

Device Handler and Method of Control Thereof

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a device handler for handling IC chips or other devices and a method of control of the same, more particularly relates to a device handler for increasing the speed of the sequential operations of an actuator attached to the device handler and improving the throughput of the device processing and a method of control of the same.

2. Description of the Related Art

Device testers have become necessary for testing IC chips and other devices finally produced. In such a tester, use is made of a device handler called a "handler". In this type of handler, a large number of IC chips stored on a tray are held by a device pickup and holding device and conveyed over a test head of the tester where the IC chips are brought into electrical contact with the test head and the IC chips tested. Further, when the tests are completed, the IC chips are conveyed by the device pickup and holding device from the test head and reloaded on trays in accordance with the test results so as to sort them into the categories of good devices and defective devices.

In this type of handler, IC chips are reloaded between customer trays and test trays before and after the tests. Further, inside the handler, the IC chips are moved by the device pickup and holding device at various positions. The device pickup and holding device generally is provided with a device holder for detachably holding a

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device, a pressure cylinder for making the device holder move in the vertical direction, and a motor actuator for making the device holder and pressure cylinder in the horizontal direction.

In the sequential operations of the handler, normally the motor actuator is used to move the device holder and pressure cylinder to predetermined positions, then the pressure cylinder is driven to make the device holder move in the vertical direction to hold or release the device. When the motor actuator is used to move the device holder and the pressure cylinder to predetermined positions, after the mechanical vibration due to the motor actuator operation dies down to a certain extent, the next operation, the driving of the pressure cylinder, is performed. As the time for the mechanical vibration to be die down to a certain extent, a wait time of about 50 to 100 ms is normally estimated.

In a conventional handler, after the elapse of the wait time, a drive signal is sent to the solenoid valve for driving the pressure cylinder and the pressure cylinder is driven to make the device holder move in the vertical direction to hold or release the device.

In this conventional handler, however, after the drive signal is sent to the solenoid valve for driving the pressure cylinder, normally it takes about 100 ms of time until the pressure cylinder is actually driven and starts to operate (pressurized air is filled in the pressure cylinder). This time has been wasted.

In the device holder of an ordinary handler, it is possible to convey back one IC chip from a certain position to another position in approximately 1 second and therefore process approximately 3600 IC chips in about one hour. If it were possible to eliminate the wasted 100 ms of time in approximately 1 second, then a

great improvement of the throughput could be expected.

SUMMARY OF THE INVENTION

The present invention was made in consideration of this circumstance and has as its object the provision of a device handler designed to increase the speed of the sequential operations of the actuator attached to the device handler and thereby improve the throughput of the device processing and a method for control of the same.

To achieve the above object, the device handler according to the present invention comprising a device holder for detachably holding a device, a first actuator for making the device holder move in a first direction, a second actuator for making the device holder and the first actuator move in a second direction different from the first direction, an interruption signal generation circuit for generating an interruption signal at a time before it is detected that the device holder and the first actuator moving along the second direction have reached predetermined stopping positions, a timer circuit for counting a wait time using as a reference the time at which the interruption signal generation circuit generates the interruption signal, and a first actuator drive signal generation circuit which outputs a signal driving the first actuator when the timer circuit detects that the predetermined wait time has elapsed.

The device handler according to the present invention preferably further comprises a first direction position detection sensor for detecting the position of the device pickup and holding device made to move in the first direction by the first actuator. When the first direction position detection sensor has detected the position of the device holder and the device holder has moved to a predetermined position, the next sequential operation,

that is, the pickup operation or the pickup release operation, is moved to.

The device handler according to the present invention preferably further comprises a second actuator drive signal generation circuit outputting a drive signal for driving the second actuator.

The interruption signal generation circuit preferably outputs the interruption signal after a predetermined time using as a reference a time when a drive signal starts to be output from the second actuator drive signal generation circuit to the second actuator.

The device holder preferably is provided with a vacuum pad for picking up a device by vacuum.

The first actuator and the second actuator are not particularly limited. It is possible to give as an example a pressure cylinder using fluid pressure or a motor actuator etc., but the present invention is particularly effective when the first actuator is a pressure cylinder and the second actuator is a motor able to be controlled in rotational angle by a drive signal.

The method for control of the device handler according to the present invention is a method for controlling a device handler provided with a device holder for detachably holding a device, a first actuator for making the device holder move in a first direction, and a second actuator for making the device holder and the first actuator move in a second direction different from the first direction, comprising the steps of generating an interruption signal at the point of time before it is detected that the device holder and the first actuator moving along the second direction by the second actuator have reached predetermined stopping positions, counting the wait time using as a reference the point of time when the interruption signal is

generated, and outputting a signal driving the first actuator when it is detected that a predetermined wait time has elapsed.

The timing for making the interruption signal be generated is preferably set to after the elapse of a predetermined time using as a reference the point of time when the drive signal for driving the second actuator starts to be output.

In the device handler according to the present invention and its method of control, an interruption signal is generated at a point of time before it is detected that the device holder and the first actuator moving along the second direction have reached predetermined stopping positions by the second actuator. Further, a signal for driving the first actuator is output when the wait time is counted and it is detected that a predetermined wait time has elapsed using as a reference the point of time of generation of the interruption signal.

Therefore, the mechanical vibration due to the stopping of the drive of a motor or other second actuator dies down in the time from the output of the signal driving the pressure cylinder or other first actuator to when the first actuator is actually driven. Therefore, the wasted time from the actual stopping of the drive of the second actuator to the actual start of the drive of the first actuator is almost completely eliminated, sequential operations of the actuator are increased in speed, and as a result the throughput of the device processing can be expected to be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and features of the present invention will be described in detail with reference to

accompanying drawings, in which

Figure 1 is a schematic view of a device pickup and holding device of a device handler according to a first embodiment of the present invention;

Fig. 2 is a flow chart of the action of a controller shown in Fig. 1;

Fig. 3 is a logical circuit diagram of part of the circuit of the controller shown in Fig. 1;

Fig. 4A is a timing chart of a device handler according to the first embodiment of the present invention, while 4B of the figure is a timing chart of a conventional device handler;

Fig. 5A is a timing chart from another perspective of a device handler according to the first embodiment of the present invention, while 5B of the figure is a timing chart from another perspective of a conventional device handler;

Fig. 6 is a schematic plane view of an IC chip device tester having the device handler according to the first embodiment of the present invention; and

Fig. 7 is a schematic side view of an IC chip device tester shown in Fig. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

As shown in Fig. 1, the device handler according to the present embodiment has a device pickup and holding device 2 for picking up and detachably holding an IC chip 4 as a device. The device pickup and holding device 2 has a vacuum pad 6 for picking up the IC chip 4 by vacuum. The vacuum pad 6 is preferably configured by for example an elastic rubber member or synthetic resin etc. so as not to damage the IC chip 4 to be picked up, but may also be configured by a metal depending on the type and

application of the device to be picked up.

The vacuum pad 6 is secured to the lower end of a movable shaft 8. The top end of the movable shaft 8 is linked to a pressure cylinder 10 serving as the first actuator. By driving the pressure cylinder 10, the movable shaft 8 can move in the Z-axial direction (first direction). The pressure cylinder 10, in the present embodiment, is an air pressure cylinder and is secured to a movable head 12. The movable head 12 is held to be able to move back and forth along the X-axial direction or Y-axial direction (second direction) along a guide rail 14. The movable head 12 is screwed together with a shaft 16 of a motor 18 serving as the second actuator. By the rotation of the shaft 16, it is controlled to move in the X-axial direction or Y-axial direction along the guide rail 14.

The motor 18 is controlled through a motor drive circuit 20 by a controller 22. Further, the cylinder 10 is controlled to send a drive signal from the controller 22 to a solenoid valve 24. Further, the introduction of the vacuum to or its release from the vacuum pad 6 is controlled by sending a drive signal to an ejector 27 for introducing vacuum to a drive tube 26 through an ejector driver circuit 28 from the controller 22.

The device pickup and holding device 2 according to the present embodiment is used for example for picking up and holding an IC chip 4 at a predetermined position A and conveying it to another position B. The overall flow of the control sequence in this case will be explained below.

First, a drive signal is sent from the controller 22 to the solenoid valve 24, the solenoid valve 24 is made to operate, air is fed into the descent cylinder chamber of the pressure cylinder 10, the movable shaft 8 is made

to move to descend in the Z-axial direction, and the vacuum pad 6 is made to abut against the top surface of an IC chip 4 accommodated at a predetermined position A. This is confirmed by a position sensor, then the controller 22 sends a drive signal to the ejector driver 28 and the IC chip 4 is picked up and held by the vacuum pad 6.

The pickup of the IC chip 4 is confirmed by the sensor, then the controller 22 sends a drive signal to the solenoid valve 24, feeds air to the ascent cylinder chamber of the pressure cylinder 10, and makes the vacuum pad 6 move upward along the Z-axial direction. This is while the vacuum pad 6 picks up and holds the IC chip 4. Next, the controller 22 sends a drive signal to the motor 18 through the motor driver 20, drives the motor 18, and makes the shaft 16 rotate by a predetermined rotational angle. As a result, the movable head 12 moves along the guide rail 14 in the X-axial or Y-axial direction and the vacuum pad 6 stops in a state positioned on another position B.

Next, the controller 22 sends a drive signal to the solenoid valve 24, feeds air to the descent cylinder chamber of the pressure cylinder 10, and makes the vacuum pad 6 move to descend along the Z-axis. At the stage where the IC chip 4 is positioned close to the position B, the controller 22 sends a drive signal through the ejector driver 28 to the ejector 27, releases the vacuum of the vacuum pad 6, and releases the pickup and hold of the IC chip 4 by the vacuum pad 6. As a result, the IC chip 4 is dropped from the vacuum pad 6 to the position B.

Next, an empty vacuum pad 6 rises along the Z-axial direction by the pressure cylinder 10 and the motor 18 is driven to move it to the original position or another

position and thereby repeatedly pick up, hold, and convey the IC chips 4 as explained above.

In this series of control sequences, in the present embodiment, the vacuum pad 6 is made to move along the X-axial or Y-axial direction to a predetermined position A or B, then a control sequence for making the vacuum pad 6 move downward in the Z-axial direction is performed based on the flow chart of Fig. 2. Note that the control shown in Fig. 2 may be performed by a dedicated control circuit, but it may also be performed by a computer having a software program corresponding to Fig. 2.

As shown in Fig. 2, when the control starts at step S1, in the controller 22 shown in Fig. 1, it is judged at step S2 whether motor output pulses have been generated or not. The motor output pulses are generated by a motor drive signal generation circuit (second actuator drive signal generation circuit) built into the controller 22. When it is judged at step S2 shown in Fig. 2 that the motor output pulses have been generated, the controller 22 shown in Fig. 1 outputs a movement pulse signal to the motor driver circuit 20 at step S3. The motor driver circuit 20 outputs a motor drive signal to the motor 18 based on the movement pulse signal and makes the shaft 16 turn. The output monitor of the motor drive pulse signal is shown in Fig. 4A. As shown in Fig. 4A, at the timing T_{ms} when the movement pulse signal is output, the motor drive signal is generated and a motor operation command is produced. The motor rises in speed from the timing T_{ms} and accelerates by a certain rate after that. It then decelerates at the timing T_{me} when the motor drive pulses are falling, then vibrates slightly and then slows completely to the speed 0.

The motor 18 sends an encoder feedback signal corresponding to the rotational angle to the motor driver

circuit 20. In the motor driver circuit 20 or controller 22, as shown by the step S4 shown in Fig. 2, the motor drive pulses (time of continuation of the pulses or number of pulses) are measured and the result of measurement made P1. The motor movement pulses P1 of the result of the measurement correspond to the distance of movement of the movable head 12 shown in Fig. 1 along the guide rail 14.

In the present embodiment, at step S5 shown in Fig. 2, it is judged if the measured motor movement pulses P1 have reached the pre-stop interruption output pulses (time of continuation of pulses or number of pulses) P2 or not. When P1 has become equal to or more than P2, the routine proceeds to step 26 shown in Fig. 2. When not, steps S4 and S5 are repeated. Whether or not P1 has become equal to or more than P2 is judged by a comparator 80 shown in Fig. 3 built into the controller 22 shown in Fig. 1.

As shown in Fig. 3, the output signal of the comparator 80 is input to a first input terminal of an AND circuit 82. A second input terminal of the AND circuit 82 receives as input a pre-stop interruption signal. The output terminal of the AND circuit 82 inputs the signal to a first input terminal of an OR circuit 84. In the present embodiment, a second input terminal of the OR circuit 84 is connected to the output terminal of a separate AND circuit 86. A first input terminal of the AND circuit 86 receives as input a movement pulse output completion signal. The "movement pulse output completion signal" is a signal output at the timing Tme shown in Fig. 4A. Further, a second input terminal of the AND circuit 86 receives as input a positioning completion signal. The "positioning completion signal" is a signal of the detection of the position of the axial center of

the vacuum pad 6 shown in Fig. 1 in the X-axial or Y-axial direction and showing the detection of movement to the predetermined position A or B. In Fig. 4A, this is the position of the timing T_i .

When it is judged at step S5 shown in Fig. 2 that the measured movement pulses P1 have reached the pre-stop interruption output pulses P2, the routine proceeds to step S6. At the timing T_{ws} shown in Fig. 4A, an interruption signal is generated from the output terminal of the OR circuit 84 shown in Fig. 3. Note that in the example shown in Fig. 3, even when it is judged that the measured movement pulses P1 have not reached the pre-stop interruption output pulses P2, when a movement pulse output completion signal and positioning completion signal are input to the AND circuit 86, the interruption signal is generated by the OR circuit 84. That is, in the timing chart shown in Fig. 4A, if the motor movement pulses end at the timing T_{me} and a positioning completion signal is generated at the timing T_i , even if an interruption signal is not generated at the timing T_{ws} , an interruption signal is generated to ensure the safety of the system. Further, in the interruption signal generation circuit of a conventional controller, since an interruption signal was generated only by the AND circuit 86 shown in Fig. 3, in the present embodiment it is sufficient to add just the comparator 80, AND circuit 82, and OR circuit 84 to the conventional interruption signal generation circuit and therefore it is possible to minimize the change to the circuit (or software).

In the present embodiment, the pre-stop interruption output pulses P2 are a value determined so that an interruption signal is generated at the point of time before detection that the axial center of the vacuum pad 6 shown in Fig. 1 has reached the predetermined stopping

position A or B in the X-axial or Y-axial direction and preset in a register. That is, the pre-stop interruption output pulses P2 are determined in advance by experiments etc. so that the interruption signal generation timing T_{ws} shown in Fig. 4A becomes before the timing T_{me} of stopping of the motor movement pulses and are stored in the register of the controller 22 shown in Fig. 1.

When an interruption signal is generated at step S6 shown in Fig. 2, an interruption is generated and control shifts to the wait routine. During this time as well, however, movement pulses are output to the driver until a prescribed position is reached. The controller 22 shown in Fig. 1 measures the time from the generation of the interruption signal by the timer circuit etc. at step S7 and makes the measured time " t ". Next, at step S8, the controller 22 shown in Fig. 1 judges if the measured time " t " is equal to or more than a predetermined wait time " t_w ". When the measured time " t " is equal to or more than the predetermined wait time t_w , the routine proceeds to step S9, while when not, steps S7 and S8 are repeated. At step S9, a drive signal is output from the controller 22 shown in Fig. 1 to the solenoid valve 24 of the pressure cylinder 10. The wait time " t_w " is the time for adjustment of the timing T_e for outputting a drive signal from the controller 22 shown in Fig. 1 to the solenoid valve 24 of the pressure cylinder 10. For example, it is a time of about 100 ms.

When a drive signal is output from the controller 22 shown in Fig. 1 to the solenoid valve 24 of the pressure cylinder 10, the solenoid valve 24 operates, air is fed to the descent cylinder chamber of the pressure cylinder 10, and, as shown in Fig. 4A, the movable shaft 8 shown in Fig. 1 starts to move at the timing T_{ss} slightly delayed after the timing T_e . The timing T_{ss} of the start

of the movement is detected by an upper cylinder sensor attached to the pressure cylinder 10. A lower cylinder sensor attached to the pressure cylinder 10 is used to detect if the movable shaft 8 shown in Fig. 1 has moved to a predetermined descent position along the Z-axial direction (step S10 shown in Fig. 2). The timing is shown by the timing Tse shown in Fig. 4A. This timing means when the vacuum pad 6 shown in Fig. 1 reaches the descent position at the maximum extent at the predetermined position A or B. In this state, the routine proceeds to step S11 shown in Fig. 2 where the next sequential operation, that is, the operation of picking up and holding or releasing the pickup of the IC chip by the vacuum pad 6, is performed. The pickup and holding or pickup release operation of the IC chip 4 by the vacuum pad 6 is performed by the controller 22 controlling the ejector 27 through the ejector driver circuit 28.

Note that instead of the above cylinder sensor, it is possible to use a position sensor mechanically or optically detecting from the outside the Z-axial direction position of the vacuum pad 6 or movable shaft 6.

In the device pickup and holding device 2 of the device handler according to the present embodiment and the method of control of the same, the motor 18 is used to move the vacuum pad 6 and pressure cylinder 10 along the X-axial or Y-axial direction and an interruption signal is generated at the timing TwS (see Fig. 4A) before it is detected that it reaches the predetermined stopping position. Further, the wait time "tw" is counted using as a reference the point of time of generation of the interruption signal. When it is detected that the predetermined wait time "tw" has elapsed, a signal for driving the solenoid valve 24 of the pressure cylinder 10

shown in Fig. 1 is output.

Therefore, as shown in Fig. 4A, the mechanical vibration due to the stopping of the drive of the motor 18 dies down in the time from the timing T_e of output of the signal for driving the solenoid valve 24 of the pressure cylinder 10 to the timing T_{ss} where the pressure cylinder is actually driven. Therefore, there is almost no wasted time from the actual stopping of the drive of the motor 18 to the timing T_{ss} of the start of the actual drive of the pressure cylinder 10. It becomes possible to proceed to the next sequential operation and thereby increase the speed of the sequential operations at the timing T_{se} . Such sequential operations are repeated several thousand or several tens of thousands of times in the device handler, so as a result it is possible to improve the throughput of the device processing.

Note that the conventional sequential operations corresponding to Fig. 4A are shown in Fig. 4B. As shown in Fig. 4B, in the conventional device, the interruption signal is generated at the timing T_i' where the positioning completion signal is generated, the wait time is measured based on the interruption signal, and a drive signal of the solenoid valve is output at the timing T_e' . Therefore, there has been a large delay between the timing T_{ss}' where the pressure cylinder actually stops to move and the timing T_{se}' where the pressure cylinder stops moving and the next sequential operation is shifted to compared with the device of the embodiment shown in Fig. 4A.

Figures 5A and 5B are timing charts showing the timing charts shown in Figs. 4A and 4B from another perspective. The same references are assigned to timings the same as the timings shown in Figs. 4A and 4B. The time MT shown by the hatching in Figs. 5A and 5B is the

actual operating time of the motor 18 including the mechanical vibration, while the time PT shown by the hatching is the actual operating time of the pressure cylinder 10. Figure 5A corresponds to Fig. 4A and is a result of the control of the device of the present embodiment. Figure 5B corresponds to Fig. 4B and is the result of the control of the conventional device. As shown in Fig. 5A, according to the control of the device of the present embodiment, it is learned that the actual operating time PT of the pressure cylinder 10 comes directly after the actual operating time MT of the motor 18 including the mechanical vibration and that the sequential operations can be increased in speed compared with control of the conventional device shown in Fig. 5B. Specifically, in the present embodiment, the time from Tms to Tse can be shortened by about 100 ms compared with the time from Tms to Tse' in the conventional device.

Second Embodiment

In the present embodiment, the example is shown of application of a device pickup and holding device similar to the device pickup and holding device 2 according to the first embodiment to an actual IC chip device tester.

As shown in Fig. 6 and Fig. 7, the IC chip device tester 30 of the present embodiment is a device for heating and testing an IC chip to be tested in a state of a temperature higher than ordinary temperature and is provided with a handler 32, test head 34, and main tester 36.

The handler 32 executes the operation of successively conveying IC chips 4 to be tested to an IC socket 36 provided at the test head 34 and stores the IC chips 4 finished being tested in predetermined trays sorted in accordance with the results of the tests.

As shown in Fig. 7, the IC socket 36 provided at the

test head 34 is connected through a cable 38 to the main tester 36. The IC chip 4 mounted detachably at the IC socket 36 is connected through the cable 38 to the main tester 36. The IC chip 4 is tested by test signals from the main tester 36.

The handler 32 has a board 40. The IC chip conveying drive parts are mainly mounted on the top of this board 40. The controller for controlling the handler 32 is mainly built into the bottom of this board 40. Some empty portion 42 is provided however. The test head 34 is arranged interchangeably at this empty portion. An IC chip 4 can be mounted to the IC socket 36 through a hole 44 formed in the board 40.

As shown in Fig. 6, first and second X-Y stages (corresponding to the device pickup and holding device 2 shown in Fig. 1) 2a and 2b are provided on the board 40. The first X-Y stage 2a is used for the work of conveying the IC chips 4 to be tested and the work of sorting the IC chips 4 finished being tested. The second X-Y stage 2b performs the work of conveying an IC chip 4 supplied from the buffer 50 to the test head 34 and conveying an IC chip 4 finished being tested from the test head 34 to another buffer 51.

The first X-Y stage 2a is provided with a first X-axial rail 14a extending along the X-axial direction, a first Y-axial rail 14b extending along the Y-axial direction and configured to be able to move in the X-direction along the first X-axial rail 14a, and a first movable head 12a able to move in the Y-axial direction along the first Y-axial rail 14b. The first movable head 12a is provided with two pressure cylinders 10a. The first X-Y stage 2a basically has the same configuration as the device pickup and holding device 2 shown in Fig. 1. In the present embodiment, the first region 52 on the

board 40 shown in Fig. 6 is made the conveyable region.

The second X-Y stage 2b is provided with a second X-axial rail 14c extending along the X-axial direction, a second Y-axial rail 14d extending along the Y-axial direction and configured to be able to move in the X-direction along the second X-axial rail 14c, and a second movable head 12b able to move in the Y-axial direction along the second Y-axial rail 14d. The second movable head 12b is provided with two pressure cylinders 10b. The X-Y stage 2b basically has the same configuration as the device pickup and holding device 2 shown in Fig. 1. In the present embodiment, the second region 56 on the board 40 shown in Fig. 6 is made the conveyable region.

In the first movement region 52 are provided feed trays 58 for storing IC chips 4 to be tested, sorting trays 60, 61, 62, and 63 for storing tested IC chips 4 sorted in accordance with the test results, and portion 64 for stacking empty trays and is arranged a heat plate 65 in proximity to the buffer 50.

The heat plate 65 is formed for example of a metal material and is provided with a plurality of IC holding depressions 66 for holding the IC chips 4 under test. The IC chips 4 under test are conveyed to the IC holding depressions 66 from the feed tray 58 by the X-Y stage 2a. The heat plate 65 heats the IC chips 4 before test by a not shown heater to heat them to a predetermined temperature. The IC chips 4 are heated to a predetermined temperature on this heat plate 65, then are moved to the buffer 50 using the first X-Y stage 2a and then moved by the second X-Y stage 2b to the test head 34 where they are tested. That is, the IC chips 4 are tested in a state higher than ordinary temperature.

The buffers 50 and 51 are configured to be able to move in the X-direction along the rails 68 and 69 and are

configured to move back and forth between the operating region 52 of the first X-Y stage 2a and the operating region 56 of the second X-Y stage 2b. That is, the buffer 50 performs the work for making the IC chip 4 under test move from the region 52 to the region 56, while the buffer 51 performs the work for carrying the IC chip 4 finished being tested from the region 56 to the region 52. Due to the existence of the buffers 50 and 51, the X-Y stages 2a and 2b can move without mutual interference.

The X-Y stages 2a and 2b have pressure cylinders 10a and 10b attached to them. These pressure cylinders 10a and 10b, like the pressure cylinder 10 shown in Fig. 1, are each provided with a movable shaft 8 and vacuum pad 6 and perform the operation of picking up an IC chip 4 from a tray or heat plate 65 or a test head 34 and the operation of dropping an IC chip 4 on a tray and heat plate 65 or test head 34.

The X-Y stages 2a and 2b of the handler 30 according to the present embodiment are controlled in the same way as the device pickup and holding device shown in Fig. 1, therefore it is possible to improve the throughput of the device processing in the handler 30.

Note that the present invention is not limited to the above embodiment and may be modified in various ways within the scope of the present invention.

For example, in the above first embodiment, the explanation was made of the controller 22 shown in Fig. 1 executing the sequence control shown in Fig. 2, but part or all of the control shown in Fig. 2 may be performed by sequence control connected to the controller 22.

Further, the device handler (handler) according to the present invention is not limited to the handler of the configuration shown in Fig. 6 and Fig. 7 and may be

modified in various ways.

As explained above, according to the device handler of the present invention and its method of control, it is possible to increase the speed of the sequential operations of the actuator mounted in the device handler and improve the throughput of the device processing.

WHAT IS CLAIMED IS:

1. A device handler comprising:
 - a device holder for detachably holding a device,
 - a first actuator for making the device holder move in a first direction,
 - a second actuator for making the device holder and the first actuator move in a second direction different from the first direction,
 - an interruption signal generation circuit for generating an interruption signal at a time before it is detected that the device holder and the first actuator moving along the second direction have reached predetermined stopping positions,
 - a timer circuit for counting a wait time using as a reference the time at which the interruption signal generation circuit generates the interruption signal, and
 - a first actuator drive signal generation circuit which outputs a signal driving the first actuator when the timer circuit detects that the predetermined wait time has elapsed.
2. The device handler as set forth in claim 1, further comprising a first direction position detection sensor for detecting the position of the device holder made to move in the first direction by the first actuator.
3. The device handler as set forth in claim 1, further comprising a second actuator drive signal generation circuit outputting a drive signal for driving the second actuator.



4. The device handler as set forth in claim 3, wherein the interruption signal generation circuit outputs the interruption signal after a predetermined time using as a reference a time when a drive signal starts to be output from the second actuator drive signal generation circuit to the second actuator.

5. The device handler as set forth in claim 1, wherein the device holder is provided with a vacuum pad for picking up the device by vacuum.

6. The device handler as set forth in claim 1, wherein the first actuator is a pressure cylinder and the second actuator is a motor able to be controlled in rotational angle by a drive signal.

7. A method for control of a device handler provided with a device holder for detachably holding a device, a first actuator for making the device holder move in a first direction, and a second actuator for making the device holder and the first actuator move in a second direction different from the first direction, comprising the steps of :

generating an interruption signal at the point of time before it is detected that the device holder and the first actuator moving along the second direction by the second actuator have reached predetermined stopping positions,

counting a wait time using as a reference the point of time when the interruption signal is generated, and outputting a signal driving the first actuator when it is detected that a predetermined wait time has elapsed.



8. The method for control of a device handler as set forth in claim 7, wherein the timing for making the interruption signal be generated is set to after the elapse of a predetermined time using as a reference the point of time when the drive signal for driving the second actuator starts to be output.



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