler.

Fig. 9 shows the schematic structure of an IC handler which shortens the index time as mentioned above. In this IC handler, two inspection sockets 11 are placed in an inspection position, and a parts discharge stage 33 for receiving two IC devices and a parts supply stage 34 for supplying two IC devices are fixed on a shuttle 35 located on one side of the inspection sockets 11. The shuttle 35 is so structured as to reciprocate in the extending direction thereof and to put the parts discharge stage 33

and the parts supply stage 34 into a predetermined supply and discharge position (IC device handling position) alternately.

Two turning arms 31 spaced at 180° about a turning shaft 0 are disposed between the inspection sockets 11 and the shuttle 35. The turning arms 31 turn about the vertical shaft 0 integrally on a horizontal plane. Each of the turning arms 31 is provided with a transfer mechanism 32 fixed at the leading end thereof, and a contact hand 5 is mounted at the bottom end of the transfer mechanism 32 to be movable upward and downward. The contact hand 5 can grasp two IC devices arranged on the parts supply stage 34 at a time, and place the IC devices on the inspection sockets 11 while grasping. When one transfer mechanism 32 at the leading end of the turning arm 31 is placed just above the inspection position, the other transfer mechanism 32 is placed just above the handling position on the shuttle 35. The two transfer mechanisms 32 transfer IC devices from the parts supply stage 34 to the inspection sockets 11, and from the inspection sockets 11 to the parts discharge stage 33, alternately.

In the state shown in Fig. 9, unillustrated IC devices are held by the contact hand 5 placed just above the inspection sockets 11, and set on the inspection sockets 11 by moving the contact hand 5 downward. On the other hand,

inspected IC devices are held by the contact hand 5 placed above the shuttle 35, and put onto the parts discharge stage 33 in the handling position on the shuttle 35 by moving the contact hand 5 downward.

Next, after the parts supply stage 34 is put into the handling position by moving the shuttle 35, the contact hand 5 moves down, takes uninspected IC devices from the parts supply stage 34, and moves up again. When the characteristic inspection on the IC devices set on the inspection sockets 11 is completed, the contact hand 5 grasping the inspected IC devices moves upward.

The two turning arms 31 turn through 180° in this state, and thereby, the contact hand 5 grasping the uninspected IC devices is moved above the inspection sockets 11 and the contact hand 5 grasping the inspected IC devices is moved above the handling position on the shuttle 35. At this time, the parts discharge stage 33 in the handling position on the shuttle 35 is empty.

In this IC handler, since the IC devices are supplied and discharged alternately by two contact hands 5 while turning the turning arms 31 through 180° , the index time equals to the sum of the time taken for one contact hand 5 to take the IC devices from the inspection sockets 11, and the turning time of the turning arms 31 and the time taken for the other contact hand 5 to set the IC devices.

However, since the IC devices are conveyed from the handling position to the inspection position by turning the turning arms 31 in the above-mentioned IC handler, the conveyance trail of the IC devices is shaped like an arc, and the conveyance distance is $\pi/2$ times as long as that of the linear movement. Therefore, in order to obtain an index time equivalent to that of the linear movement of the IC devices, the conveyance speed and acceleration required to convey the IC devices are both increased, which needs a higher-powered drive source and a more rigid conveying mechanism. Particularly, in order to turn the transfer mechanism 32 and the contact hand 5, which are provided with heavy components such as a driving cylinder and a motor, more swiftly, high driving power is needed to increase the acceleration and deceleration. Therefore, it is quite difficult to achieve such swiftness while keeping the precision of the conveyance position and the structural precision.

As another method for further shortening the index time, it is thought of to increase the number of turning arms as shown in Fig. 10. In the structure shown in Fig. 10, three turning arms 36 are located about a turning shaft. Since the turning arms 36 are spaced at 120° , it seems that the moving distance of IC devices is shortened and thereby the index time is shortened. However, this case requires

each of the three turning arms 36 to be provided with a transfer device 32 and a contact hand 5 at the leading end thereof, which increases the number of components of the apparatus and the weight of the moving parts, and needs higher driving power. Therefore, it is difficult to increase the operation speed of individual moving parts, and the manufacturing cost of the IC handler increases.

Furthermore, in the IC handler shown in Fig. 10, it can be thought of that the inspection ability is enhanced without shortening the index time by increasing the number of IC devices to be grasped by each contact hand 5 and the number of IC devices to be inspected by the inspection socket 11 at a time. However, in this case, the manufacturing cost of the contact hand 5 and the socket 11 increases according to the increased number of IC devices, and the turning radius is required to be increased by making the turning arms 36 longer in order to prevent the interference among the contact hands 5 resulting from the increased length thereof in the turning direction. As a result, the moving distance of the IC devices is increased, and thereby the index time is increased on the contrary.

SUMMARY OF THE INVENTION

Accordingly, the present invention solves the above-mentioned problems, and an object of the present invention

is to provide a new parts handling apparatus which can shorten the index time and increase working ability without increasing the number of components and can thereby restrict the rise of manufacturing cost.

In order to solve the above problems, there is provided a parts handling apparatus comprising a processing member for subjecting a part to a predetermined process, a first handling member for supplying and discharging a part placed on one side of the processing member, a second handling member for supplying and discharging a part placed on the other side of the processing member, a first holding member movable between the processing member and the first handling member to hold the part, a second holding member movable between the processing member and the second handling member to hold the part, a main driving means for making the first and second holding members reciprocate alternately between the first and second handling members and the processing member, a first auxiliary driving means for moving the first holding member close to and apart from the processing member and the first handling member, and a second auxiliary driving means for moving the second holding member close to and apart from the processing member and the second handling member.

Since the first handling member and the second handling member are placed on both sides of the processing

member and parts are supplied and discharged alternately from both sides by the first holding member and the second holding member, the conveyance route of the parts is freely determined and the index time can be shortened by short-circuiting the conveyance route.

It is preferable that the main driving means make the first and second holding members reciprocate linearly in a first direction, and that the first and second auxiliary driving means make the first and second holding members reciprocate linearly in a second direction intersecting the first direction.

Since the first and second holding members are moved linearly close to and apart from the processing member and the first and second handling members by being moved linearly in the first direction by the main driving means between the processing member and the first and second handling members, it is possible to simplify the structures of the main driving means and the first and second auxiliary driving means and to reduce the manufacturing cost of the apparatus.

Furthermore, it is preferable in this case that the first auxiliary driving means have a first connecting member for engaging the first holding member therewith movably in the first direction and holding the first holding member in the second direction, and a first drive

source fixed to move the first connecting member in the second direction and that the second auxiliary driving means have a second connecting means for engaging the second holding member therewith movably in the first direction and holding the second holding member in the second direction and a second drive source fixed to move the second connecting member in the second direction.

Although the first and second auxiliary driving means respectively move the first and second holding members in the second direction by moving the first and second connecting members in the second direction by means of the first and second drive sources, since the first and second holding members are respectively movable in the first direction with respect to the first and second connecting members, the first and second auxiliary driving means do not obstruct the movement made by the main driving means and the driving load of the main driving means can be reduced. Therefore, it is easy to increase the driving speed of the first and second holding members and to maintain driving accuracy.

Furthermore, it is preferable that the period of movement of the first and second holding members in the first direction through the main driving means and the period of movement of the first and second holding members in the second direction through the first and second

auxiliary driving means be overlapped at least partially.

In this case, particularly, it is effective in shortening the index time to set the moving route of the first and second holding members linearly as short as possible to a degree where there is no interference with peripheral mechanisms. Although the moving route is set to be linear, it is more preferable to set the moving route smoothly in accordance with the acceleration and deceleration characteristics of the main driving means and the first and second auxiliary driving means.

Since the period of movement made by the main driving means and the period of movement made by the first and second auxiliary driving means are overlapped, it is possible to optimize the moving route of the first and second holding members, and to further shorten the index time by changing the setting of the moving route.

In the above structures, it is preferable that the main driving means be a single driving system so structured as to move the first and second holding members in the same direction at the same speed.

Since the first and second holding members are moved by a single driving system in the same direction at the same speed, it is possible to simplify the structure of the driving system and to reduce the manufacturing cost of the apparatus.

As the main driving means, separate drive sources or driving members may control the first and second holding members respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic perspective view showing a first operation state of a main structure of a parts handling apparatus according to an embodiment of the present invention.

Fig. 2 is a schematic perspective view showing a second operation state of the embodiment.

Fig. 3 is a schematic perspective view showing a third operation state of the embodiment.

Fig. 4 is a schematic perspective view showing a fourth operation state of the embodiment.

Fig. 5 is a diagram shown operations of members in the embodiment.

Fig. 6 is a view explaining movements of a pair of contact hands in the embodiment.

Fig. 7 is a graph showing operation states of X, Z1 and Z2 driving systems in the embodiment.

Fig. 8 is a partially enlarged cross-sectional view showing the structure of the contact hand in the embodiment.

Fig. 9 is a schematic perspective view showing the structure of a conventional IC handler.

Fig. 10 is a schematic perspective view showing the structure of an improved conventional IC handler.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be next described with reference to the accompanying drawings. Figs. 1 to 4 show a main mechanism of a parts handling apparatus according to the embodiment of the present invention, and illustrate a series of operation steps of the apparatus in order.

In this embodiment, a servomotor 1 fixed to a frame 10 rotates a ball screw 2 extending in the right-to-left direction in the figure (referred to as "X direction" hereinafter). The frame 10 is provided with two guide rails 10a extending in the X direction and fixed thereon. An X driving member 12 is mounted movably in the X direction on the guide rails 10a, and engaged with the ball screw 2 to be moved in the X direction in correlation to the rotation of the ball screw 2.

The X driving member 12 is provided with a pair of right and left movable members 7 which are movable in the vertical direction in the figure (referred to as "Z direction" hereinafter). The movable members 7 are each provided with two contact hands 5 as holding members through respective aligning mechanisms 8. Each of the

contact hands 5 has a suction mechanism for holding an IC device by vacuum suction, which will be described later, and a mechanism for pressing outer terminals of the IC device against an inspection socket which will be also described later. The aligning mechanism 8 is a well-known mechanism for fitting the position of the contact hand 5 for the inspection socket, a parts supply stage and a parts discharge stage.

Z driving members 6 are respectively mounted slidably in the X direction on the movable members 7, and engaged with ball screws 4 which are respectively connected to servomotors 3 fixed to the frame 10. When the ball screw 4 is rotated by the servomotor 3, the Z driving member 6 moves up and down, thereby moving the movable member 7 up and down.

In the following description, a mechanism consisting of the movable member 7, the Z driving member 6, the ball screw 4 and the servomotor 3 on the left side is referred to as a Z1-axis driving system, and a mechanism consisting of the movable member 7, the Z driving member 6, the ball screw 4 and the servomotor 3 on the right side is referred to as a Z2-axis driving system. A mechanism consisting of the X driving member 12, the ball screw 2 and the servomotor 1 is referred to as an X-axis driving system.

Two inspection sockets 11 are placed as a processing

unit at the center below the above mechanisms, and each provided with an inspection pad corresponding to outer terminals of an IC device. When the outer terminals of the IC device are brought into contact with the inspection pad of the inspection socket 11, the inspection on the electric characteristics of the IC device is performed.

On the other hand, shuttles 21 and 22 are placed on the right and left sides of the inspection sockets 11 (in the X direction) to reciprocate in the forward and backward directions in the figure. The inspection sockets 11 are positioned just at the midpoint between the shuttles 21 and 22 which are each provided with a parts supply stage 23 and a parts discharge stage 24 fixed thereon. The parts supply stage 23 and the parts discharge stage 24 can each hold two IC devices corresponding to the two contact hands 5 mounted on the movable member 7. The parts supply stage 23 holds two uninspected IC devices, and supplies the IC devices to the contact hands 5, and the parts discharge stage 24 receives inspected IC devices from the contact hands 5, and discharges the IC devices.

The above Z1-axis driving system transfers IC devices between the shuttle 21 and the inspection sockets 11, and the Z2-axis driving system transfers IC devices between the shuttle 22 and the inspection sockets 11. When the X driving member 12 moves in the X direction, and, for

example, the Z1-axis driving system moves from the shuttle 21 to the inspection sockets 11, the Z2-axis driving system moves from the inspection sockets 11 to the shuttle 22. Although not illustrated, a loading robot for supplying IC devices to the parts supply stage 23 and an unloading robot for taking IC devices out of the parts discharge stage 24 are placed in front of and behind the shuttles 21 and 22.

In the above apparatus, the following operations are performed. First, as shown in Fig. 1, the Z1-axis contact hands 5 press two IC devices against the inspection sockets 11 for inspection. At this time, the Z2-axis contact hands 5 are standing by above a preset handling position on the shuttle 22 while holding two uninspected IC devices taken out of the parts supply stage 23. On the other hand, the age+24-13+afieaby~standing 34 at aempty~part~discharge~st handling position on the shuttle 21.

Next, when the inspection on the IC devices by the inspection sockets 11 is completed, the Z1-axis servomotor 3 is put into operation, the Z driving member 6 is lifted in correlation to the rotation of the ball screw 4, and the Z1-axis contact hands 5 pull the inspected IC devices up from the inspection sockets 11. Then, the servomotor 1 is put into operation, and the driving member 12 starts to move leftward in correlation to the rotation of the ball screw 2. When the X driving member 12 moves, the contact

hands 5 in both the Z1 and Z2 axis driving systems move together in the leftward direction in the figure. In a short time, the Z1-axis contact hands 5 come above the handling position on the shuttle 21, and the Z2-axis contact hands 5 come above the inspection sockets 11.

Then, the Z2-axis servomotor 3 is put into operation, the Z driving member 6 is moved down in correlation to the rotation of the ball screw 4, and the Z2-axis contact hands 5 press uninspected IC devices against the respective inspection sockets 11 as shown in Fig. 2. On the other hand, the Z1-axis contact hands 5 also move down and transfer the inspected IC devices onto the parts discharge stage 24.

As shown in Fig. 3, while inspection is being made on the IC devices pressed against the inspection sockets 11 by the Z2-axis contact hands 5, the shuttle 21 moves backward to move the parts discharge stage 24 backward and put the parts supply stage 23 into the handling position. On the other hand, the shuttle 22 moves forward and puts the parts discharge stage 24 in the handling position.

When the inspection on the IC devices is completed, the Z2-axis contact hands 5 move up to above the handling position on the shuttle 22 as shown in Fig. 4, and, on the other hand, the Z1-axis contact hands 5 press uninspected IC devices against the inspection sockets 11 for a secure

contact between the IC devices and the inspection sockets 11. The Z2-axis contact hands 5 move down and transfer the IC devices to the parts discharge stage 24.

This apparatus repeats the above-mentioned operations shown in Figs. 1 to 4, and the Z1-axis and Z2-axis driving systems operate to alternately supply IC devices to the inspection sockets 11. Fig. 5 is a diagram showing the above operations and operations of the loading robot and the unloading robot. IC device receiving operations performed by the members are indicated by projections and IC device transferring operations are indicated by recesses in the diagram. Although two lines respectively representing the positions of the parts supply stage 23 and the parts discharge stage 24 are drawn at the shuttle 21, the lower line indicates the stage in the handling position. Similarly, although two lines respectively representing the positions of the parts supply stage 23 and the parts discharge stage 24 are drawn at the shuttle 22, the upper line indicates the stage in the handling position. Furthermore, in an index unit of Fig. 5, the upper solid line indicates the operation of the Z1-axis driving system and the lower solid line indicates the operation of the Z2-axis driving system. An inspection period in Fig. 5 refers to a period in which IC devices are inspected at the inspection sockets 11.

The loading robot repeats operations of transferring uninspected IC devices onto the parts supply stage 23 on the shuttle 21, two at a time, receiving two new IC devices one by one from a parts supply tray or the like where IC devices are arranged, transferring the IC devices onto the parts supply stage 23 on the shuttle 22, two at a time, and receiving two IC devices again one by one from the parts supply tray or the like.

On the shuttle 21, the parts supply stage 23 receives two uninspected IC devices from the loading robot, the parts discharge stage 24 receives inspected IC devices from the Z1-axis contact hand 5, the parts supply stage 23 moves to the handling position, and then, the IC devices held by the parts supply stage 23 are transferred to the Z1-axis contact hands 5. At the same time, the inspected IC devices held by the parts discharge stage 24 are taken out by the unloading robot.

In the index unit, the positions and operations of the Z1-axis and Z2-axis contact hands 5 are shown. In the same manner as above, the Z1-axis contact hands 5 press and fix IC devices against the inspection sockets 11 for inspection, and move toward the shuttle 21 at the completion of inspection. At this time, the Z2-axis contact hands 5 transfer the inspected IC devices onto the parts discharge stage 24 on the shuttle 22, receive new IC devices from the

parts supply stage 23, and move toward the inspection position. After that, the Z2-axis contact hands 5 transfer the inspected IC devices onto the parts discharge stage 24 on the shuttle 22. On the other hand, the Z1-axis contact hands 5 transfer the inspected IC devices onto the parts discharge stage 24 on the shuttle 21, and the Z2-axis contact hands 5 press the IC devices against the inspection sockets 11 for inspection.

The shuttle 22 repeats identical operations to the shuttle 21. The unloading robot receives inspected IC devices two by two from the parts discharge stages 24 on the shuttles 21 and 22, and then, sequentially puts the IC devices at a predetermined position on an unillustrated inspected parts tray.

Fig. 6 illustrates the operations of the Z1-axis and Z2-axis contact hands. Each Z1-axis contact hand 5 reciprocates between the shuttle 21 and the inspection socket 11, and each Z2-axis contact hand 5 reciprocates between the shuttle 22 and the inspection socket 11. Fig. 6 shows a case in which the Z1-axis contact hand 5 conveys an inspected IC device from the inspection socket 11 to the parts discharge stage 24 on the shuttle 21 (parts discharge operation) and the Z2-axis contact hand 5 conveys an uninspected IC device from the parts supply stage 23 on the shuttle 22 (parts supply operation). The Z1-axis parts

supply operation and the Z2-axis parts discharge operation are performed symmetrically with the Z2-axis parts supply operation and the Z1-axis parts discharge operation.

First, the most basic operation mode will be described. In this mode, in order to shorten the index time, while the Z1-axis contact hand 5 is pressing the IC device under inspection at the inspection socket 11, the Z2-axis contact hand 5 takes an uninspected IC device out of the parts supply stage 23 on the shuttle 22, moves up in correlation to the upward movement of the Z driving member 6, and stands by at a standby point P set at a predetermined height from the parts supply stage 23.

Next, when the inspection at the inspection socket 11 is completed, the Z1-axis contact hand 5 moves upward through a takeout point S, and reaches a center point Q above the inspection socket 11 as indicated by an alternate long and short dashed line in Fig. 6. Then, the Z1-axis contact hand and the Z2-axis contact hand are both moved leftward horizontally along the alternate long and short dashed line by moving the X driving member 12 leftward. The Z1-axis contact hand 5 reaches a standby point R, and the Z2-axis contact hand 5 reaches the center point Q. After that, the Z2-axis contact hand 5 is moved down vertically from the center point Q together with the Z driving member 6, and pressed against the inspection socket

11. As mentioned above, in this basic mode, the time during which the Z1-axis contact hand reaches the center point Q from the inspection socket 11 and the Z2-axis contact hand reaches the inspection socket 11 from the standby point P through the center point Q is taken as index time.

However, in such a mode, the moving route of the contact hand is wasteful as indicated by the alternate long and short dashed line, and the index time is not yet sufficiently reduced. In order to save lifting time from the inspection socket 11 to the center point Q, the operation periods of the X driving member 12 and the Z driving member 6 are corrected, so that the X driving member 12 is moved to the standby point R the moment the Z1-axis contact hand reaches the takeout point S set above the inspection socket 11, and the Z2-axis contact hand is moved from the standby point P to the takeout point S. Routes of the contact hands in this case are schematically shown by a dotted line in Fig. 6.

The takeout point S is set as low as possible to a degree where the contact hand 5 can move in the horizontal direction without interfering with the mechanisms on the periphery of the inspection socket 11. The lower the takeout point S is, the shorter the index time is.

When the Z1-axis contact hand is moved up to the

takeout point S from the inspection sockets 11 together with the Z driving member 6, the X driving member 12 starts to move leftward. The mutually parallel upward movement of the Z driving member 6 and leftward movement of the X driving member 12 allow the contact hand to move toward the standby point R along a route denoted by U1 in Fig. 6. On the other hand, when the Z driving member 6 starts to move downward almost simultaneously with the start of movement of the X driving member 12, the Z2-axis contact hand is thereby moved toward the takeout point S along a route denoted by U2.

When the Z1-axis contact hand reaches the standby point R, the Z2-axis contact hand reaches the takeout point S. After that, the Z2-axis Z driving member 6 moves down and sets an IC device onto the inspection socket 11. In this case, the index time is the time during which the Z1-axis contact hand moves from the inspection position to the takeout point S and the Z2-axis contact hand reaches the takeout point S from the standby point P and then reaches the inspection sockets 11 from the takeout point S.

Since the moving time from the standby point P to the takeout point S is determined by the moving time of the X driving member 12 which has a long moving distance, it is almost equal to the moving time from the standby point P to the center point Q. Contrarily, the moving time of the Z1-

axis contact hand from the inspection position to the center point Q is longer than the moving time from the inspection position to the takeout point S, and the moving time of the Z2-axis contact hand from the center point Q to the inspection position is longer than the moving time from the takeout point S to the inspection position. Therefore, this mode of moving the contact hands by way of the takeout point S makes it possible to shorten the index time.

In a case in which the difference in moving distance between the X driving member 12 and the Z driving member 6 is small, or in a case in which the moving distance of the Z driving member 6 is longer than that of the X driving member 12, in order to decrease the index time, it is preferable to set the standby points P and R as low as possible to a degree where the contact hands are not disturbed by the mechanisms on the periphery of the shuttle 22. If the standby point P is set to such a low position that the movement of the X driving member 12 causes the moving track of the contact hand to be disturbed by the mechanisms on the periphery of the shuttle 22, movement of the Z driving member 6 may be started later than that of the X driving member 12 to some degree so that the contact hand starts to move downward from a corrected point T horizontal to the standby point P.

In order to realize a moving track of the contact hand

shown by the solid line in Fig. 6, another operation mode is adopted. In this operation mode, as shown in Fig. 7, the leftward movement of the X driving member 12 and the downward movement of the Z2-axis driving system are started almost simultaneously at the time when the Z1-axis driving system starts upward movement and the Z1-axis contact hand reaches the takeout point S, the upward movement of the Z1-axis driving system and the movement of the X driving member are stopped almost simultaneously, and then, the Z2-axis driving system is moved downward until an IC device held by the contact hand is pressed against the inspection socket 11. By thus setting the periods of the X-direction movement and the Z-direction movement so that they overlap with each other, the index time can be shortened without varying accelerations and maximum speeds of the X-direction and Z-direction driving systems. In this mode, the index time is shortened by more than about 30% compared to that of the operation mode shown by the alternate long and short dashed line in Fig. 6.

Fig. 8 is a cross-sectional view showing the structure of a main part of the contact hand 5 in this embodiment. The contact hand 5 is mounted so that the angle thereof is changeable and the center position thereof is adjustable within a predetermined range with respect to the aligning mechanism 8. As shown in Fig. 8A, a positioning plate 50

is disposed horizontally at the bottom end of the contact hand 5, and a main body 51 attached to the aligning mechanism 8 is mounted on the upper surface of the positioning plate 50. A plurality of guide holes 50a are formed on the periphery of the positioning plate 50. When the contact hand 5 comes close to the inspection socket 11, the parts supply stage 23 or the parts discharge stage 24, the guide holes 50a are fitted on guide pints 60 formed on the upper surface of the inspection socket 11, the parts supply stage 23 or the parts discharge stage 24, thereby positioning the contact hand 5 accurately.

On the lower surface of the positioning plate 50, a presser member 52 made of synthetic resin and provided with a presser surface 52a for pressing outer terminals 61a of an IC device 61 against an unillustrated inspection pad of the inspection socket 11 is mounted so as to project downward. A holding frame 53 for holding the position of the IC device 61 is placed inside the presser member 52. The contact hand 5 is provided with a center through hole inside thereof in which a guide block 54 is fitted movably up and down. A suction head 55 made of synthetic rubber is mounted to the guide block 54.

An elastic member 56 formed of a coil spring or the like is housed on the guide block 54 to urge the guide block 54 downward. The center through hole formed inside

the contact hand 5 is connected to an exhaust device which is not illustrated, and the IC device 61 is sucked by the suction head 55.

When no load is imposed from outside before the IC device 61 is sucked, the suction head 55 and the IC device 61 are pressed down by the elastic member 56 in a state shown in Fig. 8A.

On the other hand, when the IC device 61 is sucked by the suction head 55, since there is negative pressure inside the center through hole of the contact hand 5, a package of the IC device 61 is positioned in contact with the holding frame 53 as shown in Fig. 8B, and the outer terminals 61a of the IC device 61 are brought into contact with the presser surface 52a of the presser member 52.

In this state shown in Fig. 8B, the IC device 61 is delivered in a precise position, and the outer terminals 61a of the IC device 61 are pressed against the inspection socket 11 precisely and reliably.

According to this embodiment, since the shuttles 21 and 22 are placed on the right and left sides of the inspection socket 11, uninspected IC devices are conveyed from the parts supply stages 23 of the shuttles 21 and 22 toward the inspection sockets 11 and inspected IC devices are withdrawn to the parts discharge stage 24, IC devices can be supplied to the inspection position by the right and

left contact hands alternately, and a free linear transfer route can be achieved. Therefore, the index time can be shortened relatively easily without increasing the manufacturing cost.

In this embodiment, particularly, since two contact hands are moved in the X direction by the drive of a single X driving member, a single driving system having a single drive source and a single driving mechanism works sufficiently, which makes it possible to simplify the apparatus structure and to reduce the manufacturing cost.

In this embodiment, since the movable member 7, the aligning mechanisms 8 and the contact hands 5 are only supported by the X driving member 12 and the Z-axis driving systems each consisting of the servomotor 3, the ball screw 4 and the Z driving member 6 are supported by the frame 10, the weight load on the X-axis driving system can be reduced. This enhances acceleration and deceleration performance and driving accuracy of the X-axis driving system. Therefore, it is possible to speed up the operation and further shorten the index time without changing the driving ability.

Although the inspection apparatus for making an electric inspection on IC devices is described in the above embodiment, the present invention can be applied not only to such an inspection apparatus, but also to parts handling apparatuses used in various types of working machines and

assembling machines.

Furthermore, although two contact hands are operated by a single X-axis driving system in the above embodiment, separately controlled driving systems may be provided for the respective contact hands. In this case, it is possible to move the two contact hands in the horizontal direction at different speeds and timings in order to further shorten the index time.

As mentioned above, the present invention has the following advantages.

According to claim 1, since a first handling member and a second handling member are placed on both sides of a processing member and parts are supplied and discharged alternately from both sides by a first holding member and a second holding member, the conveyance route of the parts is freely determined and the index time can be shortened by shortening the conveyance route.

According to claim 2, since the first and second holding members are moved linearly close to and apart from the processing member and the first and second handling members by being moved linearly in the first direction by the main driving member between the processing member and the first and second handling members, it is possible to simplify the structures of the main driving member and the first and second auxiliary driving members and to reduce

the manufacturing cost of the apparatus.

According to claim 3, although the first and second auxiliary driving means operate the first and second holding members by moving the first and second connecting members by means of the first and second drive sources, since the first and second connecting members are movable in the second direction, the first and second auxiliary driving members do not obstruct the movement made by the main driving member and the driving load of the main driving member can be reduced. Therefore, it is easy to increase the driving speed of the first and second holding members and to maintain driving accuracy.

According to claim 4, since the period of movement made by the main driving member and the period of movement made by the first and second auxiliary driving members are overlapped, it is possible to optimize the moving route of the first and second holding members, and to further shorten the index time by changing the setting of the moving route.

According to claim 5, since the first and second holding members are moved by a single driving system in the same direction and at the same speed, it is possible to simplify the structure of the driving system and to reduce the manufacturing cost of the apparatus.

WHAT IS CLAIMED IS:

1. A parts handling apparatus, comprising:
 - a processing member for subjecting a part to a predetermined process;
 - a first handling member for supplying and discharging a part placed on one side of said processing member;
 - a second handling member for supplying and discharging a part placed on the other side of said processing member;
 - a first holding member movable between said processing member and said first handling member to hold the part;
 - a second holding member movable between said processing member and said second handling member to hold the part;
 - main driving means for making said first and second holding members reciprocate alternately between said first and second handling members and said processing member;
 - first auxiliary driving means for moving said first holding member close to and apart from said processing member and said first handling member; and
 - second auxiliary driving means for moving said second holding member close to and apart from said processing member and said second handling member.
2. A parts handling apparatus according to claim 1,



wherein

said main driving means makes said first and second holding members reciprocate linearly in a first direction, and said first and second auxiliary driving means make said first and second holding members reciprocate linearly in a second direction intersecting the first direction.

3. A parts handling apparatus according to claim 2, wherein said first auxiliary driving means has a first connecting member for engaging said first holding member therewith movably in the first direction and holding said first holding member in the second direction, and a first drive source fixed to move said first connecting member in the second direction, and said second auxiliary driving means has a second connecting means for engaging said second holding member therewith movably in the first direction and holding said second holding member in the second direction, and a second drive source fixed to move said second connecting member in the second direction.

4. A parts handling apparatus according to claim 2, wherein the period of movement of said first and second holding members in the first direction through said main driving means and the period of movement of said first and second holding members in the second direction through said



first and second auxiliary driving means are overlapped at least partially.

5. A parts handling apparatus according to claims 1 to 4, wherein said main driving means is a single driving system so structured as to move said first and second holding members in the same direction and at the same speed.



ABSTRACT

PARTS HANDLING APPARATUS

A new parts handling apparatus of the present invention can shorten the index time and increase working ability without increasing the number of components and can restrict the rise of manufacturing cost. An X driving member to be moved right and left in correlation to the rotation of a ball screw by a servomotor is provided with a pair of right and left moving members mounted movably in the Z direction. Two contact hands are attached to each moving member through aligning mechanisms respectively. The moving member is provided with a Z driving member mounted slidably in the X direction. The Z driving member is engaged with a ball screw connected to a servomotor. When the ball screw is rotated by the servomotor, the Z driving member moves up and down, thereby also moving the moving member up and down.

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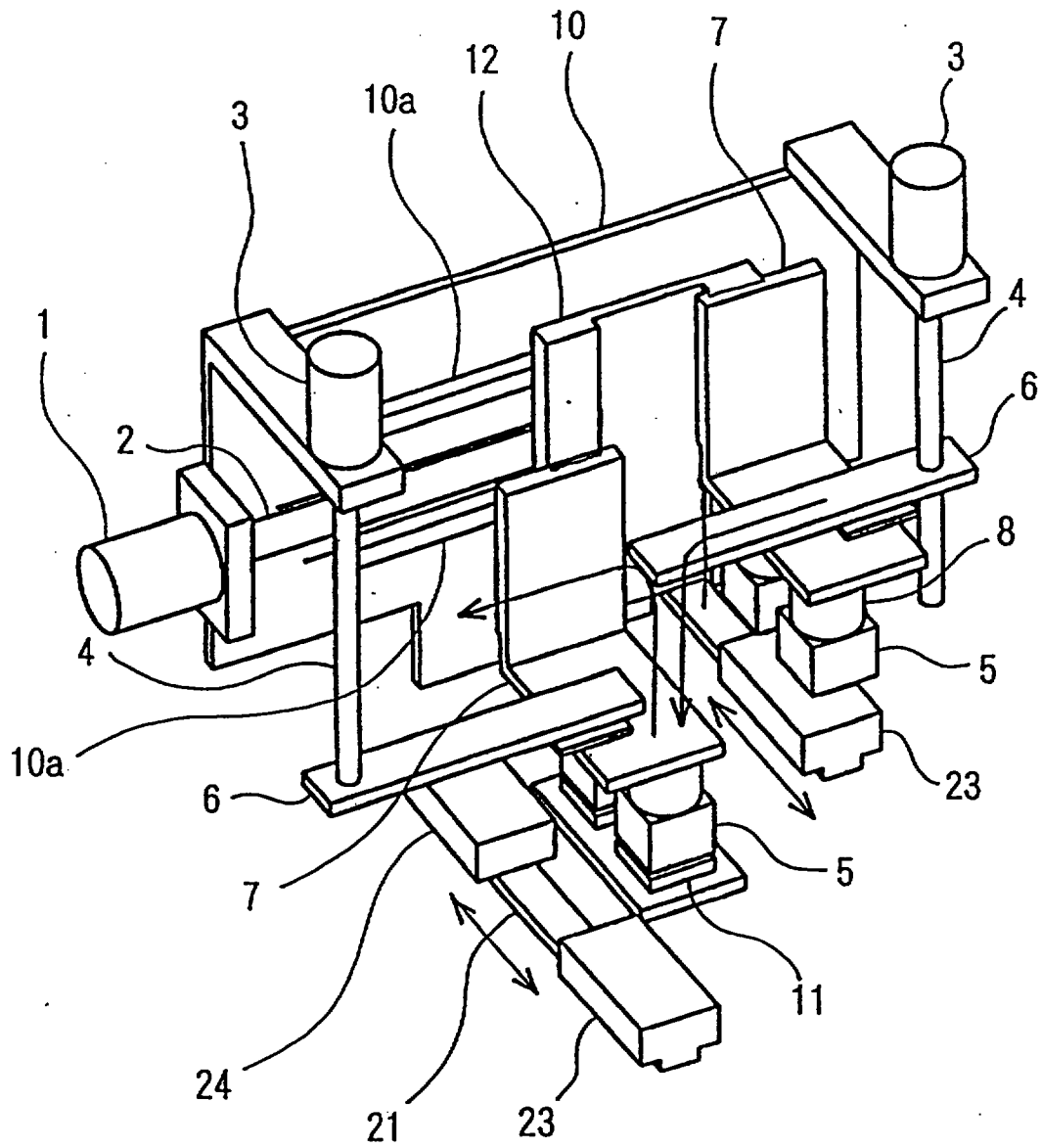


FIG. 1

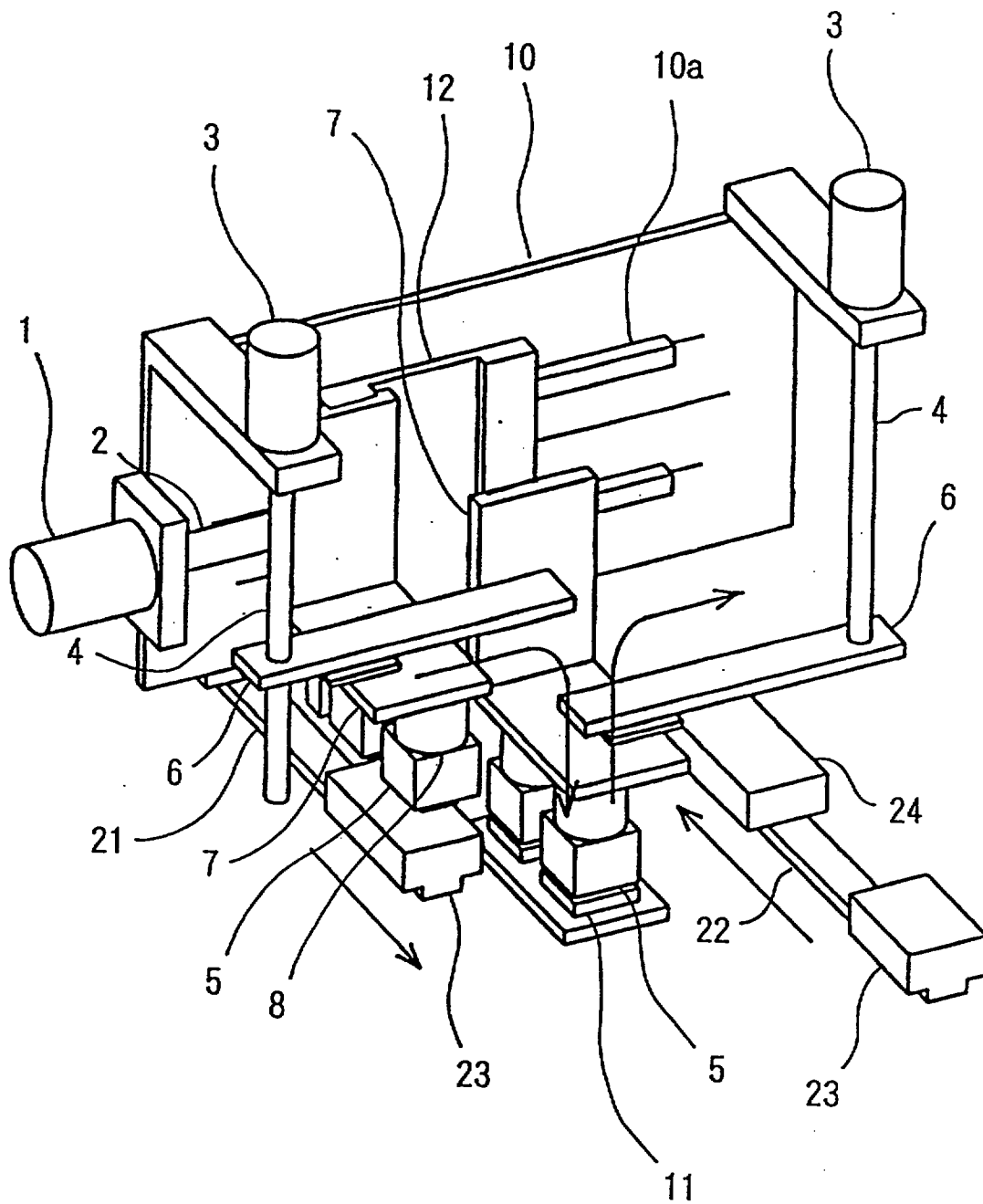


FIG. 3

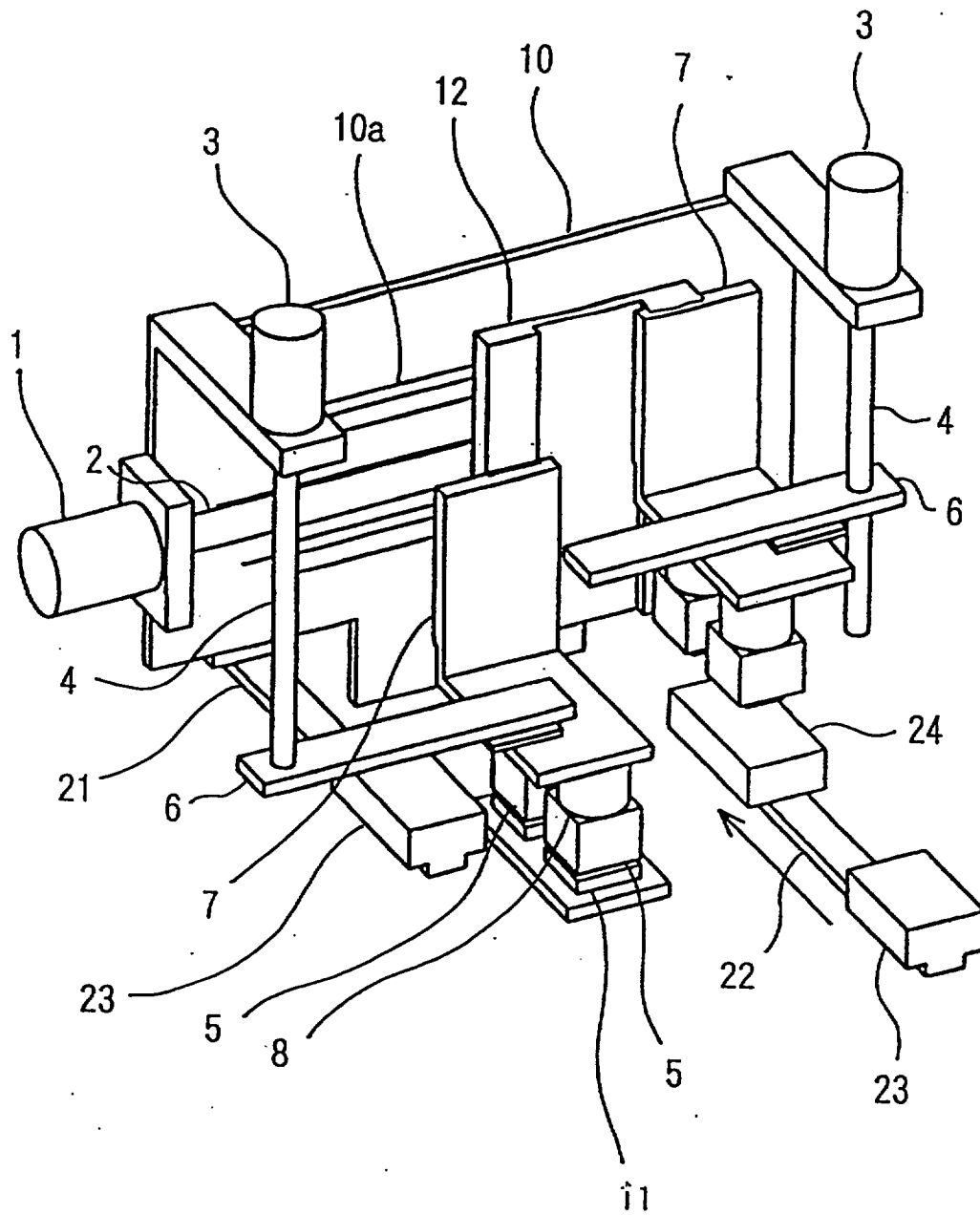


FIG. 4

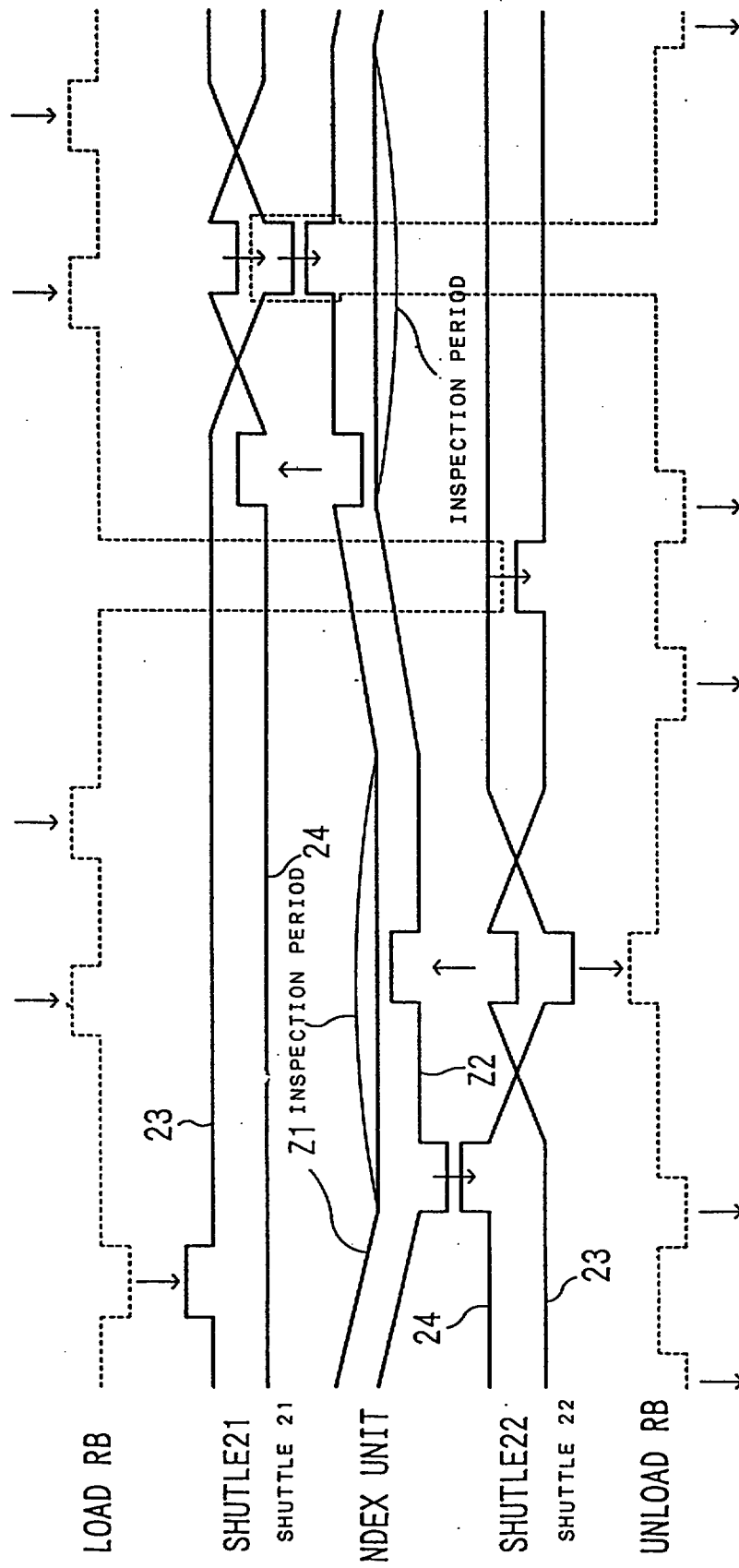


FIG. 5

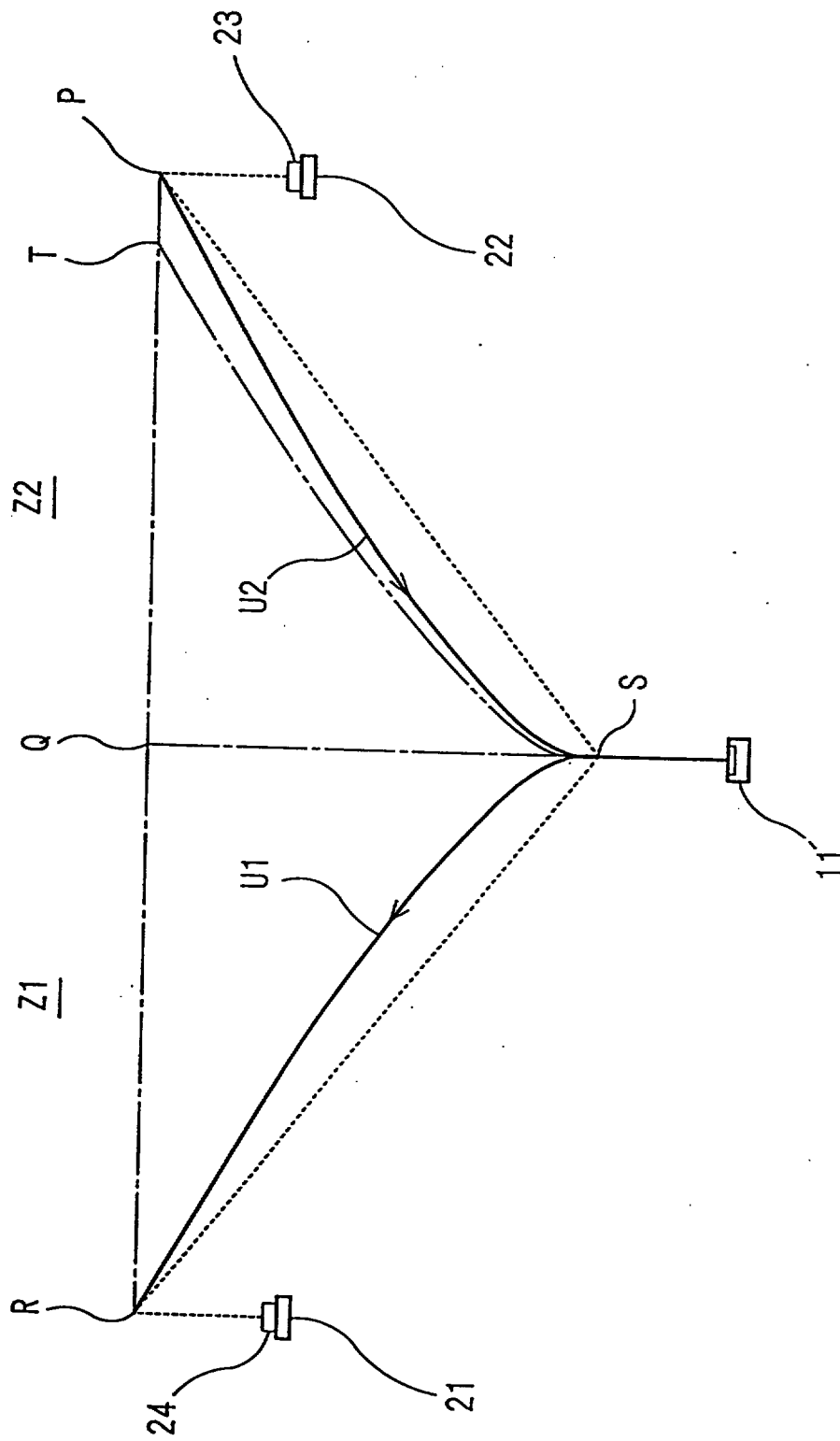


FIG. 6

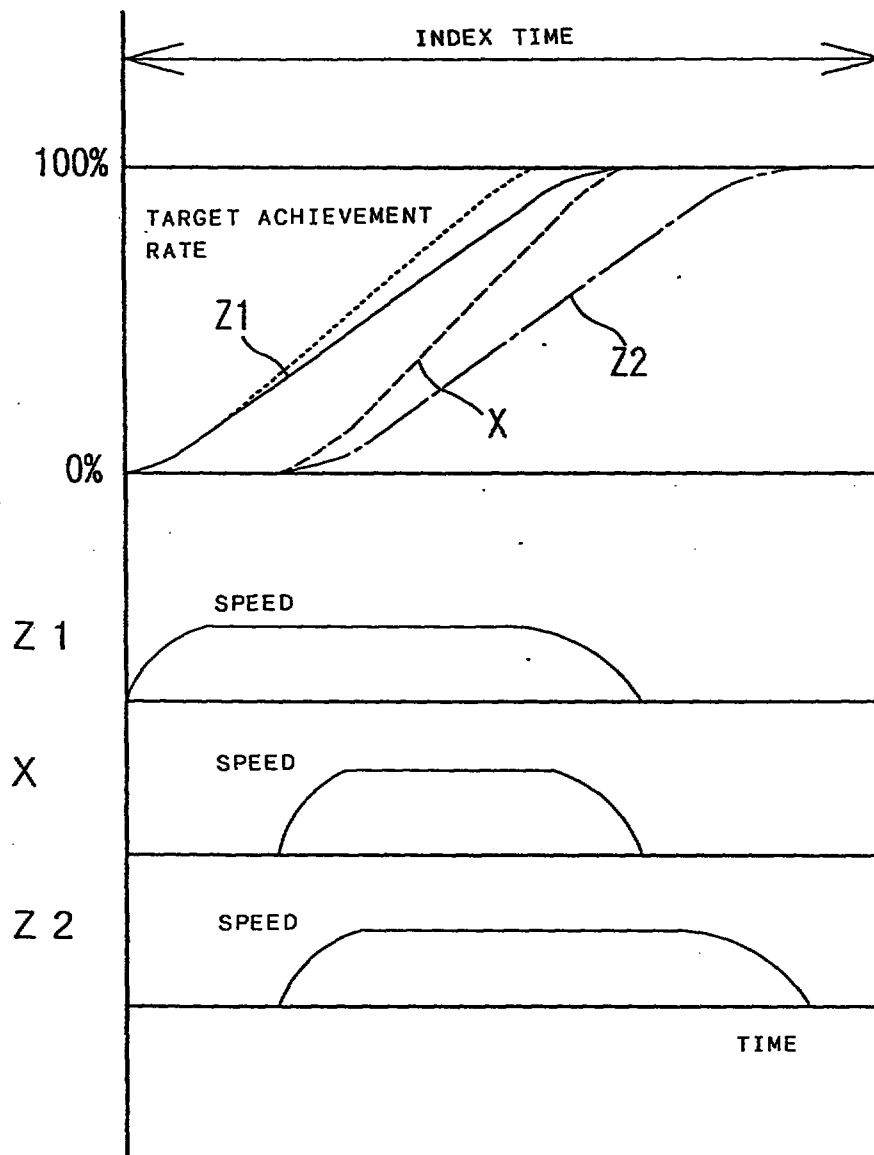


FIG. 7

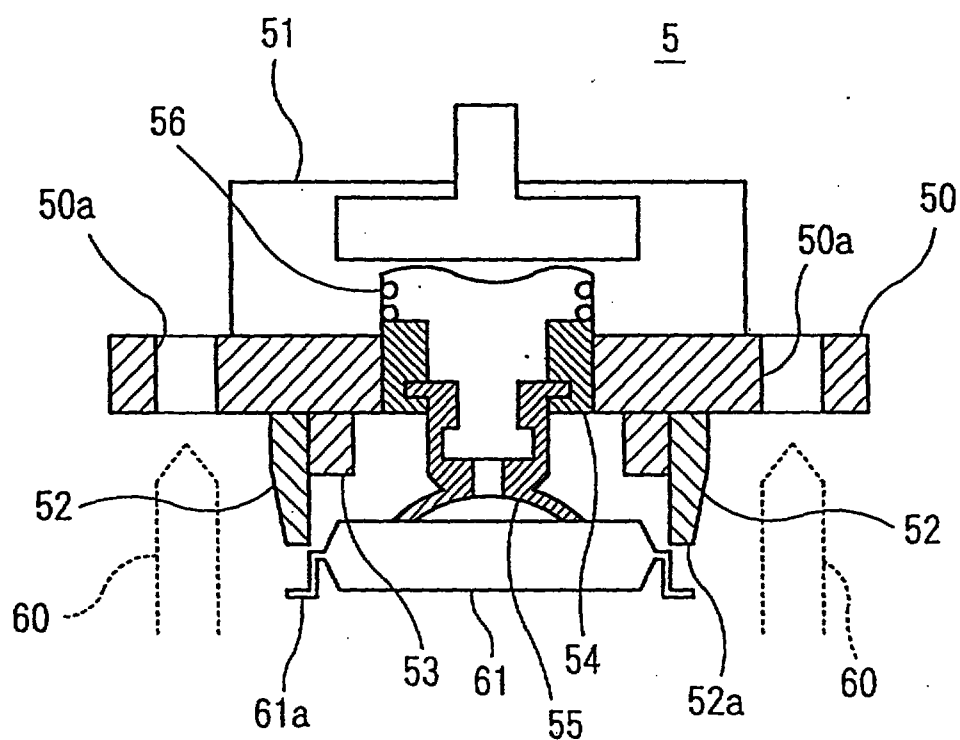
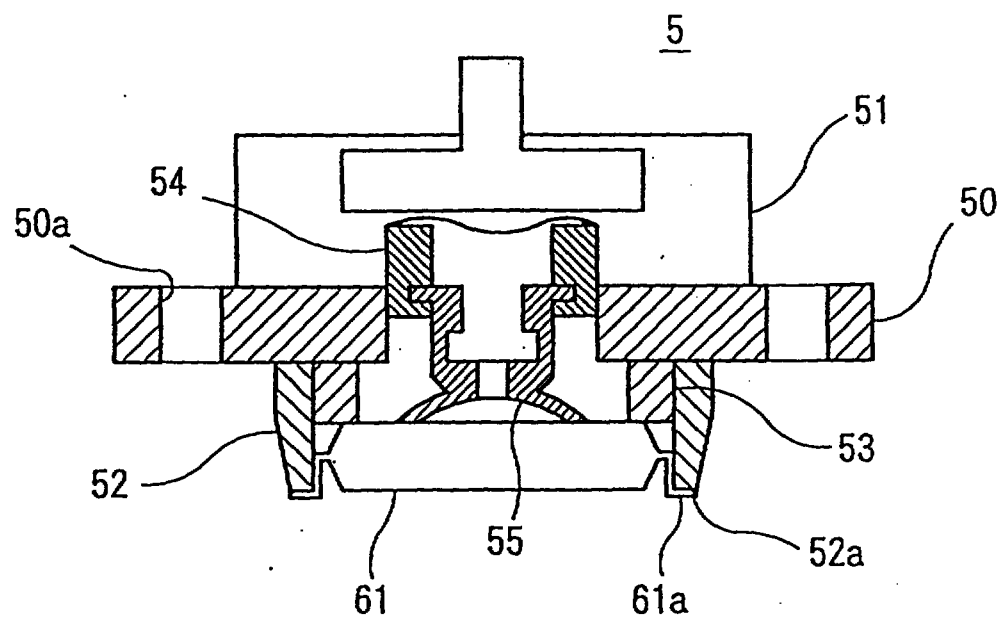


FIG. 8A



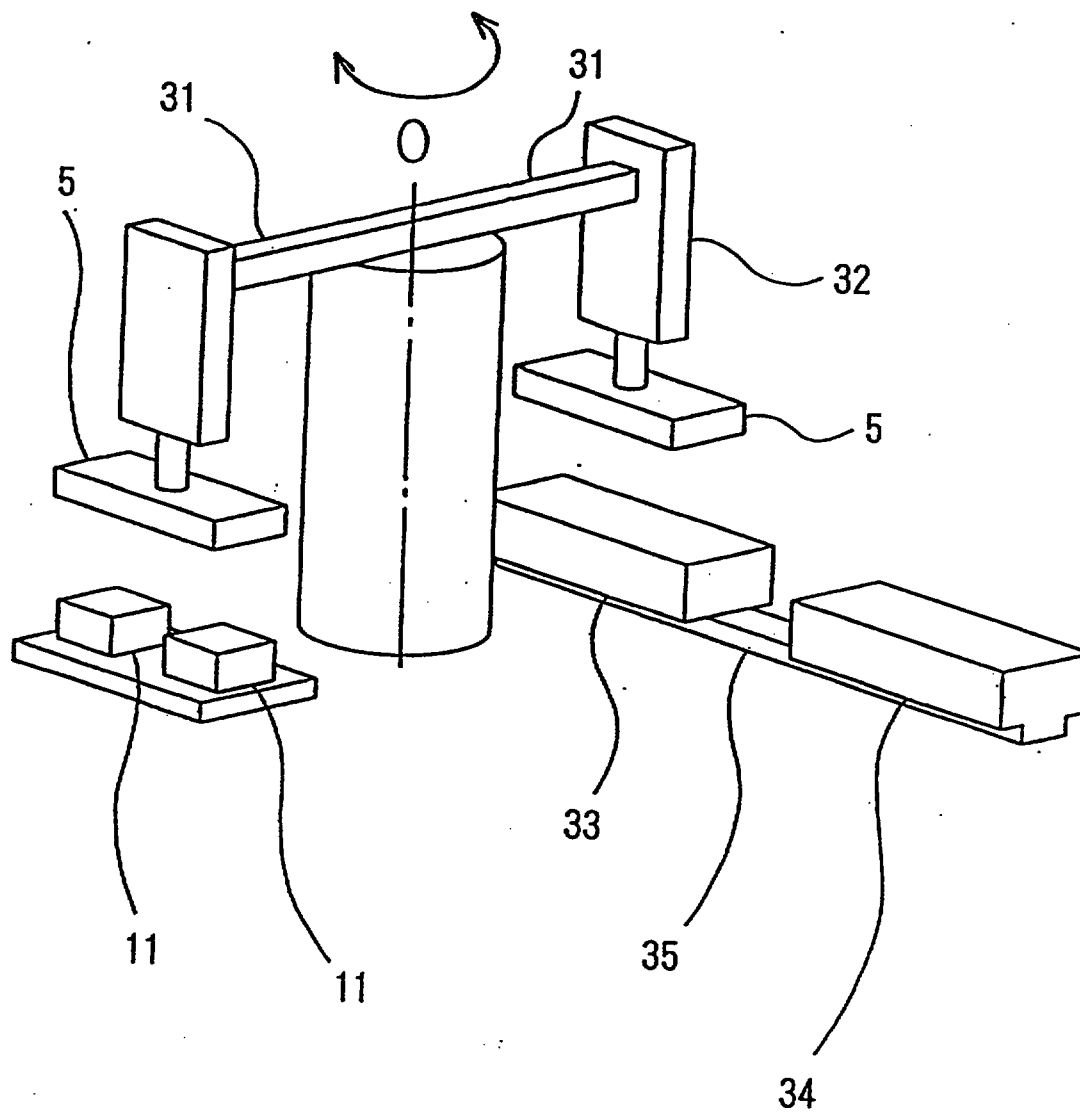


FIG. 9

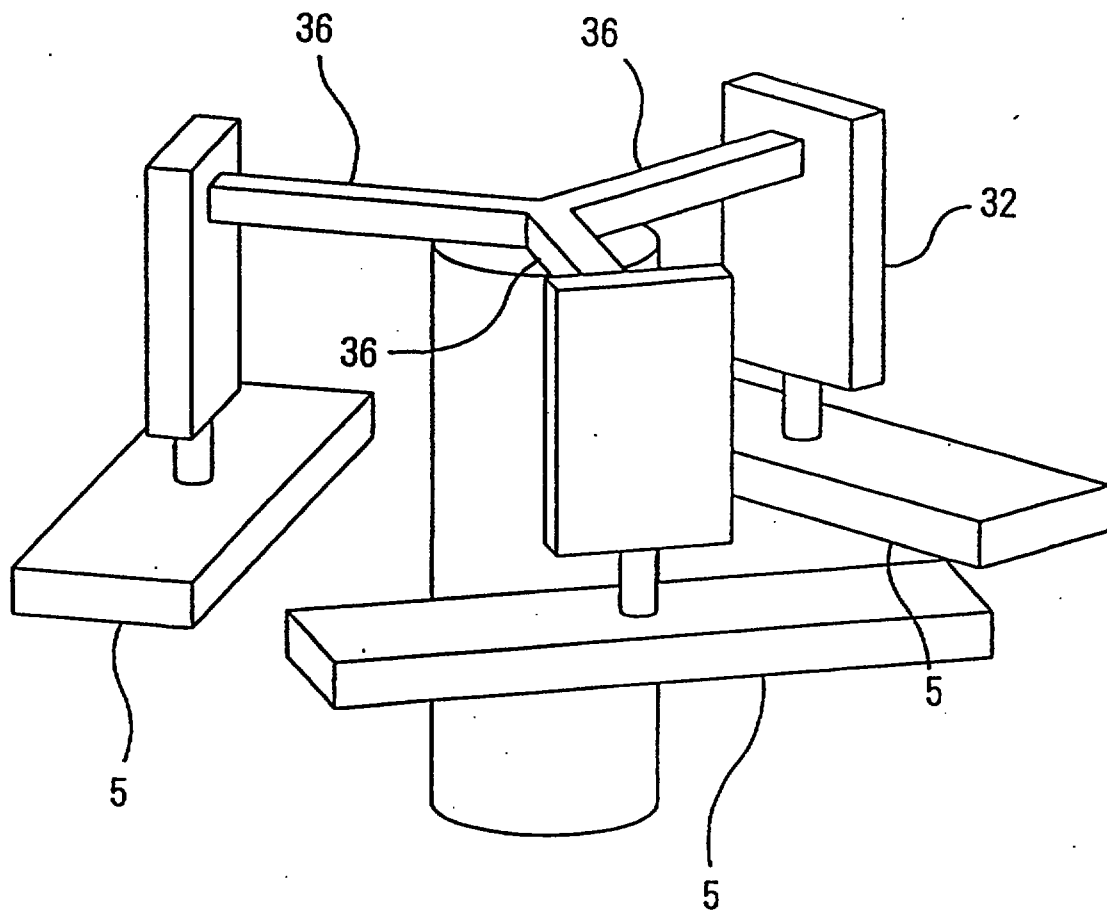
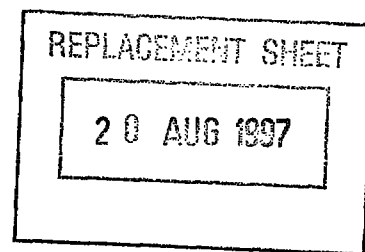


FIG. 10

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ABSTRACT

PARTS HANDLING APPARATUS



A new parts handling apparatus of the present invention can shorten the index time and increase working ability without increasing the number of components and can restrict the rise of manufacturing cost. An X driving member to be moved right and left in correlation to the rotation of a ball screw by a servomotor is provided with a pair of right and left moving members mounted movably in the Z direction. Two contact hands are attached to each moving member through aligning mechanisms respectively. The moving member is provided with a Z driving member mounted slidably in the X direction. The Z driving member is engaged with a ball screw connected to a servomotor. When the ball screw is rotated by the servomotor, the Z driving member moves up and down, thereby also moving the moving member up and down.

Figure 1

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TEXT OF THE ABSTRACT

PARTS HANDLING APPARATUS

A parts handling apparatus of the present invention can shorten the index time and increase working ability without increasing the number of components and can restrict the rise of manufacturing cost. An X driving member to be moved right and left in correlation to the rotation of a ball screw by a servomotor is provided with a pair of right and left moving members mounted movably with a pair of right and left moving members mounted movably in the Z direction. Two contact hands are attached to each moving member through aligning mechanisms respectively. The moving member is provided with a Z driving member mounted slidably in the X direction. The Z driving member is engaged with a ball screw connected to a servomotor. When the ball screw is rotated by the servomotor, the Z driving member moves up and down, thereby also moving the moving member up and down.

Figure 1.

REPLACEMENT SHEET

28 MAY 1999