

PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a processing apparatus.

Description of the Related Art

At the time of setting processing conditions for a processing apparatus including a touch panel, an operator inputs the processing conditions by operating the touch panel. In this instance, the operator inputs predetermined information (numerical values, character strings, and the like) to the processing apparatus by performing touch operations on input keys included in an input section (numeric keypad, keyboard, or the like) displayed on the touch panel. For example, Japanese Patent Laid-open No. 2001-84015 discloses a processing apparatus in which an operation panel having digit setting keys for setting a digit of a numerical value is mounted.

SUMMARY OF THE INVENTION

However, the conventional processing apparatus has a problem that, since the input keys displayed on the

touch panel are closely disposed with narrow spacings, the operator may input erroneous information in the case where the number of digits of the numerical value to be inputted is large. When erroneous information is inputted to the touch panel, the processing apparatus would process a workpiece under unintended processing conditions, possibly generating defective processing. In addition, since the processing conditions of the processing apparatus set from decimal places to 10 or more digits, if a plurality of digit setting keys are normally displayed as in the processing apparatus of Japanese Patent Laid-open No. 2001-84015, the numeric keys for inputting numerical values become small in size, and operability at the time of inputting is lowered.

Accordingly, it is an object of the present invention to provide a processing apparatus with which an increase in a region for displaying numeric keys can be restrained and erroneous input in the case of inputting a plurality of digits can be restrained.

In accordance with an aspect of the present invention, there is provided a processing apparatus including a holding table that holds a workpiece, a processing unit that processes the workpiece held by the holding table, an operation panel through which

processing conditions are inputted, and a control unit that controls the operation panel. The control unit causes the operation panel to display a plurality of input columns corresponding to a plurality of items included in the processing conditions. When one of the plurality of input columns is selected, the control unit causes the operation panel to display numeric keys. When one of the numeric keys is selected, the control unit causes the operation panel to display a plurality of different-digit numeric keys corresponding to a plurality of numerical values containing a numeral inputted by the numeric key in different digits. When one of the different-digit numeric keys is selected, the control unit inputs the numerical value of the selected different-digit numeric key into the input column.

Preferably, in the processing apparatus, selection from the different-digit numeric keys is performed by a flick operation from the numeric key.

Preferably, in the processing apparatus, the control unit has a range setting section that sets a range of numerical values to be inputted into each of the plurality of input columns. The control unit causes the operation panel to display only the different-digit numeric keys corresponding to numerical values that fall

within the range set by the range setting section.

Preferably, the processing apparatus further includes a digit storage section that stores the plurality of input columns and digits of numerical values that have previously been inputted into the plurality of input columns, in an associated manner. When one of the input columns is selected, the control unit causes the operation panel to display only the different-digit numeric keys corresponding to the digits stored in the digit storage section.

The processing apparatus of the present invention produces effects that, for example, the numeric keys for inputting numerical values are restrained from becoming small in size, operability at the time of inputting is restrained from being lowered, and operability in inputting a plurality of digits can be enhanced.

The above and other objects, features and advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claims with reference to the attached drawings showing a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view depicting a configuration example of a processing apparatus according to an embodiment;

FIG. 2 is a diagram schematically depicting one example of a functional configuration of the processing apparatus according to the embodiment;

FIG. 3 is a diagram depicting a display example of device data according to the embodiment;

FIG. 4 is a diagram for explaining one example of input processing performed into input columns according to the embodiment;

FIG. 5 is a diagram for explaining another example of the input processing performed into the input columns according to the embodiment;

FIG. 6 is a diagram for explaining a further example of the input processing performed into the input columns according to the embodiment;

FIG. 7 is a flow chart depicting one example of a processing procedure of the input processing of the processing apparatus according to the embodiment;

FIG. 8 is a diagram depicting one example of digit data according to the embodiment;

FIG. 9 is a diagram for explaining a modification

of the input processing performed into the input columns according to the embodiment;

FIG. 10 is a perspective view schematically depicting a configuration example of a processing apparatus according to a first modification of the embodiment; and

FIG. 11 is a perspective view schematically depicting a configuration example of a processing apparatus according to a second modification of the embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will be described in detail below referring to the attached drawings. The present invention is not limited by the contents of the following description of the embodiment. In addition, the configuration elements described below include those which can be easily conceived by a person skilled in the art and those which are substantially the same. Further, the configurations described below can be combined, as required. Besides, various kinds of omission, replacement, or modification of the configurations are possible within such ranges as not to depart from the gist of the present invention.

[Embodiment]

A processing apparatus 1 according to an embodiment of the present invention will be described based on the drawings. FIG. 1 is a perspective view depicting a configuration example of the processing apparatus 1 according to the embodiment. FIG. 2 is a diagram schematically depicting an example of a functional configuration of the processing apparatus 1 according to the embodiment.

As illustrated in FIG. 1, the processing apparatus 1 according to the embodiment includes a main body 2 which is a box-shaped housing. As depicted in FIG. 1, the processing apparatus 1 includes a chuck table 10, a processing unit 20, a touch panel 30, and a control unit 40. The control unit 40 is electrically connected to the chuck table 10, the processing unit 20, and the touch panel 30.

A workpiece 101 to be processed by the processing apparatus 1 is, for example, a disk-shaped semiconductor wafer or optical device wafer including silicon, sapphire, gallium arsenide, or the like. The workpiece 101 is supported in an opening of an annular frame 102 through an adhesive tape 103, to thereby configure a workpiece unit 100 including the workpiece 101.

The chuck table 10 holds the workpiece unit 100 on a holding surface thereof. The chuck table 10 communicates with a suction source not illustrated and holds the workpiece unit 100 under suction by a negative pressure supplied from the suction source. The chuck table 10 can be moved along an X-axis direction by an X-axis moving mechanism 22 to be described later and can be rotated around a Z axis by a rotational drive source not illustrated.

In the present embodiment, as depicted in FIG. 2, the processing apparatus 1 further includes an imaging unit 12, a drive mechanism 14, and a Z-axis moving mechanism 15. The control unit 40 is electrically connected to the imaging unit 12, the drive mechanism 14, and the Z-axis moving mechanism 15.

As illustrated in FIGS. 1 and 2, the imaging unit 12 is an electron microscope on which an image sensor such as a charge coupled device (CCD) or a complementary metal oxide semiconductor (CMOS) is mounted. The imaging unit 12 images a front surface of the workpiece 101 held on the holding surface of the chuck table 10. The imaging unit 12 is attached to and supported by a part of a housing of the processing unit 20 to be integrated with the processing unit 20, and is movable in a Z-axis

direction by the Z-axis moving mechanism 15 which includes a ball screw, a nut, a pulse motor, and the like. The imaging unit 12 may include, for example, a light source for applying illumination light to the front surface of the workpiece 101 held on the holding surface of the chuck table 10.

The processing unit 20 processes the workpiece 101 held by the chuck table 10. The processing unit 20 is, for example, a pair of cutting units, each of which has a cutting blade. The cutting blades of the pair of cutting units face each other in a Y-axis direction, and they are both rotated around a Y axis. The processing unit 20 cuts the workpiece 101 by using the cutting blades that are rotating. The processing unit 20 can be moved along the Y-axis direction by a Y-axis moving mechanism 27 and can be moved along the Z-axis direction by the Z-axis moving mechanism 15. The Y-axis moving mechanism 27 that moves the imaging unit 12 and the processing unit 20 in the Y-axis direction with respect to the holding surface of the chuck table 10 includes a ball screw, a nut, a pulse motor, and the like and constitutes the drive mechanism 14 together with the X-axis moving mechanism 22.

The processing apparatus 1 moves the chuck table 10 and the processing unit 20 relative to each other by

using the X-axis moving mechanism 22, the Y-axis moving mechanism 27, and the Z-axis moving mechanism 15, to thereby process the workpiece 101 held by the chuck table 10.

Note that the processing unit 20 included in the processing apparatus 1 is not limited to a cutting unit that cuts the workpiece 101 by using a cutting blade. Other examples of the processing unit 20 may include a grinding unit that grinds a similar workpiece 101 by a grindstone or the like, a polishing unit that polishes a similar workpiece 101 by a polishing pad or the like, and a laser processing unit that performs laser processing by applying a laser beam to a similar workpiece 101.

As depicted in FIG. 1, the touch panel 30 is mounted on the main body 2 in a state in which a display surface thereof is directed to outside. The touch panel 30 is disposed at a part of the housing of the processing apparatus 1 where the touch panel 30 is easy to look at and operate. Under the control of the control unit 40, the touch panel 30 displays an image of the front surface of the workpiece 101 imaged by the imaging unit 12 and various kinds of information required for processing, and accepts an input operation and the like necessary for processing from an operator. In the present embodiment,

the touch panel 30 is an example of an operation panel.

As depicted in FIG. 2, the touch panel 30 includes a display section 31 that displays various kinds of information concerning the processing apparatus 1 and an input section 32 that accepts various kinds of operation inputs concerning the processing apparatus 1, such as setting inputs of processing conditions, from the operator. The display section 31 has, for example, a display device such as a liquid crystal display and an organic electroluminescence (EL) display. The input section 32 has, for example, a touch screen that designates a contact position and coordinates of an object on the display surface of the display device.

While a case where the touch panel 30 is an example of an output section that outputs information is described in the present embodiment, this is not limitative. For example, the output section may be realized by an electronic apparatus such as a speaker or a communication device.

As depicted in FIG. 2, the processing apparatus 1 includes a storage 50. The storage 50 stores a program for realizing functions such as various kinds of processing executed by the control unit 40, data used for processing by such a program, and the like. The storage

50 is electrically connected to the control unit 40. The storage 50 can be realized by a hard disk drive (HDD), a semiconductor memory, or the like. The storage 50 may be utilized as a temporary working area at the time when a processor included in the control unit 40 executes a command described in a control program.

Note that a case where the processing apparatus 1 includes the storage 50 is described in the present embodiment, but the configuration of the processing apparatus 1 is not restricted to this. For example, the storage 50 can be a storage device to which the processing apparatus 1 can make access, such as a computer and an electronic apparatus outside the processing apparatus 1, another processing apparatus 1, and the like.

The storage 50 can store, for example, various kinds of data such as device data 500 and digit data 510. The device data 500 include, for example, data for displaying input columns in which the operator can set processing conditions for the workpiece 101. The device data 500 are prepared for each device type. For example, the device types are managed in terms of numbers assigned to devices. The device data 500 are, for example, displayed on the touch panel 30 as a device data screen

having a plurality of input columns. In the device data 500, the input columns and numerical values inputted into the input columns or default values are associated with each other. When a device number is designated, the control unit 40 inputs, into the input columns, values of setting items associated with the device number.

The digit data 510 include data that associate the input columns of the device data 500 and the like with digits of a plurality of numerical values inputted into the input columns in the past. The digit data 510 include data indicative of a range of numerical values that can be inputted into the input columns. The storage 50 storing the digit data 510 functions as a digit storage section. In addition, a case where the digit data 510 and the device data 500 are different from each other is described in the present embodiment, but the digit data 510 are not limited to this. The digit data 510 may be included in the device data 500.

Note that input processing of numerical values into the input columns indicated by the device data 500 is described in the present embodiment, but the processing in the processing apparatus 1 is not limited to this. For example, the present invention is applicable to processing performed at the time when the operator inputs

numerical values into a plurality of input columns for alignment data, cleaning data, conveyance data, kerf check data, and the like.

The control unit 40 controls each of the mechanisms (the X-axis moving mechanism 22, the Y-axis moving mechanism 27, and the Z-axis moving mechanism 15) that drive the processing apparatus 1. The control unit 40 controls each part of the processing apparatus 1, to thereby realize processing by the processing apparatus 1. The control unit 40, for example, controls each part of the processing apparatus 1 inclusive of the chuck table 10 and the processing unit 20, according to processing conditions inputted and set by the operator, to thereby realize processing of the workpiece 101.

The control unit 40 includes an arithmetic processing device such as a central processing unit (CPU), a storage device such as a read only memory (ROM) or a random access memory (RAM), and an input-output interface device. The control unit 40 is a computer capable of executing, for example, a control program for controlling each of the above-described configuration elements, according to a series of processing steps carried out by the processing apparatus 1, by use of such devices.

The control unit 40 controls the operation as a whole of the processing apparatus 1, according to the processing conditions set by the operator through the input section 32 of the touch panel 30. The control unit 40 includes a display control section 41 and a range setting section 42. The control unit 40 realizes functions, actions, and the like of the sections by executing a program.

The display control section 41 controls display of the display section 31 of the touch panel 30. The display control section 41 causes the touch panel 30 to display a plurality of input columns corresponding to a plurality of items included in the processing conditions for the devices of the workpiece 101. When one of the plurality of input columns is selected, the display control section 41 causes numeric keys to be displayed. The display control section 41 detects a gesture based on a contact detected by the input section 32, a position on the touch panel 30 where the contact is detected, variation in the position where the contact is detected, and the like. A gesture is an operation performed by the operator on the touch panel 30. The display control section 41 detects gestures such as a touch, a tap, a long touch, a release, and a flick.

When one of the numeric keys is selected by a first gesture, the display control section 41 inputs a numerical value indicated by the numeric key into the input column. The first gesture includes, for example, a gesture such as a touch or a tap. When one of the numeric keys is selected by a second gesture, the display control section 41 causes a plurality of different-digit numeric keys corresponding to a plurality of numerical values containing the numeral inputted by the numeric key in different digits (places), to be displayed. The second gesture includes, for example, a gesture such as a long touch and a flick. For example, in the case where the numeric key of "1" is selected, the display control section 41 causes different-digit numeric keys indicative of numerical values "0.1," "0.01," "10," "100," and the like which contain the selected numeral "1" in different digits (places), to be displayed. In other words, the different-digit numeric keys represent respective numerical values obtained by multiplying the numeral selected by the numeric key by 10^n (n is a positive or negative integer).

Note that the display control section 41 may cause the different-digit numeric keys to be displayed by the first gesture. In this case, when one numeric key is

selected by the first gesture including a touch, a tap, a long touch, a flick, or the like, different-digit numeric keys are displayed in the vicinity of the selected numeric key.

Next, when the operator performs a second gesture of sliding the contact position to one of the different-digit numeric keys while keeping the contact with the touch panel 30 and thereafter breaking the contact on the different-digit numeric key, the display control section 41 inputs the numerical value of the different-digit numeric key into the input column. In addition, when the operator performs a second gesture of breaking the contact on the numeric key without sliding the contact position to any of the different-digit numeric keys, the display control section 41 inputs the numerical value of the numeric key into the input column.

When one of the different-digit numeric keys is selected, the display control section 41 inputs the numerical value of the selected different-digit numeric key into the input column. The display control section 41 detects that the different-digit numeric key is selected, by a flick operation from the numeric key to the different-digit numeric key. In this manner, the processing apparatus 1 allows the operator to select one

of the different-digit numeric keys by a continuous operation from the numeric key to the different-digit numeric key, so that operability concerning the different-digit numeric keys can be enhanced. As a result, the processing apparatus 1 need not cause the touch panel 30 to always display the different-digit numeric keys, so that the size of each numeric key is not reduced, and erroneous inputs of numerals can be prevented.

The range setting section 42 sets ranges of numerical values that can be inputted into the respective input columns. For example, when the ranges of numerical values that can be inputted into the input columns are set, the range setting section 42 associates information indicative of the ranges of numerical values with the items of the input columns of the device data 500. For example, in the case where numerical values from 1 to 5000 can be inputted into an input column, the range setting section 42, for example, associates the information indicating that numerical values in the range of 1 to 5000 can be inputted into the input column, with the input column. Then, the display control section 41 causes only the different-digit numeric keys indicative of the numerical values that fall within the range set by

the range setting section 42 to be displayed in the vicinity of the relevant numeric key.

The configuration example of the processing apparatus 1 according to the present embodiment has been described above. Note that the above configuration described using FIGS. 1 and 2 is merely an example, and the configuration of the processing apparatus 1 according to the present embodiment is not limited to the described example. The functional configuration of the processing apparatus 1 according to the present embodiment can be flexibly modified according to specifications and operations.

(Example of Input Processing into Input Columns)

Next, an example of input processing performed by the processing apparatus 1 according to the embodiment will be described. FIG. 3 is a diagram depicting a display example of the device data 500, according to the embodiment. FIG. 4 is a diagram for explaining an example of input processing performed into input columns, according to the embodiment. FIGS. 5 and 6 are diagrams for explaining other examples of the input processing performed into the input columns, according to the embodiment.

The device data 500 depicted in FIG. 3 are

displayed on the display section 31 of the touch panel 30 as a device data screen under the control of the control unit 40. The device data 500 have a plurality of input columns 501. The plurality of input columns 501 are configured such that numerical values inputted by operator's operations can be inputted. In the example depicted in FIG. 3, the device data 500 have the plurality of input columns 501 corresponding to the respective items such as "spindle rotational speed," "blade height," "feeding speed," "index," "work shape and size," and "thickness." The control unit 40 controls the display section 31 of the touch panel 30 such that an input key section 600 for receiving inputs of numerical values by the operator is displayed in the vicinity of the device data 500. The control unit 40, for example, may cause the input key section 600 to be displayed when any one of the plurality of input columns 501 is selected by the operator, or may cause the input key section 600 to always be displayed.

The input key section 600 has a plurality of numeric keys 610 and a plurality of operation keys 620. The plurality of numeric keys 610 are keys from "0" to "9" for the operator to input numerical values. The plurality of operation keys 620 are keys for the operator

to select a command such as decision, movement, deletion, and shift.

In the example depicted in FIG. 3, in the device data 500, the input column 501 corresponding to "tape" of an item "thickness" is currently selected by the operator. In this case, the control unit 40 causes the input key section 600 to be displayed together with the device data 500, and controls the display section 31 of the touch panel 30 such that this input column 501 is displayed in a mode indicative of the selected state.

In a scene 1001 depicted in FIG. 4, the control unit 40 causes the display section 31 to display device data 500 not illustrated and the input key section 600. An operator's finger is in contact with the touch panel 30 at a position of the numeric key 610 of "9." Then, as depicted in a scene 1002, the operator immediately removes the finger having touched the touch panel 30 from the position of the numeric key 610 of "9." In this case, the control unit 40 detects the touching operation on the numeric key 610 of "9" through the touch panel 30. The control unit 40 recognizes that the numeric key 610 of "9" has been selected, inputs the numerical value indicated by the numeric key 610 of "9" into the input column 501, and updates the display of the device data

500. As a result, the processing apparatus 1 displays, to the operator, the device data 500 in which the numerical value "9" is inputted into the input column 501 corresponding to "tape" of the item "thickness."

In the scene 1001 depicted in FIG. 5, as illustrated in FIG. 4, the control unit 40 causes the display section 31 to display device data 500 not illustrated and the input key section 600. The operator has continued a state in which a finger is touching the position of the numeric key 610 of "9" on the touch panel 30, for a predetermined period of time or more. The predetermined period of time includes, for example, a period of time set for determining whether or not different-digit numeric keys 630 are to be displayed. Upon detecting the long-touch operation on the numeric key 610 of "9" through the input section 32, the control unit 40 controls the display section 31 to display a plurality of different-digit numeric keys 630, as depicted in a scene 1010. Note that the control unit 40 may control the display section 31 to display, upon detecting a touch operation on the numeric key 610 of "9" through the input section 32, a plurality of different-digit numeric keys 630.

In the example depicted in FIG. 5, the control unit

40 causes a plurality of different-digit numeric keys 630 to be displayed on both sides of the numeric key 610 of "9." The plurality of different-digit numeric keys 630 are, for example, a plurality of keys corresponding to a plurality of numerical values in which the numeral "9" inputted by the numeric key 610 is present in different digits (places). The plurality of different-digit numeric keys 630 include, for example, four different-digit keys after the decimal point of "0.9," "0.09," "0.009," and "0.0009," and four different-digit keys of integers "90," "900," "9000," and "90000." The different-digit numeric keys 630 of "0.9," "0.09," "0.009," and "0.0009" are superimposed on the numeric keys 610 of "8," "5," and "2" and are displayed in a column form along the numeric keys 610. The different-digit numeric keys 630 of "90," "900," "9000," and "90000" are superimposed on the numeric keys 610 of "+/-," ".", and "0" and are displayed in a column form along the numeric keys 610. The plurality of different-digit numeric keys 630 may be preset for each input column 501, or the range of numerical values that can be inputted into each input column 501 may be set by the range setting section 42.

Subsequently, in a scene 1011, the operator, while keeping the finger designating the numeric key 610 of "9"

in contact with the touch panel 30, slides the finger to the different-digit numeric key 630 of "9000." Then, in a scene 1012, the operator removes from the touch panel 30 the finger having been in contact with the different-digit numeric key 630 of "9000." The control unit 40 detects the series of operator's operations from the scene 1011 to the scene 1012, as a flick operation to the different-digit numeric key 630 of "9000," through the input section 32. In this case, the control unit 40 recognizes that the different-digit numeric key 630 of "9000" has been selected, inputs the numerical value indicated by the different-digit numeric key 630 of "9000" into the input column 501, and updates the display of the device data 500. As a result, the processing apparatus 1 displays, to the operator, the device data 500 in which the numerical value "9000" is inputted into the input column 501 corresponding to "tape" of the item "thickness." Similarly, the processing apparatus 1 can cause a plurality of different-digit numeric keys to be displayed for each of the numeric keys 610 from "1" to "8."

For example, in the case of inputting "7500" into the input column 501, the operator first performs a tap operation on the numeric key 610 of "7" to input the

numerical value "7" into the input column 501. Then, the operator performs a long-touch operation on the numeric key 610 of "5," and, when the different-digit numeric key 630 of "500" is displayed, the operator performs a flick operation to the different-digit numeric key of "500," thereby inputting the numerical value "7500" into the input column 501. As a result, the operator can input the four-digit numerical value "7500" into the input column 501 by two operations, that is, the tap operation and the long-touch and flick operation. In other words, in the case of inputting "7500" into the input column 501, the processing apparatus 1 can reduce the number of times of operation from four times for the numeric keys 610 of "7," "5," "0," and "0" to two times, so that efficiency of input work can be enhanced.

For example, in the case of inputting "0.0125" into the input column 501, the operator first performs a long-touch operation on the numeric key 610 of "1," and, when the different-digit numeric key 630 of "0.01" is displayed, the operator performs a flick operation to the different-digit numeric key 630 of "0.01," thereby inputting the numerical value "0.01" into the input column 501. Then, the operator performs a tap operation on the numeric key 610 of "2" and a tap operation on the

numeric key 610 of "5," to thereby input the numerical value "0.0125" into the input column 501. In this manner, the operator can input the numerical value "0.0125" having four decimal places into the input column 501 by three times of operation in total, that is, the long-touch and flick operation and the two times of tap operation. In other words, in the case of inputting "0.0125" into the input column 501, the processing apparatus 1 can reduce the number of times of operation from five times for the numeric keys 610 of ".,", "0,", "1,", "2,", and "5" to three times, so that the efficiency of input work can be enhanced.

As described above, in the case of inputting a numerical value of a plurality of digits into an input column 501, the processing apparatus 1 causes different-digit numeric keys 630 to be displayed, so that the number of times of operating the numeric keys 610 can be reduced, restraining erroneous inputs. For example, in the case where the plurality of numeric keys 610 displayed on the touch panel 30 are closely disposed with narrow spacings, the processing apparatus 1 reduces the number of times of operating the numeric keys 610, so that erroneous inputs can be restrained. As a result, even in the case where the number of digits of a

numerical value to be inputted is large, the processing apparatus 1 can reduce the number of times of operation as compared to the case of operating only the numeric keys 610 a plurality of times, so that erroneous inputs can be restrained and operability can be enhanced.

Further, the processing apparatus 1 displays the different-digit numeric keys 630 superimposed on the numeric keys 610, so that the plurality of different-digit numeric keys 630 can be displayed even when the plurality of numeric keys 610 displayed in the display section 31 are closely disposed with narrow spacings.

In addition, the processing apparatus 1 causes, instead of causing the plurality of different-digit numeric keys 630 to always be displayed in the input key section 600, the different-digit numeric keys 630 to be displayed when one of the numeric keys 610 is selected through continuous contact of a predetermined period of time or more, so that one of the different-digit numeric keys 630 can be selected by a flick operation. As a result, the processing apparatus 1 need not reduce the size of the keys to be displayed, so that the operator can further be restrained from making an erroneous input.

Note that the processing apparatus 1 has been described in the present embodiment by using the case

where a plurality of different-digit numeric keys 630 are displayed on the left and right sides of a selected numeric key 610, but this is not limitative. For example, the processing apparatus 1 may display the plurality of different-digit numeric keys 630 on any of the upper, lower, left, right, and oblique sides of the numeric key 610 as long as the different-digit numeric keys 630 are displayed at positions adjacent to the numeric key 610. For example, the processing apparatus 1 may display the different-digit numeric keys 630 so as to partly overlap the numeric key 610 selected by the operator.

For example, it is assumed that, in the processing apparatus 1, the range setting section 42 sets the range of numerical values that can be inputted into one of the input columns 501 to be from 1 to 5000. In this case, the processing apparatus 1 can limit the number of different-digit numeric keys 630.

In a scene 1101 depicted in FIG. 6, the control unit 40 causes the display section 31 to display device data 500 not illustrated and the input key section 600. The operator has continued a state in which a finger is touching the position of the numeric key 610 of "5" on the touch panel 30, for a predetermined period of time or more. Upon detecting the long-touch operation on the

numeric key 610 of "5" through the input section 32, the control unit 40 specifies the different-digit numeric keys 630 to be displayed, based on the range of numerical values that can be inputted into the input column 501. For example, the control unit 40 specifies three different-digit numeric keys 630 of "50," "500," and "5000" that fall within the range of 1 to 5000. As depicted in a scene 1102, the control unit 40 controls the display section 31 to display the three different-digit numeric keys 630 of "50," "500," and "5000" in the manner of surrounding the numeric key 610 of "5."

In addition, for example, it is assumed that the input range for the input column 501 of the "thickness" of the tape is set to be 0.01 to 5.00 mm by the range setting section 42. In this case, when selection of the numeric key 610 of "9" for a predetermined period of time or more is detected, the processing apparatus 1 can cause the two different-digit numeric keys 630 of "0.09" and "0.9" that fall within the set range to be displayed around the numeric key 610 of "9." As a result, the processing apparatus 1 can allow the operator to select one of the different-digit numeric keys 630 of the digits that can be inputted into the input column 501, so that erroneous inputs into the input columns 501 can further

be restrained from occurring.

(Input Processing into Input Columns)

Next, an example of a processing procedure of the input processing performed by the processing apparatus 1 according to the embodiment will be described. FIG. 7 is a flow chart depicting an example of the processing procedure of the input processing performed by the processing apparatus 1 according to the embodiment. The processing procedure depicted in FIG. 7 is realized by the control unit 40 of the processing apparatus 1 executing a program. The processing procedure depicted in FIG. 7 is performed in the case of displaying device data 500.

As depicted in FIG. 7, the control unit 40 of the processing apparatus 1 causes the touch panel 30 to display the device data 500 (step 2001). The control unit 40 controls the display section 31 of the touch panel 30 such that, for example, the device data 500 having a plurality of input columns 501 are displayed. As a result, the display section 31 displays a device data screen having the plurality of input columns 501. When processing of step 2001 is finished, the control unit 40 proceeds the processing to step 2002.

The control unit 40 determines whether or not one

of the input columns 501 has been selected (step 2002). For example, when, on the display surface supplied by the input section 32 of the touch panel 30, an object touches a position of one input column 501 of the device data screen, the control unit 40 determines that the input column 501 is selected. In the case where it is determined that any input column 501 is not selected (No in step 2002), the control unit 40 proceeds the processing to step 2015 to be described later. In addition, in the case where it is determined that one input column 501 is selected (Yes in step 2002), the control unit 40 proceeds the processing to step 2003.

The control unit 40 causes the touch panel 30 to display numeric keys 610 (step 2003). For example, the control unit 40 causes the above-described input key section 600 to be displayed, so that a plurality of numeric keys 610 are displayed in an operable manner. When the processing of step 2003 is finished, the control unit 40 proceeds the processing to step 2004.

The control unit 40 determines whether or not one of the numeric keys 610 has been selected for a predetermined period of time or more (step 2004). For example, in the case where a state in which, on the display surface supplied by the input section 32 of the

touch panel 30, an object is touching the position of one numeric key 610 has continued for a predetermined period of time or more, the control unit 40 determines that the numeric key 610 has been selected. In the case where it is determined that the numeric key 610 has been selected for a predetermined period of time or more (Yes in step 2004), the control unit 40 proceeds the processing to step 2005.

The control unit 40 specifies different-digit numeric keys 630 corresponding to the numeric key 610 (step 2005). For example, in the case where the range setting section 42 has not set a range of numerical values that can be inputted in the relevant input column 501, the control unit 40 specifies a plurality of different-digit numeric keys 630 predetermined for the numeric key 610. For example, in the case where the range setting section 42 has set a range of numerical values that can be inputted into the relevant input column 501, the control unit 40 specifies the different-digit numeric keys 630 that fall within the range. When the processing of step 2005 is finished, the control unit 40 proceeds the processing to step 2006.

The control unit 40 causes the different-digit numeric keys 630 to be displayed in the vicinity of the

numeric key 610 (step 2006). For example, the control unit 40 controls the display section 31 such that the plurality of different-digit numeric keys 630 are displayed in the vicinity of the numeric key 610 selected by the operator. When the processing of step 2006 is finished, the control unit 40 proceeds the processing to step 2007.

The control unit 40 determines whether or not a decision operation on one of the different-digit numeric keys 630 is detected (step 2007). For example, in the case where a flick operation on one of the different-digit numeric keys 630 is detected through the input section 32, the control unit 40 determines that a decision operation on the different-digit numeric key 630 is detected. In the case where it is determined that the decision operation on the different-digit numeric key 630 is detected (Yes in step 2007), the control unit 40 proceeds the processing to step 2008.

The control unit 40 inputs the numerical value of the different-digit numeric key 630 into the input column 501 (step 2008). For example, the control unit 40 specifies the numerical value of the different-digit numeric key 630 for which the decision operation has been detected, inputs the numerical value into the input

column 501, and causes the display section 31 to update the display contents. When the processing of step 2008 is finished, the control unit 40 proceeds the processing to step 2013 to be described later.

In addition, in the case where it is determined that the decision operation on any of the different-digit numeric keys 630 has not been detected (No in step 2007), the control unit 40 proceeds the processing to step 2009. The control unit 40 determines whether or not a deletion condition for the different-digit numeric keys 630 is satisfied (step 2009). The deletion condition for the different-digit numeric keys 630 includes, for example, detection of an operation of any one of removal of an operator's finger from the touch panel 30, selection of another numeric key 610, selection of another input column 501, and the like. In the case where any one of the above operations is detected, the control unit 40 determines that the deletion condition for the different-digit numeric keys 630 is satisfied. In the case where it is determined that the deletion condition for the different-digit numeric keys 630 is not satisfied (No in step 2009), the control unit 40 returns the processing to step 2007 already described and continues the processing. In the case where the deletion condition for the

different-digit numeric keys 630 is satisfied (Yes in step 2009), the control unit 40 proceeds the processing to step 2010.

The control unit 40 causes the displayed different-digit numeric keys 630 to be deleted (step 2010). For example, the control unit 40 controls the display section 31 to delete the plurality of different-digit numeric keys 630 displayed in the vicinity of the numeric key 610 selected by the operator. As a result, the display section 31 is placed into a state in which the plurality of different-digit numeric keys 630 are deleted and only the numeric keys 610 are displayed. When the processing of step 2010 is finished, the control unit 40 proceeds the processing to step 2013.

In addition, in the case where it is determined that any of the numeric keys 610 has not been selected for a predetermined period of time or more (No in step 2004), the control unit 40 proceeds the processing to step 2011. The control unit 40 determines whether or not a decision operation on one of the numeric keys 610 has been detected (step 2011). For example, in the case where a touch operation on one numeric key 610 is detected through the input section 32, the control unit 40 determines that the decision operation on the numeric key

610 has been detected. In the case where it is determined that the decision operation on any of the numeric keys 610 has not been detected (No in step 2011), the control unit 40 proceeds the processing to step 2013 to be described later.

In the case where it is determined that the decision operation on one of the numeric keys 610 has been detected (Yes in step 2011), the control unit 40 proceeds the processing to step 2012. The control unit 40 inputs the numerical value of the numeric key 610 into the input column 501 (step 2012). For example, the control unit 40 specifies the numerical value of the numeric key 610 for which the decision operation has been detected, inputs the numerical value into the input column 501, and causes the display section 31 to update the display contents. When the processing of step 2012 is finished, the control unit 40 proceeds the processing to step 2013.

The control unit 40 determines whether or not a deletion condition for the numeric keys 610 is satisfied (step 2013). The deletion condition for the numeric keys 610 includes, for example, detection of an operation of any one of removal of the operator's finger from the touch panel 30, cancellation of selection of the input

column 501, and the like. In the case where any one of the above operations is detected, the control unit 40 determines that the deletion condition for the numeric keys 610 is satisfied. In the case where it is determined that the deletion condition for the numeric keys 610 is not satisfied (No in step 2013), the control unit 40 proceeds the processing to step 2015 to be described later. In addition, in the case where it is determined that the deletion condition for the numeric keys 610 is satisfied (Yes in step 2013), the control unit 40 proceeds the processing to step 2014.

The control unit 40 deletes the numeric keys 610 displayed on the touch panel 30 (step 2014). For example, the control unit 40 causes the display section 31 to delete the above-described input key section 600, to thereby delete the plurality of numeric keys 610. When the processing of step 2014 is finished, the control unit 40 proceeds the processing to step 2015.

The control unit 40 determines whether or not the device data 500 are to be deleted (step 2015). For example, in the case where a storage operation, a finish operation, or the like for the device data 500 is detected through the input section 32, the control unit 40 determines that the device data 500 are to be deleted.

In the case where it is determined that the device data 500 are not to be deleted (No in step 2015), the control unit 40 returns the processing to step 2002 already described, and continues the processing. In addition, in the case where it is determined that the device data 500 are to be deleted, the control unit 40 proceeds the processing to step 2016.

The control unit 40 stores the value inputted in the input column 501 and deletes the device data 500 (step 2016). For example, the control unit 40 stores in the storage 50 the device data 500 on which the numerical value inputted into the input column 501 is reflected, and controls the touch panel 30 to delete the displayed device data 500. As a result, the display section 31 deletes the displayed device data screen. When the processing of step 2016 is finished, the control unit 40 finishes the processing procedure depicted in FIG. 7.

(Modification of Input Processing)

Next, an example of changing the number of different-digit numeric keys 630 to be displayed based on the numerical values inputted in the past into the input column 501 will be described. FIG. 8 is a diagram depicting an example of the digit data 510 according to the embodiment. FIG. 9 is a diagram for explaining a

modification of the input processing performed to the input columns according to the embodiment.

As illustrated in FIG. 8, the digit data 510 are data for associating the plurality of input columns 501 with digit information 511 corresponding to the respective input columns 501. The storage 50 storing the digit data 510 functions as a digit storage section. The digit data 510 are updated by the control unit 40, for example, in the case where the value inputted in any of the input columns 501 is changed. The digit data 510 include a plurality of pieces of digit information 511. The digit information 511 includes information indicative of the numbers of digits or the values themselves of the numerical values inputted in the past into the input column 501. For example, the digit information 511 includes information indicative of "20" at the first time, "22" at the second time, and so on. In this case, the digit information 511 indicates that the possibility that a two-digit numerical value is to be inputted into the input column 501 is high. For example, the digit information 511 includes information indicative of "three digits" at the first time, "two digits" at the second time, and so on. In this case, the digit information 511 indicates that the possibility that a numerical value of

two or three digits is to be inputted into the input column 501 is high. Note that the digit data 510 stores the digits of input values for desired number of times, for example, the last three times, and the stored digits are updated every time the input values are updated, so that only the digits corresponding to the last three times of input can be displayed.

In a scene 1201 depicted in FIG. 9, the control unit 40 causes the display section 31 to display device data 500 not illustrated and the input key section 600. The operator has continued a state in which a finger is touching the position of the numeric key 610 of "5" on the touch panel 30, for a predetermined period of time or more. When the long-touch operation on the numeric key 610 of "5" is detected through the input section 32, the control unit 40 extracts digit information 511 corresponding to the input column 501 from the digit data 510. In this case, it is assumed that the digit information 511 indicates "three digits" at the first time and "two digits" at the second time. The control unit 40 specifies the different-digit numeric keys 630 to be displayed, based on the extracted digit information 511. For example, the control unit 40 specifies two different-digit numeric keys 630 of "50" and "500" of

equal to or less than three digits. As depicted in a scene 1202, the control unit 40 controls the display section 31 such that the two different-digit numeric keys 630 of "50" and "500" are displayed at positions on the left side and the upper side of the numeric key 610 of "5."

In this manner, the processing apparatus 1 can cause the display section 31 to display only the different-digit numeric keys 630 that fall within the range of numerical values which can be inputted into the input column 501 and that correspond to the digit information 511 indicative of the results of input in the past into the input column 501. As a result, the processing apparatus 1 cause the display section 31 to display only the different-digit numeric keys 630 corresponding to the number of digits inputted in the past into the input column 501, so that erroneous selection of different-digit numeric keys 630 is avoided, and erroneous inputs into the input columns 501 can be further restrained.

Note that the above-described modification of the input processing can be realized by adding processing of specifying different-digit numeric keys 630 to be displayed based on the digit information 511 to step 2005

of the processing procedure depicted in FIG. 7, or by replacing the latter with the former.

Note that the processing apparatus 1 of the above-described embodiment can combine the technical thoughts of the input processing and the modification.

[First Modification]

A processing apparatus 1 according to a first modification of the above embodiment will be described below. FIG. 10 is a perspective view schematically depicting a configuration example of the processing apparatus 1 according to the first modification of the embodiment. Note that, in the following modification, the parts same as those in the above-described embodiment are denoted by the same reference symbols, thereby omitting overlapping descriptions. Note that, in the example depicted in FIG. 10, the above-described main body 2 is omitted from the processing apparatus 1, for simplification of explanation.

As illustrated in FIG. 10, the processing apparatus 1 according to the first modification of the embodiment is a laser processing apparatus that applies a laser beam to the workpiece 101. The processing apparatus 1 includes a chuck table 10, a processing unit 20, a touch panel 30, and a control unit 40, as a basic configuration. The

processing apparatus 1 further includes an imaging unit 12, a drive mechanism 14, and a Z-axis moving mechanism 15. The processing unit 20 has a laser applying unit 5, in place of the above-described cutting blades.

The laser applying unit 5 includes, for example, an oscillator, an intensity adjusting section (attenuator), a polarizing direction setting section, a mirror element, a condenser lens, and the like. The laser applying unit 5 is controlled by the control unit 40.

The processing apparatus 1 processes the workpiece 101 partitioned by streets which are scheduled division lines, along the streets. The processing apparatus 1, for example, applies a laser beam of such a wavelength as to be transmitted through the workpiece 101, to continuously form modified layers (modified regions) inside the workpiece 101 along the streets. Further, the processing apparatus 1 may have a function of exerting an external force along the streets where strength has been lowered due to the formation of the modified layers, thereby dividing the workpiece 101. In addition, the processing apparatus 1, for example, applies a laser beam of such a wavelength as to be absorbed by the workpiece 101, to form cut grooves along the streets on a front surface of the workpiece 101. The cut grooves may have a depth for

half cutting the workpiece 101 or a depth for full cutting the workpiece 101.

The configuration example of the processing apparatus 1 according to the first modification of the present embodiment has been described. Note that the above-described configuration described using FIG. 10 is merely an example, and the configuration of the processing apparatus 1 according to the first modification of the present embodiment is not limited to the described example. The functional configuration of the processing apparatus 1 according to the first modification of the present embodiment can be flexibly modified according to specifications and operations.

The processing apparatus 1 depicted in FIG. 10 causes the touch panel 30 to display the above-described input key section 600. For example, the operator has continued a state in which a finger is touching the position of the numeric key 610 of "8" on the touch panel 30, for a predetermined period of time or more. When the long-touch operation on the numeric key 610 of "8" is detected through the input section 32, the control unit 40 controls the touch panel 30 to display a plurality of different-digit numeric keys 630.

The plurality of different-digit numeric keys 630

are, for example, keys indicative of numerical values containing numeral "8" inputted by the numeric key 610 in different digits. The plurality of different-digit numeric keys 630 include, for example, four different-digit decimal keys of "0.8," "0.08," "0.008," and "0.0008" and four different-digit integer keys of "80," "800," "8000," and "80000."

When a flick operation from the numeric key 610 of "8" to the different-digit numeric key 630 of "800" is detected, the processing apparatus 1 inputs the numerical value indicated by the different-digit numeric key 630 of "800" into the input column 501 and updates the display of the device data 500. As a result, the processing apparatus 1 displays, to the operator, the device data 500 in which the numerical value "800" is inputted to the input column 501 corresponding to "tape" of the item "thickness."

In this manner, like the above-described embodiment, with the processing apparatus 1 according to the first modification, the operator need not operate the numeric keys 610 a plurality of times in performing an input operation to the input column 501, which can contribute to prevention of erroneous inputs. As a result, even in the case where the number of digits of

the numerical value to be inputted is large, the processing apparatus 1 can reduce the number of times of operation, as compared to the case of operating the numeric keys 610 a plurality of times, so that erroneous inputs can be restrained and operability can be enhanced.

[Second Modification]

A processing apparatus 1 according to a second modification of the above-described embodiment will be described below. FIG. 11 is a perspective view schematically depicting a configuration example of the processing apparatus 1 according to the second modification of the embodiment. Note that, in the following modification, the parts same as those in the above-described embodiment are denoted by the same reference symbols, thereby omitting overlapping descriptions. Note that, in the example depicted in FIG. 11, the above-described main body 2 is omitted from the processing apparatus 1, for simplification of explanation.

As depicted in FIG. 11, the processing apparatus 1 according to the second modification of the embodiment is a grinding apparatus that grinds workpieces accommodated in cassettes 91 and 92. The processing apparatus 1 includes a chuck table 10, a processing unit 20, a touch

panel 30, and a control unit 40, as a basic configuration. The processing unit 20 has a grinding unit in place of the above-described cutting blades or the laser applying unit.

The processing unit 20 includes, for example, a grinding wheel 25 having grindstones 21 arranged in an annular pattern, a spindle 23, and a servo motor 24. The grinding wheel 25 is mounted to a lower end of the spindle 23 and is rotated attendant on rotation of the spindle 23. The spindle 23 supports the grinding wheel 25 rotatably around a rotational axis not illustrated that extends substantially parallel to a Z-axis direction parallel to a vertical direction. The servo motor 24 functions as a rotational drive source that supplies rotational power to the spindle 23.

The processing apparatus 1 holds a workpiece unit 100 including a disk-shaped workpiece such as a semiconductor wafer by the chuck table 10, and presses the grinding wheel 25 with the grindstones 21 arranged in an annular pattern against the workpiece unit 100 by a feeding mechanism while rotating the grinding wheel 25, thereby grinding the workpiece.

The configuration example of the processing apparatus 1 according to the second modification of the

embodiment has been described above. Note that the configuration described above using FIG. 11 is merely an example, and the configuration of the processing apparatus 1 according to the second modification of the present embodiment is not limited to the described example. The functional configuration of the processing apparatus 1 according to the second modification of the present embodiment can be flexibly modified according to specifications and operations.

The processing apparatus 1 depicted in FIG. 11 causes the touch panel 30 to display the above-described input key section 600. For example, the operator has continued a state in which a finger is touching the position of the numeric key 610 of "1" on the touch panel 30, for a predetermined period of time or more. When the long-touch operation on the numeric key 610 of "1" is detected through the input section 32, the control unit 40 controls the touch panel 30 to display a plurality of different-digit numeric keys 630.

The plurality of different-digit numeric keys 630 are, for example, keys indicative of numerical values containing numeral "1" inputted by the numeric key 610 in different digits. The plurality of different-digit numeric keys 630 include, for example, four different-

digit decimal keys of "0.1," "0.01," "0.001," and "0.0001" and four different-digit integer keys of "10," "100," "1000," and "10000."

When a flick operation from the numeric key 610 of "1" to the different-digit numeric key 630 of "10000" is detected, the processing apparatus 1 inputs the numerical value indicated by the different-digit numeric key 630 of "10000" into the input column 501 and updates the display of device data 500. As a result, the processing apparatus 1 displays, to the operator, the device data 500 in which the numerical value "10000" is inputted into the input column 501 corresponding to "tape" of the item "thickness."

In this manner, like the above-described embodiment, with the processing apparatus 1 according to the second modification, the operator need not to operate the numeric keys 610 a plurality of times in performing an input operation into the input column 501, which can contribute to prevention of erroneous inputs. As a result, even in the case where the number of digits of the numerical value to be inputted is large, the processing apparatus 1 can reduce the number of times of operation, as compared to the case of operating the numeric keys 610 a plurality of times, so that erroneous

inputs can be restrained and operability can be enhanced.

Note that the first modification and the second modification of the embodiment can adopt the technical thoughts of the processing apparatus 1 of the above-described embodiment.

The embodiment, first modification, and second modification have described the case where the processing apparatus 1 displays the different-digit numeric keys 630 around one numeric key 610 when the operator performs a long-touch operation on the numeric key 610, but this is not limitative. For example, the processing apparatus 1 may display the different-digit numeric keys 630 around the numeric key 610 when the operator touches the numeric key 610. In this case, if the operator removes a finger, a contact body, or the like from the touch panel 30 at the position of the numeric key 610, the processing apparatus 1 inputs the numerical value indicated by the numeric key 610 into the input column 501. In addition, if the operator performs a flick operation of moving the finger, the contact body, or the like to one of the different-digit numeric keys 630 while keeping the contact with the touch panel 30 and then breaking the contact on the different-digit numeric key 630, the processing apparatus 1 inputs the different-digit

numerical value indicated by the different-digit numeric key 630 into the input column 501.

The present invention is not limited to the details of the above described preferred embodiment. The scope of the invention is defined by the appended claims and all changes and modifications as fall within the equivalence of the scope of the claims are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. A processing apparatus comprising:
a holding table that holds a workpiece;
a processing unit that processes the workpiece held
by the holding table;
an operation panel through which processing
conditions are inputted; and
a control unit that controls the operation panel,
wherein the control unit
causes the operation panel to display a
plurality of input columns corresponding to a plurality
of items included in the processing conditions,
causes the operation panel to display
numeric keys when one of the plurality of input columns
is selected,
causes the operation panel to display, when
one of the numeric keys is selected, a plurality of
different-digit numeric keys corresponding to a plurality
of numerical values containing a numeral inputted by the
numeric key in different digits, and
inputs, when one of the different-digit
numeric keys is selected, the numerical value of the
selected different-digit numeric key into the input
column,

wherein

the different-digit numeric keys represent respective numerical values obtained by multiplying the numeral selected by the numeric key by 10^n ,

where n is a positive or negative integer.

2. The processing apparatus according to claim 1, wherein selection from the different-digit numeric keys is performed by a flick operation from the numeric key.

3. The processing apparatus according to claim 1, wherein the control unit

has a range setting section that sets a range of numerical values to be inputted into each of the plurality of input columns, and

causes the operation panel to display only the different-digit numeric keys corresponding to numerical values that fall within the range set by the range setting section.

4. The processing apparatus according to claim 1, further comprising:

a digit storage section that stores the plurality of input columns and digits of numerical values that have previously been inputted into the plurality of input columns, in an associated manner,

wherein, when one of the input columns is selected,

the control unit causes the operation panel to display only the different-digit numeric keys corresponding to the digits stored in the digit storage section.